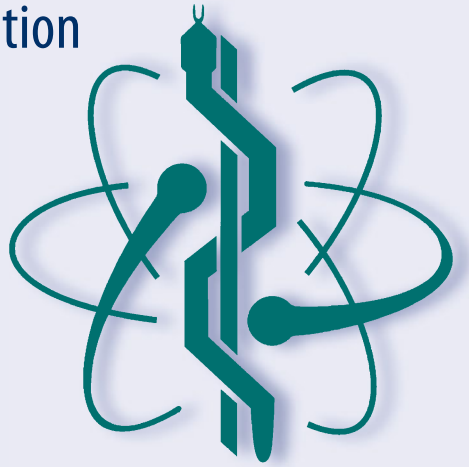
IFMBE Proceedings 95

Van Toi Vo · Thi-Hiep Nguyen · Binh Long Vong · Ngoc Bich Le · Thanh Qua Nguyen *Editors*

9th International Conference on the Development of Biomedical Engineering in Vietnam

Proceedings of BME 9, 2022, Ho Chi Minh City, Vietnam: Translational Healthcare Technology from Advanced to Low and Middle-Income Countries in the Era of Covid and Digital Transformation



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Editors

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Preface

Vietnam is a rapidly developing, socially dynamic country, where interest in biomedical engineering (BME) activities has grown steadily. Located in a low- and middle-income countries (LMIC) ecosystem, Vietnam yet has an intellectual workforce of an advanced country. Hence, these conferences organized in Vietnam offer unique forums for the BME international community to share experiences and develop support and collaboration networks to improve educational, research and entrepreneurship in LMIC and advanced countries.

In **January 2004**, under the sponsorship of the U.S. National Science Foundation, Professor Vo Van Toi of the Biomedical Engineering Department of Tufts University, Medford, Massachusetts, the USA, led a U.S. delegation that consisted of Biomedical Engineering professors from different universities in the USA and visited several universities and research institutions in Vietnam to assess the state of development of this field. This delegation proposed a five-year plan that was enthusiastically embraced by the international scientific communities to actively develop collaborations with Vietnam.

Within this framework, **in July 2005, the First International Conference on the Development of Biomedical Engineering in Vietnam** was organized by Professor Vo Van Toi at University of Technology in Ho Chi Minh City. From that conference, a Consortium of Vietnam-International Universities was created to advise and assist the development of Biomedical Engineering in Vietnamese universities.

In **July 2007, the Second International Conference** on the Development of Biomedical Engineering in Vietnam was held at University of Technology in Hanoi with the participations of the Asia-Pacific International Molecular Biology Network (AIMBN), Biomedical Engineering Society Singapore (BESS), International Federation for Medical and Biological Engineering (IFMBE), Société Française de Génie Biologique et Médical (SFGBM) and IFMBE Asia-Pacific Working Group.

In **March 2009, International University (IU) established its Biomedical Engineering (BME) Department** and the **Engineer degree program in BME**. The BME Department at IU has since established the International Conference on the Development of Biomedical Engineering, a biennial event.

In **January 2010**, **the Third International Conference** on the Development of Biomedical Engineering in Vietnam was organized by IU in Ho Chi Minh City. It reflected the steady growth of the activities in this field in Vietnam and featured the contributions of researchers of 21 countries, including: Australia, Belgium, Canada, Denmark, France, India, Japan, Korea, Malaysia, New Zealand, Philippines, Poland, Russia, Singapore, Spain, Switzerland, Taiwan, Thailand, the UK, the USA and Vietnam. The conference was endorsed by the International Federation for Medical and Biological Engineering (IFMBE). It also hosted the Clinical Engineering Workshop of the IFMBE Asia-Pacific Working Group. The contributed papers were published in the IFMBE Proceedings Series by Springer (ISBN 978-3-642-12019-0).

