

# The 14<sup>th</sup> International Conference on QiR (Quality in Research)



**In conjunction with :**

4<sup>th</sup> Asian Symposium on Material  
Processing (ASMP)

International Conference in Saving Energy in  
Refrigeration and Air Conditioning (ICSERA)

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# PROCEEDING

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STMIK  
LOMBOK

# PREFACE

## WELCOME FROM THE RECTOR OF UNIVERSITAS INDONESIA

It is both a pleasure and honor for me to welcome you all to the 14<sup>th</sup> International Conference on QiR (Quality in Research) 2015. Globalization today results in very competitive atmosphere in all aspects. This flourishing competition should consider the harmony and balance between human needs and the environment quality for creating favorable sustainable future. Steps to ensure the preservation of the environment for our future generations are slowly but surely taken. This fragile balance between the development and innovation of mankind as an effort to enhance their quality of life with its harmony with nature must be maintained as a way to achieve sustainable future - helping us make products and services more efficient, design better buildings, produce safer cars and keep people healthier.



Nowadays, scientists and researchers, hand in hand with industrial experts are creating and developing new green technologies that give us hope for a Sustainable Future. Great minds in Engineering, Architecture and Design areas especially has come up with ideas such as Green Architecture that has the capability to cut down urban resource use dramatically, and making urban expansion sustainable; New Nuclear Material; Waste-Sourced Biofuel/Pyrolysis, where technology is now able to turn biomass waste such as paper, grass or wood chips into gas and eventually ethanol; Biomimicry, that has given the rise to self-healing materials. This in turn will give longer lives to most consumer goods, and thereby reducing the demand for raw materials and waste; and many more innovations that should be encouraged for the motivation of current and future development.

These Green and Smart Technologies can help protect, conserve and even restore our precious shared environment. To develop this technology, we need to combine engineering, scientific or technological approaches, with ecology, economics and the social sciences and humanities. The Green and Smart Technologies innovation field is now wide open and offers exciting new territories to explore and develop. Creative thinking by our top technical and scientific researchers is giving us a more and more treasures of new workable ideas. However, innovations require more than just brilliant ideas. Innovations require resources, skills, technology, knowledge, tools, techniques and so much more. But most of all, innovations require people. People are the driving force behind every need of change, changes that are aimed to improve mankind's quality of life, to enhance their living conditions or to simply make life easier and more comfortable.

This conference is about learning of the fundamental aspects which can transform the world and society, thinking ahead to possible challenges facing the globe, discovering innovations related to opportunities for industry, and most importantly, this conference is about bringing together interdisciplinary people to accelerate activities in many areas simultaneously. This is what makes the conference exceptional this year in terms of potential impact from this networking.

I extend my sincere thanks to the Faculty of Engineering Universitas Indonesia, supporting parties and institutions for their participation and contributions in QiR 2015. I would also thank the people of Mataram especially our colleagues from Universitas Mataram and STMIK Lombok for their gracious support and hospitality. Additionally, I extend a hearty thank you to the members of the organizing committees for dedicating their valuable time so that each one of us enjoys an exceptional conference program over the next several days. May we have a successful, stimulating, fruitful and rewarding conference.

**Prof. Dr. Ir. Muhammad Anis, M.Met.**  
**Rector**  
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# PREFACE

## **WELCOME FROM THE DEAN OF FACULTY OF ENGINEERING UNIVERSITAS INDONESIA**

Welcome to the 14<sup>th</sup> International Conference on QiR (Quality in Research) 2015. The Faculty of Engineering Universitas Indonesia is proud that this year we could once again held an international conference of this grand scale. This two-day, biennial conference is presented together with our co-hosts Universitas Mataram and STMIK Lombok and speaks to the importance of fostering relationships among national and international front liners, thinkers, academics, executives, government and business officials, practitioners and leaders across the globe in an effort to share knowledge and best practices as part of a worldwide network.



For almost twenty years, the first definition of sustainable development and sustainability includes sentences like 'much remain to be done in the areas of sustainability' or 'the underlying science is still far from exact and we all still need to make a big effort' are common introducing and/or concluding phrases in both literature and scientific forums. I envisioned that QiR will be a platform where academicians, scientists, researchers and practitioners from engineering, architecture, design, and community services to share, discuss, and move forward with their findings and innovations. I hope that the intellectual discourse will result in future collaborations between universities, research institutions and industry both locally and internationally. In particular it is expected that focus will be given to issues on innovations for the enhancement of human life and the environment.

In accordance to this year's theme, this conference will cover a wide range of green and smart technology issues, especially state of the art information and knowledge of new innovations, ideas, creative methods or applications which can be implemented to enhance the human life with various smart technologies developed to improve mankind's quality of life and green technologies to make sure that we make a contribution to keeping our environment for our future generations. The itinerary for the two days has been carefully planned to ensure a lively exchange of ideas and the development of innovative strategies and there will be many opportunities for everyone in attendance to share their expertise with, and learn from, peers from around the world.

We foresee more and more challenges in our future. Challenges in how to improve our life, how can we enhance our society, how can we make our lives and the lives of our society better? These challenges should be answered together by developing collaborations for future research in various engineering and design areas. Let's make this conference an international media for exchange of knowledge, experience and research as well as the review of progress and discussion on the state of the art and future trend of prospective collaboration and networking in broad field of eco-based technology development.

