

SUSTAINABLE FOOD INNOVATIONS:

PRODUCT DEVELOPMENT, PACKAGING, AND WASTE VALORIZATION

**Innovations in Sustainable Food Processing,
Functional Foods and Smart Technologies**

Edited by

**Kamlesh Prasad, PhD
Shubhra Shekhar, M. Tech.
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**Sant Longowal Institute of Engineering and Technology,
Longowal – 148106, Sangrur, Punjab, INDIA**

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Published By

Publication Division
Sant Longowal Institute of Engineering and Technology,
Longowal - 148106 (Punjab) INDIA

Sustainable Food Innovations: Product Development, Packaging, and Waste
Valorization

Sant Longowal Institute of Engineering and Technology, Longowal,
(Punjab) INDIA

SLIET Communication No. 4401/18112025

ISBN: 978-81-990304-3-5 (Hardback)

ISBN: 978-81-990304-2-8 (e-Book)

About the Editor

Kamlesh Prasad, PhD

Prof. Kamlesh Prasad is a distinguished academician, researcher, and food technologist with extensive experience in teaching, research, academics, administration, and scholarly publishing. He is currently serving as Professor in the Department of Food Engineering and Technology at Sant Longowal Institute of Engineering and Technology (SLIET), Longowal, Punjab, India. In addition to his academic responsibilities, he has served as Head of the Department (Food Engineering and Technology), Coordinator of the Internal Quality Assurance Cell (IQAC), Chairman of the Rajbhasha Hindi Cell, and Public Grievance Officer (PGO) of the institute. He is also the Chairman of the Conference on Future Innovations, Food Allergies, and Traditional Foods (FIFATF-2025 and FIFATF-2026).

Prof. Prasad obtained his postgraduate degree in Food Technology from the CSIR-CFTRI, Mysore. He subsequently earned his doctoral degree in Food Technology from GBPUA&T, Pant Nagar. His major areas of specialisation include fruit and vegetable processing, non-destructive quality evaluation of foods, image analysis, food process optimisation, nanotechnology applications in food systems, engineering properties of biological materials, innovative food processing technologies, and traditional foods to combat hidden hunger.

Prof. Prasad has authored and co-authored more than 200 research papers published in reputable national and international journals and conference proceedings. He has also authored several books, edited scholarly volumes, and contributed chapters to books published by leading national and international publishers. His publications have served as valuable references for researchers, students, and professionals in food science, food engineering, and postharvest technology. Also associated with several prestigious professional societies and scientific organisations, including the ASABE, IFT, AFST(I), NSI, USI, IEEE, and other national and international professional bodies. In addition to his research accomplishments, Prof. Prasad has actively contributed to academic leadership, curriculum development, student mentoring, and research capacity building.

This edited book is being published as part of the conference proceedings, reflecting his commitment to advancing research and disseminating knowledge in these critical domains.

Shubhra Shekhar, M. Tech.

Mr Shubhra Shekhar is a PhD candidate in the School of Chemical Engineering at the University of New South Wales (UNSW), Sydney, Australia. He is currently a member of the Faculty Board, holds higher-degree research student positions in engineering, has served as President of the Chemical Engineering Research Society (CERS), and is a member of the AGSE Industry PhD cohort, actively engaging with both industry and academic partners. His research focuses on non-destructive sensing and advanced characterisation methods to improve quality assurance and process understanding in modern food systems. His work brings together principles from chemical engineering, computer science, and data-driven modelling to develop innovative approaches for analysing complex food products and their behaviour.

He is a GATE achiever and has completed an M. Tech. (Food Process Engineering) from NIT, Rourkela. He received the Best Student Award from the Association of Food Scientists and Technologists, India (AFSTI), Mysuru, in 2021 and ranked top in the deemed-to-be university at graduation. He was also the All-India Topper (Elite) and received a Silver Medal for the NPTEL Course conducted by IIT Kharagpur. Got an appreciation letter from Nestle India Ltd., Moga, for his contributions in the form of recommendations. Won several prizes in academics, co-curricular and extracurricular activities. Received letters of appreciation for his contributions to several events and activities. He has successfully delegated his responsibilities as the in-charge of the Society of Food Technocrats (SOFT), the Photography Club (SVIESA), and numerous other professional committees and events. He has industrial exposure with Mondelez India Foods Private Limited, Baddi, HP; Mrs Bector's Food Specialities Limited, Greater Noida, UP; and Nestle India Limited, Moga, Punjab. He is a widely travelled person and has visited countries including Australia, Switzerland, Italy, France, Vatican City, Belgium, the Netherlands, Germany, the Czech Republic, Austria, Hungary, Singapore, Thailand, and Hong Kong. His work is published as articles in books, journals, and conference proceedings of international repute.