In **January 2012, the Fourth International Conference** on the Development of Biomedical Engineering in Vietnam was organized in Ho Chi Minh City as a mega-conference. It was kicked off by the Regenerative Medicine Conference (Jan 8–10, 2012) with the theme "BUILDING A FACE" USING A REGENERATIVE MEDICINE APPROACH", endorsed mainly by the Tissue Engineering and Regenerative Medicine International Society (TERMIS) and co-organized by Professor Stephen E. Feinberg, University of Michigan Health System, the USA; Professor Anh Le, University of Southern California, the USA; and Professor Vo Van Toi, International University—VNU-HCM, Vietnam. It was followed by the Computational Medicine Conference, endorsed mainly by the Computational Surgery International Network (COSINE) and the Computational Molecular Medicine of German National Funding Agency; and the General Biomedical Engineering Conference, endorsed mainly by the International Federation for Medical and Biological Engineering (IFMBE) (Jan 10–12) and co-organized by Professor Paolo Carloni, German Research School for Simulation Sciences GmbH, Germany; Professor Marc Garbey, University of Houston, the USA; and Professor Vo Van Toi, International University—VNU-HCM, Vietnam. It featured the contributions of 435 scientists from 30 countries, including: Australia, Austria, Belgium, Canada, China, Finland, France, Germany, Hungary, India, Iran, Italy, Japan, Jordan, Korea, Malaysia, Netherlands, Pakistan, Poland, Russian Federation, Singapore, Spain, Switzerland, Taiwan, Turkey, Ukraine, the UK, the USA, Uruguay and Vietnam. The contributed papers were published in the IFMBE Proceedings Series by Springer (ISBN 978-3-642-32182-5).

In **June 2014, the Fifth International Conference** on the Development of Biomedical Engineering in Vietnam occurred at IU of VNU-HCM. It officially opened the season for celebration of the 20th anniversary of Vietnam National Universities—Ho Chi Minh City. It also marked the 10th anniversary of International University and the 5th anniversary of the Biomedical Engineering Department. This conference features 231 papers of 532 authors and co-authors from 26 countries including Australia, Bangladesh, Belgium, Canada, China, Croatia, Czech Republic, Denmark, Finland, France, Germany, India, Israel, Italy, Japan, Korea, Malaysia, Norway, Singapore, Slovenia, Switzerland, Taiwan, Turkey, the UK, the USA and Vietnam. Almost all Vietnamese institutions have their delegations. Besides Vietnam, the 2 countries that have the most contributors were the USA and Australia. The plenary session featured the lectures on the progress in different fields of Biomedical Engineering by 8 distinguished keynote speakers such as Prof. Ratko Magjarevic, President of IFMBE; Dr. Robert A. Lieberman, Vice-President of International Society for Optics and Photonics SPIE; Prof. Vo-Dinh Tuan, Director of Fitzpatrick Institute for Photonics, Duke University, the USA; Prof. Christian Griesinger, Director of Max Planck Institute for Biophysical Chemistry, Germany; Prof. Anja Boisen, Director of VKR Centre Of Excellence "NAMEC", Denmark; Prof. Yin Xiao, Director of Australia-China Centre for Tissue Engineering and Regenerative Medicine, Queensland University of Technology, Australia; Prof. Yukio Nagasaki, Department of Materials Science and Medical Sciences, University of Tsukuba, Japan; and Prof. Fong-Chin Su, President of Taiwanese Society of Biomedical Engineering, Director, Medical Device Innovation Center, National Cheng Kung University, Taiwan. The contributed papers were published in the IFMBE Proceedings Series by Springer

(Vol. 46, Editors: Vo Van Toi and Tran Ha Lien Phuong, 2015, ISSN 1680-0737 ISSN 1433-9277 (electronic), ISBN 978-3-319-11775-1 ISBN 978-3-319-11776-8 (eBook), DOI 10.1007/978-3-319-11776-8).