My deepest appreciation to our sponsors, supported parties and various contributors for their never ending supports of this conference. I would also like to convey my gratitude to all of our distinguished speakers for making the time to share their knowledge with us. To our fellow researchers and/or practitioners from Indonesia and overseas, welcome and enjoy your stay in this amazing island, Lombok. I would also like to invite all participants in expressing our appreciation to all members of the QiR 2015 organizing committee for their hard work in making this conference another success.

**Prof. Dr. Ir. Dedi Priadi, DEA  
Dean Faculty of Engineering  
Universitas Indonesia**

## WELCOME FROM THE QIR 2015 ORGANIZING COMMITTEE

Welcome to the 14<sup>th</sup> International Conference on QIR (Quality in Research) 2015. It is a great pleasure for Faculty of Engineering Universitas Indonesia to be hosting this biennial event with Faculty of Engineering Universitas Mataram and STMIK Lombok, in the spirit of strengthening of cooperation and mutual growth to be world class institution. For the first time, the QIR 2015 is held in Lombok Island, one of Indonesia's beautiful paradise islands. It is with our utmost pleasure to hold this year's QIR 2015 in conjunction with 4<sup>th</sup> Asian Symposium on Material Processing (ASMP), and International Conference in Saving Energy in Refrigeration and Air Conditioning (ICSERA).



The aim of this International Conference with our selected theme, "Green and Smart Technology for Sustainable Future", is to provide an international forum for exchanging knowledge and research expertise as well as creating a prospective collaboration and networking on various fields of science, engineering and design. We hope this conference can be a kick-off for the strengthened action and partnerships on creating a platform for us; national and international thinkers, academics, government officials, business executives and practitioners, to present and discuss the pivotal role of engineers in innovative products which will reduce environmental impacts, applications in sustainable planning, manufacturing, architecture, and many more to grow and ensure the rising prosperity of our society going into the future. Under this theme, the conference focuses on the innovative contributions in green and smart technology to encourage and motivate current and future development for achieving sustainable future.

Over the period of 18 years, this biennial international conference started from annual national conference and now has become an important place of encounter between scholars and practitioners from different countries, cultures and backgrounds discussing contemporary engineering and design issues dealt in their hometown, country or even region. Serving as a platform for an engineering and design dialogue, this conference will have 21 invited speakers and has gathered more than 500 papers from more than 17 countries all over the world:

- 86 papers on International Symposium on Civil and Environmental Engineering
- 129 papers on International Symposium on Mechanical and Maritime Engineering
- 121 papers on International Symposium on Electrical and Computer Engineering
- 107 papers on International Symposium on Materials and Metallurgy Engineering
- 36 papers on International Symposium on Architecture, Interior and Urban Planning
- 56 papers on International Symposium on Chemical and Bioprocess Engineering
- 74 papers on International Symposium on Industrial Engineering
- 21 papers on International Symposium on Community Development

This year, we have a special talkshow planned as a special session within our plenary lecture. This talk show was planned by our alumni with the theme "**Serve Our Country**". After more than five decades of existence, FTUI has in its library hundreds if not thousands undeveloped innovation ideas and research from its faculties, graduates and students, all of which are aimed at enhancing the quality of human life and the environment, especially in Indonesia. We feel that it's time we contribute more to our country by making sure that these innovations and research can be implemented and produced for a better future of our nation. The talk show will feature some of the most prominent figure in Indonesia's government and will discuss how these innovations can be used by the government in areas such as: electrical, oil and gas, IT, mining, design, manufacture and how the industry can be a part of it.

My deepest gratitude: to all of our speakers, participants, contributors, partners, exhibitors and professional associations, who have given this conference their generous support. I would also like to thank all members of the Organizing Committee, our International Advisory Board and distinguished Reviewers for all of their support and advice. We also

owe our success to the full support of the Rector of Universitas Indonesia and the Dean of Faculty of Engineering. Last but not least, a special thanks to our co-hosts, Universitas Mataram and STMIK Lombok for all of their immense supports in making this conference a success.

Allow me to wish all of you a meaningful and rewarding conference. We wish you a pleasant and memorable stay in Lombok. Thank you and we hope to see you again at the QIR 2017.

**Dr. Fitri Yuli Zulkifli, ST., MSc.**  
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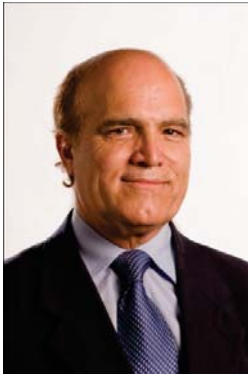
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In 1987 he gained the specialist degree at the National Laboratory of Civil Engineering (LNEC), distinguished with Manuel Rocha Award. In 1998, he created the Geotechnical Research Centre at the Technical University of Lisbon – IST and he served as its President until 2000. In 2001 he gets the degree of specialist in Geotechnique attributed by the Portuguese Association of Engineers.

Professor Correia is registered as an expert (external member) of "Agência de Avaliação e Acreditação do Ensino Superior" (Agency for Assessment and Accreditation of Higher Education - A3ES) for the scientific area of Civil Engineering, starting from 2013 when he served as a panel member in the evaluation of undergraduate and graduate courses for three institutions

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Francesco Picchioni was born in 1971. He is a professor of chemical product technology at the University of Groningen (RuG). His research interests include synthesis and application of bio-based and renewable polymeric materials for a variety of industrial applications. He studied and graduated from the University of Pisa. In 2010 he was elected Lecturer Gold 2010: a prize from the Royal Dutch Chemical Society to promote initiatives and innovation in chemistry education.