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Harish Kumar Sharma S/o Mrs Sharda Sharma and Late Shri M. M. S. Sharma is a Professor (HAG) of Sant Longowal Institute of Engineering & Technology (SLIET) (Deemed University) (Established by: Government of India) and worked as Director, National Institute of Technology (NIT) (An Institution of National Importance), Agartala and Founder Mentor Director of Indian Institute of Information Technology (IIIT), Agartala. Professor Sharma is involved in Teaching, Research, and Administration and has published 167 papers in peer-reviewed Journals and a total of 205 papers in National/International Journals/Proceedings. He has supervised 18Ph.Ds and 44 M.Tech. students for their theses and authored/edited (10) books, (02) proceedings, and (02) manuals, published by reputed National and International Publishing Houses. He contributed 34 book chapters published by National and International Publishing Houses and visited different countries. Professor Sharma has successfully handled several projects and successfully transferred technology on a commercial scale. He has filed two patents, holds four copyrights, and provided technical assistance to various industries.

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Preface

It gives us immense pleasure to present ***Sustainable Food Innovations: Product Development, Packaging, and Waste Valorization***, an edited volume bringing together the research contributions addressing important contemporary challenges and opportunities in sustainable food processing, food product development, packaging, and resource valorization.

The food sector increasingly needs to meet growing demand for nutritious, safe, affordable, high-quality foods while using natural resources efficiently and reducing food and agricultural waste. Sustainable food innovation therefore requires approaches that integrate product development, nutritional improvement, efficient processing, waste reduction, value addition, and environmentally responsible packaging.

The book comprises fourteen chapters covering diverse themes. These include food applications for addressing celiac disease, techno-economic evaluation of wheat bran for fibre-rich food products, rice straw for sustainable packaging, utilization of underexplored banana species, food allergen reduction using cold plasma, and the nutritional and functional potential of tangerine peel waste.

Several chapters emphasize the valorization of underutilized crops and food resources. The volume includes studies on Tardi (*Dioscorea bellophylla*) starch, amla cultivars, multi-millet formulations, bitter melon, jute leaves, asparagus bean flour, dietary-fibre recovery, and bioactive compounds from stinging nettle. These contributions show the potential of diverse plant resources and food-processing residues as sources of nutrients, functional ingredients, bioactive compounds, and value-added food products.

The book also highlights sustainable packaging and innovative processing technologies. Converting rice straw into packaging materials offers a way to create value from agricultural residue, while starch-based antimicrobial films show the potential of renewable materials for functional packaging applications. Other contributions address cold plasma treatment, drying technologies, extraction processes, and hydrothermal recovery of dietary fibre.

An important feature of this volume is its multidisciplinary approach, bringing together perspectives from food technology, food engineering, agricultural sciences, nutrition, biotechnology, materials science, and related disciplines.

We hope that “*Sustainable Food Innovations: Product Development, Packaging, and Waste Valorization*” will serve as a useful reference for researchers, academicians, postgraduate and doctoral students, food technologists, engineers, industry professionals, and other stakeholders.

We sincerely thank all the authors, reviewers, institutions, colleagues, students, and supporters whose contributions have made this volume possible.

K. Prasad, S. Shekhar, and H. K. Sharma (Editors)

Acknowledgement

The publication of *Sustainable Food Innovations: Product Development, Packaging, and Waste Valorization* has been made possible through the collective efforts, cooperation, and support of numerous individuals and institutions. As editors, we sincerely acknowledge everyone who contributed to preparing and completing this volume.