The **Sixth International Conference** on the Development of Biomedical Engineering in Vietnam occurred from June 27 to June 29, 2016, at IU of VNU-HCM. The theme of the conference was Healthcare Technologies for Developing Countries. The contributed papers were from 417 authors and co-authors, of whom 253 were corresponding authors from 23 countries including Australia, Canada, China, Finland, France, Germany, Hong Kong, India, Indonesia, Italy, Japan, Korea, Malaysia, Norway, Portugal, Singapore, Spain, Taiwan, Thailand, the UK, the USA and Vietnam. Besides Vietnam, 3 countries had the most contributors that were Australia, the USA and Korea. Ten distinguished keynote speakers gave their talks in plenary sessions and special topics sessions. They were: Prof. **Jeff W.M. Bulte**, Professor of Radiology, Oncology, Biomedical Engineering and Chemical & Biomolecular Engineering, Director, Cellular Imaging Section, Institute for Cell Engineering, Johns Hopkins University School of Medicine, the USA; Prof. **Paolo Carloni**, German Research School for Simulation Sciences GmbH and Institute for Advanced Simulation (IAS), Germany; Prof. **John Huguenard,** Director, Neuroscience Graduate Program, Stanford University, Professional Advisory Board, Epilepsy Foundation, the USA; Prof. **Ryuji Kohno**, Director, Medical Information and Communication Technology Center, Yokohama National University, Japan, Distinguished Professor, University of Oulu, Finland; Dr. **Sajeda Meghji**, Emeritus Reader in Oral Biology, University College London (UCL), the UK; Prof. **Beom-Jin Lee**, Dean of College of Pharmacy, Ajou University, Head of the Pharmaceutical Research and Development Agency, Korean Pharmaceutical Manufacturing Associations, Korea; Prof. **Yu-Lung Lo**, Distinguished Professor, Head of Department of Mechanical Engineering, National Cheng Kung University, Taiwan; Prof. **Yasuhiko Tabata**, Chairman, Department of Biomaterials, Institute for Frontier Medical Sciences, Kyoto University, Board of Governors, Tissue Engineering Society International, Japanese Society of Biomaterials, Japanese Tissue Engineering Society, Society for Hard Tissue Regenerative Medicine, Japanese Society of Inflammation and Regeneration, Japan Society of Drug Delivery System, Japanese Regenerative Medicine Society, Japan; Prof. **Christopher Wildrick Woods**, Director of Master of Science in Global Health, Director of Graduate Studies, Duke Global Health Institute, Duke University, Chief, Infectious Diseases Division, Durham VA Medical Center, the USA; and Prof. **Hairong Zheng**, Director of National Engineering Laboratory—Medical Imaging Technology and Equipment, Director of SIAT—Institute of Biomedical and Health Engineering, Director of Paul C. Lauterbur Research Centre for Biomedical Imaging, Shenzhen Institutes of Advanced Technology (SIAT), Chinese Academy of Sciences, China.

Furthermore, 44 invited speakers gave their talks or tutorial lectures in the parallel sessions including Materials for Biomedical Applications, Biomechanics, Lab-on-a-chip & Point-of-Care Technologies, Mathematical Modeling in Medicine, Biophotonics, Public Health, Pharmaceutical Sciences and Biomedicine, Medical Instrumentations, Healthcare Information Technology and Bioinformatics, Biomedical Signal & Image Processing, Neuroscience and Neuroengineering, Advanced in Stem Cell and

Cell Reprogramming, Molecular and Cellular Techniques in Medicine, Ultrasonic Characterization of Bone Tissues and Advanced Molecular Simulation and Experimental Biophysical Approaches for Drug Design.

In addition, the Vietnam–UK workshop in the BME field which was funded by the Newton Fund Researcher Links of British Council was conjointly organized by Prof. Le Hoai Quoc (SHTP), Dr. Le Chi Hieu (University of Greenwich) and Prof. Vo Van Toi (BME-IU) and coordinated by Dr. Le Quoc Trung (BME-IU). Researchers from 10 UK universities: (1) University of Greenwich, (2) Cardiff University, (3) North Umbria University, (4) Sheffield University, (5) University of Hertfordshire, (6) Newcastle University, (7) Oxford University, (8) London South Bank University, (9) University of Derby and (10) Aston University and representatives of British Council participated. The last day of the workshop was devoted to a round-table discussion among 21 Vietnamese and 12 UK researchers.