In 2000 Prof. Picchioni moved from Italy to Eindhoven and since 2003 he has worked at the Rijksuniversiteit Groningen University where he's currently teaching: Interfacial Engineering, Polymer Chemistry (for Industrial Engineering and Management), Polymer Products, and From bacteria to plastic, In collaboration with other teachers (responsible for only a part of the course).

# INVITED SPEAKER

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H.J. (Erik) Heeres (25-06-1963) carried out his Ph.D. research at the University of Groningen on the development of novel homogeneous lanthanide catalysts for the conversion of unsaturated hydrocarbons and graduated in 1990. Afterwards, he performed a post-doc at the University of Oxford in the group of Prof. J. M. Brown on asymmetric catalysis.

From 1991-1999, he was employed at Shell Research B.V. (Amsterdam and Pernis, the Netherlands) and worked on a range of applied catalysis topics. He joined the chemical engineering department of the University of Groningen in 1999 as an assistant professor. In 2003 he was appointed here as a full professor in green chemical reaction engineering. His research interests concern the development of efficient catalytic technology for acid-

and metal-based catalytic biomass conversions, with an emphasis on biofuels (catalytic pyrolysis, pyrolysis oil upgrading), platform chemicals (levulinic acid, hydroxymethylfurfural) and performance materials from biomass (starch modifications).

The group is actively involved in national and international consortia. Heeres (h-index 36) is the (co-) author of 155 papers in international peer reviewed journals and 13 patents in the field of (applied) catalysis and chemical reaction engineering. Heeres supervised 30 PhD students and up to 50 master students. He was nominated twice for the teacher of the year award of the Chemistry bachelor and master program and once for the Faculty teacher of the year award. He is currently an editorial board member of the journal Sustainable Chemical Processes. Heeres is a member of the Koninklijke Hollandsche Maatschappij der Wetenschappen..

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Professor Umemuro received his Bachelor of Engineering in Control Engineering, Faculty of Engineering, Tokyo Institute of Technology in 1987, Master of Engineering in Control Engineering, Graduate School of Science and Engineering, Tokyo Institute of Technology in 1989, and his Doctor of Engineering in Industrial Engineering and Management, Graduate School of Decision Science and Technology, Tokyo Institute of Technology in 1998. He is currently Professor at the Department of Industrial Engineering and Management, Graduate School of Decision Science and Technology, Tokyo Institute of Technology.



Professor Umemuro is also members of the following Professional Societies: International Society for Gerontechnology, Japan Ergonomics Society (a member of International Ergonomics Association), Japan Industrial Management Association, Japanese Cognitive Science Society, Japanese Society for Artificial Intelligence, The Japan Society for Management Information. He also serves as Trustee for the Japan Ergonomics Society since 1999 till today, served as President for the International Society for Gerontechnology Japan Chapter, 2006-2012 and Editorial Board of the Japan Society for Management Information 2002-2004. Professor Umemuro has published 25 publications in Preferred Journals, 50 publications in Edited Conference Proceedings, 5 Publications as Invited Contributions, 4 books publications, and 3 books translations.

## INVITED SPEAKER

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Professor Han received his Bachelor Degree in 1980 at Mechanical Engineering from Seoul National University. In 1982, he received his Master in Mechanical Engineering from Seoul National University and in 1988 he finished his Ph.D in Mechanical Engineering, University of Minnesota, USA. He currently serves as the Director of BKplus-Energy ODA Center, Kookmin University, Director of Energy Engineering Human Development Center, Kookmin University, and Director of Well-being Environment Research Center, Kookmin University.

Professor Han holds a certification as Professional Engineer from Minnesota State Board of AELSLAGID, Registration No. 21924 (since 1992). He is the President of the Society of Air-conditioning and Refrigerating Engineers in Korea (SAREK) since 201; the Central Construction Committee, Ministry of Land, Infrastructure and Transportation, Korea since 2013; the Editor-in-Chief, Koran Air Cleaning Association (KACA) from 2004; Member of the Korean Society of Automotive Engineering (KSAE) from 2001; Arbitrator for The Korean Commercial Arbitration Board from 1998. He is also a member of the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) from 1990 and member of American Society of Mechanical Engineers (ASME) from 1988.

**PROF. JOSAPHAT TETUKO SRI SUMANTYO**  
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He was an Associate Professor (permanent staff) at the Center for Environmental Remote Sensing (CEReS), Chiba University from 2005 to 2013, then Full Professor (permanent) at the same center from 2013 to now, member of international and domestic organizations, reviewer of journals, and organizations. His main interests are theoretically scattering microwave analysis and its applications in microwave (radar) remote sensing. He manages Josaphat Microwave Remote Sensing Laboratory (JMRS�), Center for Environmental Remote Sensing (CEReS), Chiba University, Japan.

His laboratory promotes the education and research to develop the internationally technologies and sciences. He always encourages the undergraduate and postgraduate students to know the microwave phenomenon and to be familiar with the interaction between microwave and natural matters (i.e. vegetation, artificial materials, earth surface, and snow), therefore they could develop original methods or sensor during studying in the courses.

# INVITED SPEAKER

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Professor Loos is a Professor at the Faculty of Mathematics and Natural Sciences, University of Groningen, Netherlands. Her fields of disciplines are: Polymer Science, Chemistry, Applied, Materials Science, and Multidisciplinary. Her main research interests are focused on the design, synthesis and characterization of novel tailor made macromolecules as well as on the development of sustainable, eco-efficient and competitive production methods of polymeric materials. By utilizing modern polymer synthesis techniques including biocatalysis and other controlled polymerization methods her research aims to expand fundamental scientific knowledge towards advanced technologies.