First, we express our heartfelt gratitude to all the contributing authors for sharing their research findings, knowledge, and expertise. The fourteen chapters covering sustainable food product development, agricultural and food-waste valorization, sustainable packaging, functional ingredients, food allergen management, processing technologies, nutritional enhancement, dietary-fibre recovery, and bioactive compounds form the foundation of this book.

We sincerely thank the reviewers and subject experts for their valuable time, critical evaluation, and constructive suggestions. Their scholarly inputs have helped improve the quality, scientific content, and presentation of the chapters.

We gratefully acknowledge Sant Longowal Institute of Engineering and Technology (SLIET), Longowal, for providing the institutional support and academic environment necessary for this scholarly initiative. We particularly appreciate the support of all FIFATF-2025 sponsors in bringing this edited volume to publication.

We also acknowledge the valuable contribution of the Department of Food Engineering and Technology, SLIET, Longowal, whose academic and research environment continues to encourage innovation and knowledge dissemination in food engineering and technology.

We extend our sincere thanks to the collaborating institutions and academic partners whose researchers contributed to this volume. We particularly acknowledge the association of researchers from national and international institutions.

We thank our research scholars, students, faculty members, colleagues, collaborators, and well-wishers for their valuable support, encouragement, and academic contributions. We also appreciate the efforts of all those who assisted with manuscript preparation, editing, compilation, formatting, proofreading, correspondence, and publication. Special thanks to my scholars, Gunjan Thakur and Sunil Kumar, for their efforts in shaping this book in its present form.

Finally, we express our heartfelt gratitude to our families and friends for their patience, encouragement, and continued support throughout the preparation of this book. Thanks are also extended to the administrations of the institute and the Ministry of Food Processing Industry for their support.

We sincerely hope that this volume will contribute to advancing research and innovation in sustainable food product development, resource-efficient processing, sustainable packaging, agricultural and food-waste valorization, nutritional enhancement, and the development of environmentally and economically sustainable food systems.

K. Prasad, S. Shekhar, and H. K. Sharma (Editors)

In-situ cold plasma treatment for removing food allergens - A short review of effectiveness, mechanisms and implementation strategies

Anisha  and Yogesh Kumar 

Abstract. Cold plasma (CP) is an effective technique for reducing food allergen antigenicity, with studies showing reductions of more than 50% in specific allergen proteins. In recent decades, CP has been explored to reduce the IgE-reactivity of major food allergens (peanut, milk, egg, shrimp, soy, wheat, sesame) by generating reactive oxygen and nitrogen species that modify protein structures by oxidizing amino acids, forming new disulfide bonds, altering secondary protein structures and increasing surface hydrophobicity. The in-situ approach, or direct plasma exposure of grains, nuts, or seeds in their natural state, eliminates the need for chemical, enzymatic, or wet pretreatments. It also significantly reduces material-handling costs and losses. Therefore, this short review explores recent studies to assess evidence of allergenicity reduction, the physicochemical mechanisms, and practical strategies for in situ cold plasma implementation.

Keywords: Cold Plasma, Food allergens, Protein, Antigenicity

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ISBN: 978-81-990304-3-5 (Hardback), 978-81-990304-2-8 (e-Book)

1 Introduction

Food allergies are an increasing public-health and food-industry challenge, affecting approximately 2–10% of the population and contributing to severe allergic reactions. Common food allergens include proteins from milk (casein, whey), eggs (ovalbumin, ovomucoid), peanuts, tree nuts, soy, wheat (gliadin), fish, and shellfish. These allergens can provoke immune responses even at trace levels, making effective mitigation strategies crucial for public safety and food industry compliance. Traditionally, processing methods like thermal processing, hydrothermal processing, soaking, enzymatic hydrolysis, and fermentation have been used to reduce allergenicity (Gull et al., 2016a; Gull et al., 2015, 2016b, 2017; Kaur and Prasad, 2024; Kaur et al., 2021; Kaur et al., 2024). Heat treatments can denature proteins but may not eliminate allergenicity completely and can negatively affect nutritional and sensory quality. Enzymatic hydrolysis or fermentation can damage allergenic proteins but may leave residual allergenic fragments and can alter product texture and flavor (García Arteaga et al., 2022). Chemical treatments, which can target specific proteins, are sometimes effective but raise concerns about safety, regulatory approval, and consumer acceptance. Overall, these methods offer a reduction in allergenicity but can deteriorate nutritional or sensory attributes and are not effective across all allergens or matrices (Narciso et al., 2024). In this context, in situ cold plasma (CP) treatment has emerged as a promising non-thermal technology that can modify allergenic proteins without compromising food quality (Kaur et al., 2022; Shekhar et al., 2025). CP generates reactive species (reactive oxygen and nitrogen species) that interact with proteins to alter their structure, reduce immunoreactivity, and inactivate allergens. CP treatment does not need water, can maintain low temperature and can also inactivate microbes and modify biomolecules through short-lived reactive species (Zhang et al., 2021). In the context of allergen control, CP have been reported to reduce IgE binding (antigenicity) and the capacity to trigger immune responses (allergenicity) while preserving food quality (Cheng et al., 2023). Therefore, this short review examines current evidence on the effectiveness of in situ cold plasma for allergen reduction, explores the underlying molecular mechanisms, and discusses implementation strategies for practical application in the food industry.