Other activities included a field trip to visit SHTP and a new medical device manufacturer, and social events were also organized to introduce to the international guests Vietnamese culture.

The contributed articles were published in the "IFMBE Proceedings Series", Vol. 63 by Springer, Editors: Vo Van Toi, Nguyen Le Thanh An and Nguyen Duc Thang, ISBN: 978-981-10-4360-4, 2017. Sponsors included VNU-HCM, IU, Office of Naval Research Global, U.S. Army International Technology Center—Pacific, Springer, IFMBE, SHTP, NAFOSTED, Newton Fund, Korea United Pharm. Inc., Global IMD Center, ESTC and others.

The **Seventh International Conference** (BME7) on the Development of Biomedical Engineering in Vietnam occurred from June 27 to June 29, 2018, at IU of VNU-HCM. The theme of BME7 was Translational Health Science and Technology for Developing Countries. This conference featured 202 papers, including 145 oral talks and 57 posters, of about 500 authors and co-authors from 19 countries including Australia, Canada, China, Czech, France, Germany, Israel, Italy, Japan, Korea, the Netherlands, Portugal, Singapore, Switzerland, Taiwan, Thailand, the UK, the USA and Vietnam. Besides Vietnam, 3 countries had the most contributors that were the UK, Korea and the USA. Fifteen distinguished keynote speakers gave their talks either in plenary sessions for the general public or in parallel sessions in in-depth specific topics. They were: (1) **Jeff Bulte**, Professor of Radiology, Oncology, Biomedical Engineering and Chemical & Biomolecular Engineering, Johns Hopkins University School of Medicine, the USA; (2) **Nigel Culkin**, Professor of Enterprise and Entrepreneurial Development, Fellow and Past-President of the Institute of Small Business and Entrepreneurship (ISBE), University of Hertfordshire, the UK; (3) **Guillaume Haiat**, Senior Research Director, French National Centre for Scientific Research, Paris, France; (4) **Sunderesh S. Heragu**, Professor and Head of School of Industrial Engineering and Management, Donald and Cathey Humphreys Chair, Oklahoma State University, the USA; (5) **Beom-Jin Lee**, Professor and Dean of College of Pharmacy, Ajou University, Head of the Pharmaceutical Research and Development Agency, Korean Pharmaceutical Manufacturing Associations, Korea; (6) **Yung-cang Li**, Professor of School of Engineering, RMIT University, Australia; (7) **Paul Milgram**, Professor of University of Toronto, Department of Mechanical & Industrial Engineering, Institute of Biomaterials and Biomedical Engineering, Toronto, Canada;

(8) **Nam-Trung Nguyen**, Professor and Director of Queensland Micro- and Nanotechnology Centre, Griffith University, Queensland, Australia; (9) **Ruth Nussinov**, Professor and Senior Principal Investigator of National Cancer Institute and Tel Aviv University, Israel; (10) **Wellington Pham**, Associate Professor of Radiology and Radiological Sciences, Biomedical Engineering, Vanderbilt University School of Medicine, the USA; (11) **Evan Y. Snyder**, Professor of Stanford Burnham Prebys (SBP) Medical Discovery Institute, Director of Center for Stem Cells and Regenerative Medicine, Director of Stem Cell Research Center, Stanford Children's Health Research Center, the USA; (12) **Masahiro Takei**, Professor and Vice-Dean of Department of Mechanical Engineering, Medical System Engineering, Chiba University, Japan; (13) **Alex Vitkin**, Professor of Medical Biophysics and Radiation Oncology, University of Toronto, Canada; (14) **Cui Wen**, Distinguished Professor of School of Engineering, RMIT University, Australia; and (15) **Ping Xue**, Professor of the Department of Physics, Tsinghua University, China.