She is a Member of the board of the study group Macromolecules (studiegroep macromoleculen) of the chemistry section of the Dutch Science Foundation (NWO), Member of the board of the National Dutch Graduate School of Polymer Science & Technology (PTN), Member of the program committee of the Dutch Belgian Beamline (DUBBLE) at the European Synchrotron Research Facility (ESRF) in Grenoble, France, Member of the Scientific Evaluator Board of the German Academic Exchange Service (DAAD). She currently serves as Associate Editor Europe of the Journal of Renewable Materials, Member of the Editorial Board of Journal of Renewable Materials, Member of the Editorial Board of Polymer, Member of the Editorial Board of Polymers, Reviewer for scientific journals, Reviewer for grant proposals (national and international), Scientific advisor of Dutch and German courts, Industrial consulting and Contract Research.

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## INVITED SPEAKER

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Professor Hirano finished his Bachelor of Engineering in 1977 from Waseda University Japan and continued on to finished his Master of Science in 1979 and Ph.D in Engineering in 1990 from the same University. He went to Temple University Fox School, PA, USA to pursue his Executive MBA degree and finished in 2002 when he returned to Waseda University to take his Ph.D in International Business Management and finished them in 2007. He is currently a Professor at the Graduate School of Engineering Management, Shibaura Institute of Technology and a Guest Professor for the Kochi University of Technology, Japan.

Professor Hirano currently serves as the Vice-Chairperson of IEEE Technology and Engineering Management Society, Chairperson for Entrepreneur Engineering Society, Director & Secretary-General for the Japan MOT Society, and Member of Committee for The Japan Society for Science and Research Management, and holds membership several other notable societies and associations.

His research interest includes: Innovation Management, MOT (Management of Technology), SME Clustering in Manufacturing Industry, Regional Development, and Entrepreneurship. Professor Hirano was awarded the President Award for NTT Science and Core Technology Laboratory Group and NTT Basic Research Laboratories. He is the holder of 52 patents; one of them is the Method of fabricating circuit elements on an insulating substrate (US Patent 787136).

**PROF. MASAFUMI YOHDA**  
**TOKYO UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, JAPAN**  
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Professor Masafumi Yohda served as a professor since May 2003 in the Department of Biotechnology and Life Science, Tokyo University of Agriculture and Technology. Before that he was a researcher for the Institute of Physical and Chemical Research (RIKEN) since 1991. He finished his Bachelor, Master and Doctor from Department of Chemical Engineering, The University of Tokyo in 1982, 1984, and 1987 respectively. In 1999 he was awarded the Excellent paper award of Journal of Bioscience and Bioengineering.



His research field includes Biochemistry, Molecular Biology, Biophysics, System Engineering, and Environmental Science. Professor Yohda is the Councilor of the Japanese Biochemical Society, Director of the Protein Society of Japan, Director and Manager of East Japan Branch of the Society of Biotechnology, Director of the Chem-Bio Informatics Society. He is also a member of the Molecular Biology Society of Japan, The Society of Chemical Engineers, Japan, Japan Society for Environmental Biotechnology, to name a few.

# INVITED SPEAKER

**PROF. MICHIHARU TABE**  
**SHIZUOKA UNIVERSITY, JAPAN**  
(romtabe@rie.shizuoka.ac.jp)



Michiharu Tabe received the B.S. and M.S. degrees and the Ph.D. degree in engineering from Keio University, Japan, in 1973, 1975, and 1984, respectively. He joined Nippon Telegraph and Telephone Corporation in 1975, and had been engaged in research on Si processes for high-speed bipolar transistors and ultra-small MOSFETs. In 1984-85, he was a visiting researcher at Stanford University and studied oxidation of Si surfaces by Synchrotron Radiation. In 1990, he started to work on Si nanodevices, primarily single electron transistors.

Since 1994 up to now, he has been a Professor at Research Institute of Electronics, Shizuoka University, Japan. He is currently working on a new research area of "Single Dopant Atom Devices". Recently, two papers published from his group have been officially adopted as Emerging Technologies in "International Technology Roadmap for Semiconductors".

He is also an Adjunct Professor of University of Indonesia and an Honorable Professor of Obuda University, Hungary. In 2012, he received Prize for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology of Japanese Government, the 20th TakayanagiKenjiro Memorial Award in 2006, and a Fellowship of Japanese Society of Applied Physics in 2008.

**PROF. MING YANG**  
**TOKYO METROPOLITAN UNIVERSITY, JAPAN**

Prof. Ming Yang is a Professor in the Faculty of System Design Graduate School of System Design, Dept of Intelligent Mechanical Systems, Tokyo Metropolitan University, Tokyo, Japan. His Research Topics include: Micro-Forming and Micro-Fabrication.

## INVITED SPEAKER

**DR. MIOARA MANDEA**  
**CENTRE NATIONAL D'ETUDES SPATIALES, FRANCE**  
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Dr. Mioara Mandea is General Secretary of the European Geosciences Union and Program Manager for the Solid Earth Observation/Directorate for Strategy and Programs of Centre National d'Etudes Spatiales (French Space Agency), Paris. She graduated in Engineering in Geology and Geophysics from the University of Bucharest before earning doctorates from the University of Bucharest in geophysics and geophysical prospecting in 1993 and from the Institut de Physique du Globe de Paris in internal geophysics in 1996. In addition, she earned the Habilitation à Diriger des Recherches from the University Paris VII in 2001.