6. Conclusion

Cold Plasma has emerged as a promising non-thermal technology for reducing the allergenicity of major food proteins such as those found in peanuts, soy, milk, eggs, cereals, and shellfish. Recent studies show that CP can reduce IgE-binding capacity by 30% to over 75%, depending on the food matrix, treatment parameters, and plasma type. The underlying mechanisms include oxidation of amino acid residues, disruption of secondary structures, disulfide bond formation, and protein aggregation, all of which contribute to masking or destroying allergenic epitopes. From a practical standpoint, in-situ CP treatment offers several advantages over conventional methods:

- It avoids chemical or enzymatic pretreatments, reducing cost and complexity.
- It preserves nutritional and sensory quality better than heat or chemical approaches.
- It can be integrated into existing processing lines through modular plasma reactors (DBD, APPJ, plasma bubbling).
- In-package CP treatment provides additional safety by minimizing recontamination risks.

However, successful industrial adoption requires careful optimization of parameters such as gas composition, exposure time, and moisture levels to balance allergen reduction with product quality. Regulatory acceptance will depend on standardized dose metrics, validated allergen quantification methods, and clinical evidence of reduced allergenic risk.

References

- Alaguthevar, R., Packialakshmi, J.S., Murugesan, B., Rhim, J.W., Thiyaamoorthy, U., (2024). In-package cold plasma treatment to extend the shelf life of food. *Comprehensive Reviews in Food Science and Food Safety* 23(2). <https://doi.org/10.1111/1541-4337.13318>
- Ali, K., Mukhtar, F., Mukhtar, S., Hassan, S.A., Nabi, B.G., Aadil, R.M., (2025). Advancements and Impacts of Cold Plasma Technology on Dried Nuts and Related Products. *Journal of Food Process Engineering* 48(3). <https://doi.org/10.1111/jfpe.70080>
- Chen, Y., Chen, Y., Li, T., Wang, J., Zhang, W., (2024). Coconut milk allergenicity: Insight into reducing the affinity of coconut globulin to