Furthermore, 15 invited speakers gave their talks or tutorial lectures in the parallel sessions including: Medical Instrumentations and Entrepreneurship, Biomaterials and 3D Printing, Nanomedicine and Drug Delivery Systems, Biophotonics, Biomechanics, Translational Health Science and Technology for Developing Countries, Recent Computational and Experimental Advances in Molecular Medicine, Regenerative Medicine and Tissue Engineering, Lab-on-a-chip & Point-of-Care Technologies, Biomedical Signal and Image Processing, Public Health: Cancer Therapy and Reconstructive Surgery and Advanced Technologies in Sleep Diagnosis and Sleep Medicine.

In addition to these activities, a memorable event at the BME7 was the Award Ceremony of the Keylab to Prof. Ruth Nussinov, Professor and Senior Principal Investigator of National Cancer Institute (the USA) and Tel Aviv University, Israel; and the Signing Ceremony of the Memorandum of Understanding (MOU) between IU and Chung Hsing National University, Taiwan, as well as the MOU between the Biomedical Engineering Departments of IU and of Gwanju Institute of Science and Technology (GIST), Korea.

In addition, the Vietnam–UK (VN-UK) Newton Workshop in the BME field was organized under the auspice of Researcher Links workshop grant delivered by British Council. Researchers from the UK and Vietnam met together to determine the opportunities for long-term collaboration. The mentors of the workshop included Prof. Le Hoai Quoc (SHTP), Prof. Vo Van Toi (BME-IU), Prof. Tony Cass (Imperial College London) and Prof. Nguyen T.K Thanh (University College London). The coordinators were Dr. Cecile Perrault—Lecturer, Department of Mechanical Engineering, University of Sheffield, UK, and Dr. Huynh Chan Khon, Lecturer at BME-IU. The workshop aimed to establish Microfluidics, Nanomaterials and Point-of-Care networks and stimulate collaborations on the R&D, technology transfer and entrepreneurship between the UK and Vietnam. It gathered 15 experts from 11 UK well-known institutions, more than 20 experts from different research, education and business institutions in Vietnam and representatives of British Council. Eleven UK universities including: (1) University College London, (2) Imperial College London, (3) University of Sheffield, (4) Newcastle University, (5) Coventry University, (6) University of Brighton, (7) University of Oxford, (8) University of Cambridge, (9) Manchester Metropolitan University (10) University of Portsmouth and (11) Oxford University Clinical Research Unit in Vietnam. Mr. Nguyen Minh Tuan, Head of Vietnam Ministry of Health's Medical Equipment and Construction

Department, was the main invited speaker. The last day of the workshop was devoted to a round-table discussion among researchers. Several funding agencies in Vietnam and the UK were introduced. Many collaborative projects were identified to pave the way for follow-up concrete research proposals to be submitted for funding.

Furthermore, Professor Vo Van Toi and BME Department faculty met with interested BME groups elsewhere and individual researchers below to discuss future mutual collaborations: (1) Dr. Tani Tohru's group from Japan (Image guided surgery, Novel surgery methods); (2) Prof. Guillaume Haiat from France (Biomechanics, Quantitative ultrasound); (3) Prof. Sun Kim and 3 other professors from the BME Dept., Hanyang Uni., South Korea (Biosignal acquisition and processing system for educational purpose, Ubiquitous healthcare...); and (4) Prof. Jae Gwan Kim and 4 other professors from the BMSE Dept., GIST, South Korea (Biophotonics, Genomic medicine, Sleep medicine...).

Several BME companies exhibited their products during the conference. Other activities included a field trip to visit manufacturers in SHTP. A banquet and social events were also organized to introduce to the international guests Vietnamese culture. Sponsors: VNU-HCM, IU, Office of Naval Research Global, VNPT, IFMBE, NAFOSTED, SHTP, Newton Fund, British Council, Korea United Pharm. Inc., CUBE DCM Korea, Vitech Development Co. Ltd., T&N Trading and Investment Co. Ltd., Tan Mai Thanh Medical and Instrument Co. Ltd., BCE Vietnam Co. Ltd., Ho Chi Minh City Department of Science and Technology, Cao Thang International Eye Hospital, SISG Group, EST Co. JSC., PTK Co. Ltd. and many others. More information on the BME7 can be found at: http://csc.hcmiu.edu.vn/bmeconf/bme2018/.