Her research interests mainly concern measuring, mapping, and understanding the multitude of magnetic fields encountered in near Earth and near Earth-like planets. Her fields of research also include geo-potential field mapping, on global or regional scales, with important implications for the understanding of rapid changes within the Earth's system. Dr. Mandea has published more than 200 papers. She is currently General Secretary of the European Geosciences Union. She has been awarded the Van Straelen prize (French Geological Society) and the Hepites prize (Romanian Academy), and is also a Titular Member of the Academy of Romanian Scientists.

**PROF. MUHAMMAD IDRUS ALHAMID**  
**UNIVERSITAS INDONESIA, INDONESIA**  
**(mamak@eng.ui.ac.id, mamak@indo.net.id)**

Professor Alhamid finished his Bachelor Degree from the Mechanical Engineering Department, Universitas Indonesia in 1978 and continued on to finished his Doctorate from Katholieke Universiteit, Leuven, Belgium in 1989. He is currently a Professor and Researcher in the Mechanical Engineering Department, Universitas Indonesia, Head of Energy Conversion Division and Head of Refrigeration and Air Conditioning Laboratories in said University.



He teaches Ventilation System and Air Conditioning, Refrigeration Technology, Energy and Safety inside Building, Drying Technology, Kapita Selecta, and Engineering Design. Professor Alhamid is also involved and head several researches as follow: Development of Renewable Energy for Organic Rankine Cycle using Eco-Friendly Fluid, Capillary Expansion Device Development for Cascade Refrigeration System with New Alternative Refrigerant: Azeotropis Mixing Carbon Dioxide and Ethane, Design of Methane Storage Prototype with Activated Carbon (AC) from Indonesian Coal as Adsorbent, Development of Freeze Vacuum Dryer with Condenser Heat and Vibration, Solar Thermal Cooling System (Kawasaki, Waseda Univ & MoE Japan), Potential NAMAs for Building Energy (UNEP).

He is a member of the Indonesian Engineers Association (PII) since 1985, a member of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) since 1990, a member of the Air System and Refrigeration Expert Association since 1999 and member of the International Solar Energy Society (ISES) since 2008.

# INVITED SPEAKER

**PROF. MOHAMMAD NASIR**  
**MINISTER OF RESEARCH, TECHNOLOGY AND HIGHER EDUCATION REPUBLIC OF INDONESIA**  
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HE Mr. Prof. H. Mohammad Nasir, Ph.D., Ak was born in Ngawi, East Java Indonesia in 27 June 1960. He was awarded his Bachelor for the Economic Faculty University of Diponegoro in Semarang in 1988. He later finished his Master in the University of Gadjah Mada (UGM), Yogyakarta in 1993 and earned his Ph.D in Accounting from the University of Science, Malaysia.

After experiencing work in the private sector, Prof. Nasir went back to his roots and started teaching at his alma mater, the Faculty of Economy, University of Diponegoro. His areas of teachings include: Management Control Systems, Management Accounting, Strategic Management, Organizational Behaviour, Behavioural Accounting, and Property Management.

Professor Nasir was appointed Vice Rector of Finance and Resources from 2006-2010 and Dean for the Faculty of Economic and Business from 2011-2014. He was elected as Rector on September 2014, however before his inauguration as Rector he was appointed as the Minister of Research, Technology and Higher Education by the President of the Republic of Indonesia.

**PROF. OLIVER CARSTEN**  
**UNIVERSITY OF LEEDS, ENGLAND**  
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Professor Oliver Carsten is a Professor of Transport Safety at the Institute for Transport Studies (ITS), University of Leeds. Professor Carsten did his undergraduate studies at the University of Oxford and obtained his PhD from the University of Michigan. Subsequently he worked at the University of Michigan Transportation Research Institute (UMTRI) for ten years. He joined the Institute for Transport Studies in 1987.



He has been project coordinator of several European projects, including HOPES which examined the safety impacts of various field trials, VRU-TOO which applied new technologies to improve the safety and mobility of pedestrians, HINT which examined the human implications of new technologies, and HASTE which has studied the effect on driving performance and safety of using in-vehicle information systems.

Currently he is coordinator of the European ecoDriver integrated (large) project on green driving support systems. He has led the development of the advanced driving simulator at Leeds and has directed projects to examine techniques for reducing unsafe driving on rural arterial roads and for investigating the benefits of Intelligent Speed Adaptation (ISA). He has been chair of the DRIVE I safety and behavioral group, was a member of the DRIVE Safety Task Force, is chair of the Road User Behavior Working Party of the Parliamentary Advisory Council for Transport Safety and has been a member of several expert groups of the European Transport Safety Council. He is editor-in-chief of the academic journal *Cognition, Technology and Work*.

**PROF. DR. RAINER LEISTEN**  
**UNIVERSITY OF DUISBURG-ESSEN, GERMANY**  
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Professor Leisten studied mathematics and business administration at the University of Cologne, Germany. He received his Ph.D. in business administration from the University of Cologne in 1984 with a thesis on scheduling problems with limited buffer capacities under the supervision of Prof. Dr.-Ing. Dr. Theodor Ellinger. Afterwards, Prof. Leisten gained three years experience as a controller in the headquarter of Commerzbank AG in Frankfurt.

Moving back to academia, he earned his postdoctoral lecturer qualification (habilitation) in business administration from the University of Heidelberg in 1995 with a thesis on aggregation and disaggregation in planning. In 1995 he became full professor at the University of Greifswald and held the chair of Production Management. In 1999 he was appointed as a full professor at the University of Duisburg (now University of Duisburg-Essen) to hold the chair of Production and Operations Management. Prof. Leisten is currently the chair of Business Administration and Operations Management.