- immunoglobulin E by atmospheric cold plasma. Food Chemistry: X 23, 101732. <https://doi.org/10.1016/j.fochx.2024.101732>
- Cheng, J.-H., Li, J., Sun, D.-W., (2023). Effects of dielectric barrier discharge cold plasma on structure, surface hydrophobicity and allergenic properties of shrimp tropomyosin. Food Chemistry 409, 135316. <https://doi.org/10.1016/j.foodchem.2022.135316>
- Cherif, M.M., Assadi, I., Khezami, L., Ben Hamadi, N., Assadi, A.A., Elfalleh, W., (2023). Review on Recent Applications of Cold Plasma for Safe and Sustainable Food Production: Principles, Implementation, and Application Limits. Applied Sciences 13(4), 2381. <https://doi.org/10.3390/app13042381>
- Dong, G., Hinds, L.M., Soro, A.B., Hu, Z., Sun, D.-W., Tiwari, B.K., (2024). Non-Thermal Processing Technologies for Allergen Control in Alternative Protein Sources for Food Industry Applications. Food Engineering Reviews 16(4), 595-617. <https://doi.org/10.1007/s12393-024-09378-2>
- García Arteaga, V., Demand, V., Kern, K., Strube, A., Szardenings, M., Muranyi, I., Eisner, P., Schweiggert-Weisz, U., (2022). Enzymatic Hydrolysis and Fermentation of Pea Protein Isolate and Its Effects on Antigenic Proteins, Functional Properties, and Sensory Profile. Foods 11(1), 118. <https://doi.org/10.3390/foods11010118>
- Gull, A., Naik, G.A., Prasad, K., Kumar, P., (2016a). Technological, Processing and Nutritional approach of Finger Millet (*Eleusine coracana*) - A Mini Review. Journal of Food Processing & Technology 7(6), 1000593. <https://doi.org/10.4172/2157-7110.1000593>
- Gull, A., Prasad, K., Kumar, P., (2015). Effect of millet flours and carrot pomace on cooking qualities, color and texture of developed pasta. LWT - Food Science and Technology 63(1), 470-474. <https://doi.org/10.1016/j.lwt.2015.03.008>
- Gull, A., Prasad, K., Kumar, P., (2016b). Evaluation of functional, antinutritional, pasting and microstructural properties of Millet flours. Journal of Food Measurement and Characterization 10(1), 96-102. <https://doi.org/10.1007/s11694-015-9281-0>
- Gull, A., Prasad, K., Kumar, P., (2017). Drying kinetics of millet, poamce and wheat based pasta and its effect on microstructure, color, water absorption and pasting properties. Journal of Food Measurement and

- Characterization 11(2), 675-684. <https://doi.org/10.1007/s11694-016-9437-6>
- Hsieh, K.-C., Cheng, K.-C., Ting, Y., (2025). Moisture-dependent cold plasma pretreatment enhances allergen Ara h 1 reduction during heat processing in peanuts. Food Chemistry 493, 145830. <https://doi.org/10.1016/j.foodchem.2025.145830>
- Hsu, F.C., Lin, W.T., Hsieh, K.C., Cheng, K.C., Wu, J.S.B., Ting, Y., (2023). Mitigating the allergenicity of peanut allergen Ara h 1 by cold atmospheric pressure argon plasma jet. Journal of the Science of Food and Agriculture 103(6), 3017-3027. <https://doi.org/10.1002/jsfa.12454>
- Kaur, R., Prasad, K., (2024). Development and characterization of chickpea based ready to use replacement beverage mix. Journal of Food Measurement and Characterization 18(5), 3595-3618. <https://doi.org/10.1007/s11694-024-02430-z>
- Kaur, R., Shekhar, S., Chaudhary, S., Singh, B., Prasad, K., (2022). Non-thermal food preservation technologies, in: Sehgal, S., Singh, B., Sharma, V. (Eds.), *Smart and Sustainable Food Technologies*. Springer, Gateway East, Singapore, pp. 157-195. ISBN: 978-981-19-1746-2. https://doi.org/10.1007/978-981-19-1746-2_6
- Kaur, R., Shekhar, S., Kumar, P., Prasad, K., (2021). Image Analysis as a Non-Destructive Approach in Selective Characterization of Promising Indian Chickpea Cultivars. Biology and Life Sciences Forum 6(1), 112. <https://doi.org/10.3390/Foods2021-11013>
- Kaur, R., Shekhar, S., Prasad, K., (2024). Functional beverages: Recent trends and prospects as potential meal replacers. Food Materials Research 4, e006. <https://doi.org/10.48130/fmr-0023-0041>
- Koorehpaz, K., Andishmand, H., Masoumi, B., Assadpour, E., Yousefi, M., Li, Y., Jafari, S.M., (2025). A review of the effects of cold plasma on reducing the allergenicity of food proteins; principles, mechanisms and applications. International Journal of Biological Macromolecules 322, 146972. <https://doi.org/10.1016/j.ijbiomac.2025.146972>
- Li, B., Peng, L., Cao, Y., Liu, S., Zhu, Y., Dou, J., Yang, Z., Zhou, C., (2024). Insights into Cold Plasma Treatment on the Cereal and Legume Proteins Modification: Principle, Mechanism, and Application. Foods 13(10), 1522. <https://doi.org/10.3390/foods13101522>
- Manoharan, D., Rajan, A., Stephen, J., Radhakrishnan, M., (2023). Evaluating the influence of cold plasma bubbling on protein structure and