The contributed articles were published in the "IFMBE Proceedings Series", Vol. 69 by Springer, Editors: Vo Van Toi, Le Quoc Trung, Ngo Thanh Hoan and Nguyen Thi Hiep, ISBN: 978-981-13-5859-3. 2020. This is a book series, owned by the International Federation of Medical and Biological Engineering (IFMBE). The book series publishes the proceedings of all IFMBE conferences as printed books as well as electronic books on CD/DVD and Springer content platform link.springer.com. Every paper receives a DOI and is fully citable and recognized by several indexing services.

The **Eighth International Conference** (BME8) on the Development of Biomedical Engineering in Vietnam was originally planned for July 2020 with the theme: "Healthcare Technology for Smart City in Low- and Middle-Income Countries". The organizing committee of the conference received 153 submissions from 348 authors and co-authors from 20 countries, including Australia, Canada, France, Germany, India, Indonesia, Italy, Japan, Korea, Norway, Philippines, Spain, Singapore, Sweden, Switzerland, Taiwan, Thailand, the UK, the USA and Vietnam. However, since the COVID-19 pandemic was in full force, the planned face-to-face meeting was canceled. Yet, each manuscript was pre-reviewed by a Program Committee (PC) member before it was reviewed by two independent reviewers. The accepted manuscripts appeared in "IFMBE Proceedings Series", Vol. 85 by Springer, Editors: Vo Van Toi, Thi Hiep Nguyen, Vong Binh Long and Ha Thi Thanh Huong, ISBN: 978-3-030-75505-8, 2022. Unlike the previous proceedings, this 1,074 page one was printed in B5 format and in color.

The **Ninth International Conference** (BME9) on the Development of Biomedical Engineering in Vietnam occurred from December 27 to December 29, 2022, when the

pandemic situation was under control, with the theme: "Translational Healthcare Technology from Advanced to Low- and Middle-Income Countries (LMIC) in the Era of Covid and Digital Transformation". The conference website: https://bme.hcmiu.edu.vn/bme9/.

This conference was under the jurisdiction of Vietnam National Universities in Ho Chi Minh City (VNU) and co-organized by the School of Biomedical Engineering and the School of Medicine, both are members of VNU-HCM. Our sponsors included: Science and Technology Division of HCM City and the following companies: Thai Binh Scientific, Korea Pharma, BCE Việt Nam, T&N, Life Sciences, Merck Vietnam, Công Ty Giải Pháp Y Sinh ABT, ITS VN_Vạn Nam, DKSH, Dolomite-Blacksheep, Vitech, Trung Sơn TSSE, TABC, SISC, T&H and Mediworld.

The organizing committee of the conference received 161 submissions from 455 authors and co-authors from 14 countries, including Australia, France, Germany, Iran, Japan, Korea, Malaysia, New Zealand, Saudi Arabia, Switzerland, Taiwan, the UK, the USA and Vietnam. Eight distinguished keynote speakers gave their talks in the plenary sessions for the general public: Prof. **Anh D. Le,** University of Pennsylvania, the USA; Prof. **Nguyen Van Tuan,** University of Technology Sydney, Australia; Prof. **Nagasaki Yukio**, University of Tsukuba, Japan; Prof. **Mark Johnson**, Northwestern University, the USA; Prof. **Beom-Jin Lee**, Ajou University, Korea; Prof. **Chung-Gyu Park**, Seoul National University, Korea; Prof. **Thanh Duc Nguyen,** University of Connecticut, the USA; and Prof. **Karlheinz Peter,** Baker Heart and Diabetes Institute, Australia. Nine invited speakers gave talks in parallel sessions on in-depth specific topics: Prof. **Hang Ta**, Griffith University, Australia; Prof. **Michinao Hashimoto**, Singapore University of Technology and Design; Prof. **Nghiem Doan,** Griffith University, Australia; Prof. **Xiaowei Wang**, Baker Heart, and Diabetes Institute, Australia; Dr. **Justin Burrell**, Center for Innovation & Precision Dentistry at the University of Pennsylvania, the USA; Dr. **Hyun Je Kim**, Seoul National University, Korea; Prof. **Tien-Tuan Dao**, Centrale Lille Institute, France; Prof. **Vu-Hieu Nguyen**, Université Paris-Est Créteil, France; and Prof. **Yuning Hong**, Department of Biochemistry and Chemistry, La Trobe Institute for Molecular Science, La Trobe University, Australia.