His primary areas of research interests include: Scheduling in Manufacturing, Coordination Aspects in Multi-Level/Multi-Stage (Production) Planning and Control Systems, and Supply Chain Management. He has published continuously in international journals and is conducting continuously research projects with business partners as well as international partners from academia.

**DR. ROKIAH OMAR**  
**UNIVERSITI KEBANGSAAN MALAYSIA, MALAYSIA**  
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Rokiah Omar received her Bachelor of Optometry degree from the Universiti Kebangsaan Malaysia (UKM). After completing her BOptom in 1990, she was employed as an Optometrist with a private practice in Kuala Lumpur before joining UKM as a tutor in 1994. She obtained her PhD. in Low Vision from University of New South Wales, Australia in 2002. She is a Fellow in Low Vision of the American Academy of Optometry, Fellow of Association of Malaysian Optometrists, Founding members of Malaysian Academy of Optometry and Associate Fellow Academy of Science Malaysia.



Dr Rokiah became the first optometrist in the Asia region to be inducted as an International Blind Sports Federation International (IBSA) and International Paralympics Committee (IPC) Visually Impaired Classifier. She classifies visually impaired athletes at many disable sports/games locally and internationally. She was selected to represent Asia's continent to provide classification for visually impaired athletes at the London Paralympics Games 2012.

She is currently the Classification Director for the Asian Paralympic Committee (APC) and was in charged for classification of disable athletes at the Incheon Asian Para Games 2014 for 23 disable sports involving 44 countries. Her research interests include low vision rehabilitation, special population needs, quality of life and Public Health Optometry. She received many research and innovation awards at national and international levels.

# INVITED SPEAKER

**PROF. SANGKWON JEONG**  
**KOREA ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY**  
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Professor Jeong finished his Bachelor and Master degrees from Seoul National University at 1985 and 1987 respectively. He received his Ph.D from MIT at 1992 where he continued to work in their Cryogenic Engineering Laboratory as visiting engineer and MIT Plasma Fusion Center from 1992-1995 as a research Engineer. Professor Jeong returned to Korea where he took up a position with the Korea Advanced Institute of Science and Technology where he is currently a Professor for the Department of Mechanical Engineering.

His research interests include the following: Cryogenics, Cryocooler design, applied superconductivity system, Cryogenic heat transfer, and Refrigeration. He was awarded the JSPS Fellowship in 1999 from Korea Science and Engineering Foundation, Overseas Research Fellowship for 2000 from Korea Research Foundation, Outstanding Research Paper Award by KIASC in 2004 and Overseas Research Fellowship for 2005 by SBS Foundation. Professor Jeong has 5 registered patents and 4 claimed patents between the year 2001-2006.

He is a member of the Korean Society of Mechanical Engineers (KSME), Korea Institute of Applied Superconductivity and Cryogenics (KIASC), American Society of Mechanical Engineers (ASME), and International Institute of Refrigeration (IIR). Professor Jeong is the Associate Editor for: the Journal of the Korea Institute of Applied Superconductivity and Cryogenics, Journal of Mechanical Science and Technology, and Cryogenics.

**VERONICA SOEBARTO, PH.D.**  
**THE UNIVERSITY OF ADELAIDE, AUSTRALIA**  
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Veronica Soebarto is an Associate Professor and Deputy Head and Associate Head (Research) at the School of Architecture and Built Environment, The University of Adelaide. She holds a PhD in Architecture and Master of Architecture, both from Texas A&M University (College Station, Texas), and a Bachelor of Architectural Engineering from the University of Indonesia. Prior to joining The University of Adelaide in 1998, she was a Post-Doctoral Research Associate at Texas A&M University, a part-time lecturer at The University of Indonesia and an architect in Jakarta.



At The University of Adelaide, she teaches sustainable design, technology and environment courses at the undergraduate and postgraduate levels. Her main research interests include human thermal comfort, building thermal/energy simulation, environmental monitoring, and sustainable building design and assessments, and she supervises Honours, Masters and PhD students in these areas.

Veronica received a Faculty of the Professions' Executive Dean's Research Award in 2014. She has published more than 80 publications in journals, book chapters and conference proceedings. She is a member of the Editorial Board of Journal of Building Performance Simulation and an Associate Editor of Architectural Science Review. She is the 2014-2015 President of Architectural Science Association (ANZAScA).