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- Narciso, J.O., Gulzar, S., Soliva-Fortuny, R., Martín-Belloso, O., (2024). Emerging Chemical, Biochemical, and Non-Thermal Physical Treatments in the Production of Hypoallergenic Plant Protein Ingredients. *Foods* 13(14), 2180. <https://doi.org/10.3390/foods13142180>
- Ng, S.W., Lu, P., Rulikowska, A., Boehm, D., O'Neill, G., Bourke, P., (2021). The effect of atmospheric cold plasma treatment on the antigenic properties of bovine milk casein and whey proteins. *Food Chemistry* 342, 128283. <https://doi.org/10.1016/j.foodchem.2020.128283>
- Olatunde, O.O., Hewage, A., Dissanayake, T., Aluko, R.E., Karaca, A.C., Shang, N., Bandara, N., (2023). Cold atmospheric plasma-induced protein modification: Novel nonthermal processing technology to improve protein quality, functionality, and allergenicity reduction. *Comprehensive Reviews in Food Science and Food Safety* 22(3), 2197-2234. <https://doi.org/10.1111/1541-4337.13144>
- Perera, K.Y., Prendeville, J., Jaiswal, A.K., Jaiswal, S., (2022). Cold Plasma Technology in Food Packaging. *Coatings* 12(12), 1896. <https://doi.org/10.3390/coatings12121896>
- Sharma, S., Singh, R.K., (2022). Effect of atmospheric pressure cold plasma treatment time and composition of feed gas on properties of skim milk. *LWT - Food Science and Technology* 154, 112747. <https://doi.org/10.1016/j.lwt.2021.112747>
- Shekhar, S., Singh, S.K., Singha, P., (2025). Application of Emerging Technologies for Preservation of Ready-To-Eat Snacks, in: Pandiselvam, R., Koç, G.Ç. (Eds.), *Ready-to-Eat Snacks: Emerging Technologies for Production and Safety*. Apple Academic Press, Palm Bay, FL, USA. ISBN: 9781003570127. <https://doi.org/10.1201/9781003570127-13>
- Tang, C., Cheng, J.-H., Zhong, H., Li, J., Sun, D.-W., (2025). Effects of cold plasma-assisted alcalase on the structure, allergenicity and epitopes of shrimp tropomyosin. *Food Chemistry* 492, 145284. <https://doi.org/10.1016/j.foodchem.2025.145284>
- Venkataraman, H., Cahill, O., Sarangapani, C., Cullen, P.J., Barry-Ryan, C., (2020). Impact of cold plasma processing on major peanut allergens. *Scientific Reports* 10(1). <https://doi.org/10.1038/s41598-020-72636-w>

- Zhang, B., Tan, C., Zou, F., Sun, Y., Shang, N., Wu, W., (2022). Impacts of Cold Plasma Technology on Sensory, Nutritional and Safety Quality of Food: A Review. *Foods* 11(18), 2818. <https://doi.org/10.3390/foods11182818>
- Zhang, Q., Cheng, Z., Zhang, J., Nasiru, M.M., Wang, Y., Fu, L., (2021). Atmospheric cold plasma treatment of soybean protein isolate: insights into the structural, physicochemical, and allergenic characteristics. *Journal of Food Science* 86(1), 68-77. <https://doi.org/10.1111/1750-3841.15556>

SUSTAINABLE FOOD INNOVATIONS:

PRODUCT DEVELOPMENT, PACKAGING, AND WASTE VALORIZATION

Innovations in Sustainable Food Processing, Functional Foods and Smart Technologies

This book presents recent research and innovative applications in sustainable food product development, packaging and waste valorization. It explores the utilization of biodegradable crops, food processing by-products and agricultural residues, development of functional and specialized food products, sustainable packaging materials, and emerging processing technologies. The chapters highlight multidisciplinary approaches integrating food science, food engineering, nutrition, biotechnology and materials science for resource-efficient, environmentally sustainable and value-added food systems. The volume serves as a useful reference for researchers, academics, students, industry professionals and Policymakers working towards innovations in sustainable food processing, functional foods and smart technologies.

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ISBN: 978-81-990304-3-5



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