In these proceedings, selected and carefully single-blind peer-reviewed manuscripts will appear under 11 topics: Medical Instrumentations; Tissue Engineering and Regenerative Medicine; Pharmaceutical Engineering; AI and Data Science for Healthcare; Molecular Medicine; Lab-on-a-chip and Microfluidics; Biophotonics; Biomedical Entrepreneurship; Neuroengineering; Modelling and Simulation in Biomedical Engineering; and Miscellany. The IFMBE Proceedings are indexed by Scopus, Scimago, Google Scholar and EI Compendex, among others. They are also submitted to Thomson Reuters (Clarivate, ISI Proceedings) for evaluation.

For your search convenience, the author index is published at the end of this proceeding.

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Finally, we would like to thank Springer Publisher for their best assistance.

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Notes

Vietnam National Universities in Ho Chi Minh City (VNU-HCM) is one of the two leading university networks in Vietnam reporting directly to the Prime Minister of the country. It was founded in January 1995 and currently has 7 university members and several research institutions for a total of more than 5600 staff (including 2600 teaching staff), 60,000 full-time undergraduates, 7946 master's and 1050 Ph.D. students.

International University (IU) of VNU-HCM was established in 2003 to be a platform to promote the reform of higher education in Vietnam. It is the first public university that teaches all courses in English. It has extensive collaborations with many universities in Australia, New Zealand, Thailand, the UK, and the USA. At IU, there are about 9,400 students, 300 faculty and 200 staff.

The School of Biomedical Engineering Department (BME) at IU was established in 2009 as the Department of IU and became a School in 2019. It offers accredited degrees of engineering, master's and Ph.D. in BME. Its activities concentrate on the Design and Applications of Medical Devices to satisfy the urgent need of the country. Other activities include Signal and Image Processing, Pharmaceutical Engineering and Regenerative Medicine. The School promotes the close relationship between education, research and entrepreneurship. Its motto is high quality, sustainability and usefulness. It has more than 420 undergraduate and graduate students and 28 faculty and staff. In December 2015, the BME-IU undergraduate program was assessed by the ASEAN University Network Quality Assessment (AUN-QA) and ranked as the best in Vietnam and 2nd best in ASEAN of all programs assessed by AUN till that time. In 2019, it was accredited by the American-based ABET.

Professor Vo Van Toi, Vice-Provost for Life and Health Science, Engineering and Technology Development of IU and Founder of the BME Department, obtained his Ph.D. in Micro-engineering at the Swiss Federal Institute of Technology—Lausanne (EPFL), Switzerland, in 1983. From 1983 to 1984, he was Postdoctoral Fellow at the Health Science and Technology Division (HST), a joint program of Harvard-MIT (USA). From 1984 to 2009, he was Faculty of the School of Engineering at Tufts University. He was Co-chair of the joint educational programs between the School of Engineering and School of Medicine and between the School of Engineering and School of Dental Medicine. From 1991 to 1992, he was on sabbatical from Tufts to be Research Professor at the Scheie Eye Research Institute of University of Pennsylvania (USA). From 1992 to 1994, he helped create and was Vice-Director of the Eye Research Institute in Sion (Switzerland). He was instrumental in establishing the BME Department at Tufts

in 2003. From 2004 to 2007, he was nominated by President G. Bush to be Member of the Board of Directors of the Vietnam Education Foundation (VEF), a U.S. federal agency established by the U.S. Congress to bring the USA and Vietnam closer through educational exchanges related to science, engineering, mathematics, medicine and technology. From 2007 to 2009, he was on leave from Tufts to be Executive Director of VEF. In 2009, he resigned from VEF and took early retirement from Tufts to go back to Vietnam to establish and chair the BME Department at IU until 2018. He initiated the International Conferences on the Development of Biomedical Engineering. His research interests include the Design and Applications of Medical Devices, the Mechanism of Human Visual Systems, Ophthalmology and Telemedicine.