# PROGRAM AT GLANCE

Date	Time	Program	Venue
<b>10 August 2015</b>	04.00-06.00 pm	Registration and Welcome Drink	Pre-function Hall
<b>11 August 2015</b>	07.30-08.00 am	Registration	Pre-function Hall
	08.00-08.40 am	Opening Ceremony	Rinjani Room I, II, III
	08.40-09.00 am	Photo Session	
	09.00-09.30 am	Keynote Speech 1	
	09.30-10.30 am	Talk show: Serve the Country	
	10.30-10.45 am	Coffee break	
	10.45-12.00 am	Keynote Speech 2 and 3	
	12.00-01.00 pm	Lunch	Restaurant
		Poster Session	Pre-function Hall
		Exhibition	
	01.00-03.00 pm	Parallel session	Meeting Rooms
	03.00-03.30 pm	Coffee Break	Pre-function Hall
		Poster Session	
Exhibition			
03.30-05.00 pm	Parallel session	Meeting Rooms	
05.00-07.00 pm	Poster Session	Pre-function Hall	
	Exhibition		
07.00-09.00 pm	Banquette Dinner	Rinjani Room I, II, III	
<b>12 August 2015</b>	08.00-10.00 am	Parallel session	Meeting Rooms
	10.00-10.30 am	Coffee Break	Pre-function Hall
		Poster Session	
		Exhibition	
	10.30-12.00 am	Parallel session	Meeting Rooms
	12.00-01.00 pm	Lunch	Restaurant
		Poster Session	Pre-function Hall
		Exhibition	
01.00-03.00 pm	Parallel session	Meeting Rooms	
03.00-03.30 pm	Coffee Break	Pre-function Hall	
	Poster Session		
	Exhibition		
03.30-05.00 pm	Parallel session	Meeting Rooms	
05.00 - 06.00 pm	Closing Ceremony	Selaparang Room	
<b>13 August 2015</b>	08.00 am-08.00 pm	Social Tour Lombok	



# SYMPOSIUM **A**

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**International Symposium on Civil  
and Environmental Engineering**



## Zero Order Degradation Rate of Vitamin C in Fresh Orange and Strawberry Juices without Any Preservatives during Storage

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**Keywords:** Vitamin C; Orange; Strawberry; Zero order

**Abstract.** Fresh orange and strawberry are rich in vitamin C, which is an essential nutrient to promote a healthy immune system. Vitamin C is easily degraded through oxidation process into dehydroascorbic acid during storage. Therefore, it is important to study the factors influencing the degradation rate of vitamin C in fruit juices without any preservatives. The aims of this research were to study the kinetic degradation of vitamin C in fresh orange (concentrated and non-concentrated) and strawberry juices during storage and how the temperature affects these kinetics. Fresh juices were stored at room, refrigerated and frozen temperature. The content of vitamin C in fresh juices were analyzed using direct iodometric titration. Kinetic study of vitamin C degradation for these juices were carried out under isothermal condition. The degradation rates of vitamin C in fresh fruit juices based on zero kinetic model were compared. At room temperature the degradation rates of vitamin C in strawberry juice were about ten times faster than those in the orange juice. At refrigerated temperature the degradation rates of vitamin C in orange and strawberry juices with sugar were twice lower than theirs without sugar addition.

### Introduction

Vitamin C is belong to one of the most potent antioxidant that is important for human health. Antioxidants can block some damages caused by free radicals. Free radical mostly exist in tobacco smoke and polluted air are responsible for cell damages leading to lung cancer and asthma. The deficiency in vitamin C causes scurvy that is characterized by bleeding gums, weakness, fatigue, anemia and depression. Vitamin C deficiency may occur in people who eat few fruits or vegetables and in smokers too.

Vitamin C enhances the absorption of iron thus preventing anemia. Vitamin C also plays important role in collagen formation which is essential for wound healing in patient recovering from surgery. According to Jusi [1], vitamin C is needed to form collagen that is needed to heal damaged tissues. The healing power of the damaged tissues is increased with vitamin C intake. The strength of the fibrous was reduced by 50% vitamin C supplementation [1].

Men, women and children need 90, 75 and 45 mg/day of vitamin C, respectively based on Recommended Dietary Allowances (RDA) [2]. The human body is not able to make vitamin C on its own. It is important to consume vitamin C rich foods, such as fruits and vegetables (potatoes, spinach, tomatoes, broccoli, strawberries, orange, etc.). Orange and strawberry are commonly consumed in fresh juice with some added sugar. Strawberry juice contains about 20-40 mg vitamin C per 100 ml juice, whereas orange juice only contains about 10-20 mg vitamin C/100 ml. Consumers always expect a high content of vitamin C remaining in this juices, however this vitamin is easily degraded mainly through oxidation process into dehydroascorbic acid during the preparation and storage. Several factors influencing the degradation rate of vitamin C are sugar presence, temperature, light exposure and dissolve oxygen concentration [3]. Ascorbic acid is one of the most heat sensitive nutrients and usually considered as an index of nutrient quality during processing and storage of food. If ascorbic acid is well retained in food, the other nutrients are also well retained [4].

Kabasakalis [5] stated that the quality of some fruit juices was indicated by its vitamin C contents which was dependent on its initial content and its rate of loss upon storage. He found out

the amount of ascorbic acid in some commercial juices within the range of 2.4 to 43 mg/100 ml juice. He compared the vitamin C content and the loss rate between commercial fruit juices and fresh juices under different storage condition, open and closed containers, and upon storage in the refrigerator and at room temperature. The commercial orange juice and fresh orange juices which stored in refrigerator for 31 days in open container showed higher loss in their vitamin C content than those stored in closed container.

In United State and Europe, orange juice has been produced in numerous forms such as frozen concentrated juice. Increased awareness of people to consume orange juice as natural as possible, without extensive processing, has contributed increase demand of fresh squeezed orange juice. Lee [6] from Florida Department of Citrus studied vitamin C loss in frozen unpasteurized fresh squeezed orange juice in polyethylene-bottle (HDPE). This orange juice was stored at  $-23^{\circ}\text{C}$  and initially contained 40.6 mg vitamin C/100 ml juice. The vitamin C content declined linearly to 32.8 mg vitamin C/100 ml juice over 24 months. Oxidative enzyme reaction was considered to be responsible for the loss of vitamin C in frozen unpasteurized fresh squeezed orange juice.