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Medical Instrumentations

A Novel Device for Simultaneously Grinding Multiple Tissue Samples Without Cross-Contamination

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Abstract. Clinical and diagnostic tests in laboratories are useful in screening, diagnosis, and prognosis. These tests require grinding specimens. Commonly, this is done by hand using mortars and pestles. With this method, only one sample can be done at a time, and the results are not uniform. A novel device for simultaneously grinding multiple tissue samples without cross-contamination is described below. The device consists of a first unit having several pestles and Eppendorf housings separated from each other, a second unit containing a planetary gear system connected to operate these Eppendorf tubes and pestles, and a third unit containing a motor and controller. These units are geometrically configured and dimensioned so that when they are stacked on top of one another they are in lock position and consequently the pestles are lined up with the Eppendorf tubes. The device was built so that 12 samples can be grinded at a time. A programable controller allowed users to select the grinding time at will. A mechanism permitted users to eject conveniently the pestles into the Eppendorf tubes after grinding to help avoid cross contamination. Many tests with shrimp leg tissues infected by white spot syndrome virus (WSSV) against controlled samples consisted of pure water were conducted. The grinded samples were inspected by eyes and checked for contamination using Polymerase Chain Reaction (PCR) machine. The results showed that device allows grinding tissues homogeneously in an effective way and reducing handiwork without cross-contamination. Small industrial production were conducted.

Keywords: DNA Extraction · Shrimp Tissue · Eppendorf Tube · Homogenizing · Grinding Device

1 Introduction

1.1 Literature Review

Biological samples need one or more pre-treatment measures before processing and identification [1] and tissue homogenization is a common method for preparing samples in the analysis of clinical samples [2]. The homogenization process includes vigorously

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mixing and griding two immiscible compounds (e.g., tissues and buffer solution) to get a homogenous compound [1]. The traditional method of tube and pestle is often widely used in laboratories for griding or homogenizing small tissue samples in limited amounts [2]. This method seems to have done the least harm to the cellular elements, and the reality that this approach may only accommodate very limited amounts of tissue at any given time can also be disadvantageous in certain situations [3]. When a greater amount of tissue needs homogenization, a device such as a blender or electronic pestle device is sufficient, but this technique is often a time-consuming and manual process; there has been not found successful way to integrate it into a large amount of sample by using the most effective method at the same time up to now [1].

One of the standard processes involving homogenization is the quantitation of proteins from tissues which is called The Bradford protein assay [4], a simple and reliable method for estimating protein concentrations. Bradford has been the standard form of protein quantification in several laboratories [1, 5]. The theory behind this experiment is that the attachment behind protein molecules to a dye called Coomassie Brilliant Blue G-250 [6] under acidic conditions results in a transition of color from brown to blue [7]. The protein quantitative can then be measured and calculated by spectrophotometer [8] to show the amount of dye in the blue form [9]. It is normally accomplished by calculating the absorbency of the solvent at 595 nm [10]. There are two stages performed by the Bradford, including the Standard assay procedure, which is ideal for testing from 10 to 100 μg protein and the Micro assay procedure, which is more sensitive and productive when protein levels are low (from 1 to 10 μg protein) [5, 8, 10].

1.2 Analysis of Existing Devices

To perform the above processes, the tissue can be crushed by hand, using rotating the pellet or stick on a sample in a tube until it is broken down (Fig. 1). The method is common but not efficient and time-consuming.

Fig. 1. The common griding method

Investigation of the existing devices on the market showed that there are 3 main types of micro-tube homogenizer: first is the basic one with low cost, portable and low speed, then the larger one with higher speed and the last one is the fully automatic device that is a high-speed homogenizer. Table 1 lists the above devices.

After conducting the review and analyzing the existing devices, we found that their main issue is that none of them allowed grinding many tissue samples at the same time.