Vitamin C content in freshly home-made orange and strawberry juices are interesting to study in order to get more information on the decrease of nutritional quality of juices upon storage. Freshly made juices without any chemical preservatives were commonly prepared at home, hospitals and home industries. Consumers should know how to store the juices to get maximum benefit of vitamin C content when consume them. The aims of this research were to study and compare the kinetic degradation rate of vitamin C in fresh orange and strawberry juices during storage and to investigate how temperature and added sugar affects these kinetics.

## Material and Methods

**Reagents.** The reagents were  $\text{KIO}_3$  0.1 N, KI 10%,  $\text{H}_2\text{SO}_4$  2 N,  $\text{Na}_2\text{S}_2\text{O}_3$  0.1 N, Iodin 0.1 N, starch as indicator and ascorbic acid p.a.

**Fruit juices.** Fruit juices are strawberry (*Fragaria vesca*) and orange (*Citrus reticulata*) which were bought from the local supermarket of Surabaya, East Java, Indonesia. The strawberries were washed and cut into small pieces then blended with some water using home blender. The oranges were washed, cut into two pieces and squeezed with home orange juice squeezer. The concentrated orange juice was made without any water added to the squeezed orange juice, whereas orange juice was made with 300 ml water added to 300 ml squeezed orange juice. Some sugar was added to juices to study the influence of sugar on the vitamin C degradation rate. The fresh juices were stored at 3 storage conditions, i.e. room temperature, refrigerated temperature and frozen temperature.

**Vitamin C determination.** Vitamin C in the fresh strawberry and orange juices were determined using iodometric titration. The end points of the titration were indicated by the color change from red to red-orange for strawberry juice and from yellow to yellowish-green for orange juice.

**Data analysis.** The degradation rate of vitamin C in the fresh concentrated orange juice, orange juice and strawberry juice during storage were evaluated using zero order kinetics model. Zero order kinetic in a batch reactor [7] is:

$$-r_A = -\frac{dC_A}{dt} = k \quad (1)$$

In fruit juice, the relation of ascorbic acid content ( $C_A$ ) with time of storage ( $t$ ) can be expressed by:

$$C_A(t) = C_{A0} - k.t \quad (2)$$

$C_{A0}$  is initial vitamin C content in fruit juice (mg ascorbic acid per 100 ml juice) and  $k$  is a zero order rate constant (mg ascorbic acid per 100 ml juice  $\text{time}^{-1}$ ). Degradation vitamin C rate for zero order kinetic is equal to  $k$  according to Eq. (1).

The temperature dependence of vitamin C loss rate constant was studied using the Arrhenius equation as follow:

$$k = k_0 e^{-E_a/RT} \quad (3)$$

where  $k_0$  is frequency factor,  $E_a$  is activation energy (cal/mol),  $R$  is an universal gas constant (1.987 cal/mol/K) and  $T$  is absolute temperature in K.

### Results and Discussion

Vitamin C content in fruit juices was determined every certain time interval during storage. Initial vitamin C content ranged from 15-23 mg per 100 ml juice in concentrated orange juice, 9-13 mg/100 ml juice in orange juice, and 22-37 mg per 100 ml juice strawberry juice.

Ascorbic acid degradation rate were calculated using zero order kinetics. The determination coefficient ( $r^2$ ) obtained from the zero order kinetic model fitting in vitamin C degradation in both orange and strawberry juices were in the range of 0.90 – 0.99 according to the previous investigation [3, 8]. The ascorbic acid degradation rates in freshly home made orange and strawberry juices stored at various temperatures, i.e. room temperatures, refrigerated temperatures, and frozen temperatures were shown in Table 1/ Fig. 1, Table 2 / Fig. 2, and Table 3/ Fig. 3, respectively. Initial vitamin C content in strawberry juice was always higher than concentrated orange juice, but their vitamin C degradation rates were also higher than those in orange and concentrated juices.

Table 1. Zero order rate constant for concentrated orange, orange and strawberry juices in room temperature

Juice	Storage temperature [°C]	Initial ascorbic acid concentration [mg AA/100 ml]	zero order rate constant [mg AA/100 ml juice/hour]	
			without sugar	with sugar
concentrated orange	29±3	15-19	0.635	0.661
orange	29±3	9-10	0.434	0.623
strawberry	28±1	22-37	4.419	2.319

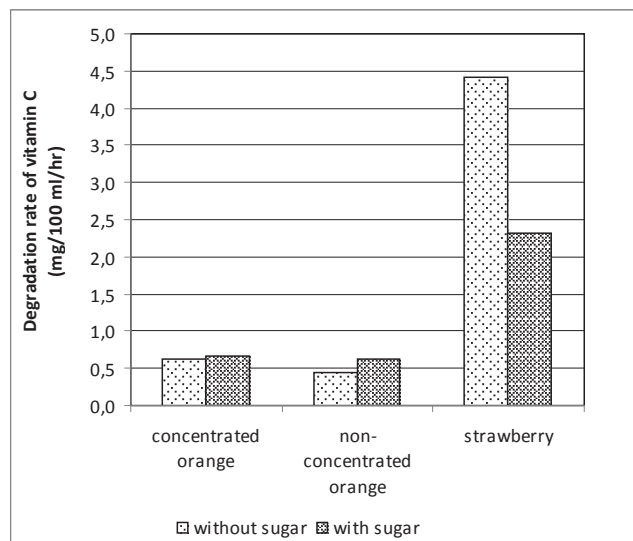


Fig. 1. Vitamin C Degradation Rate in Concentrated Orange Juice, Orange Juice and Strawberry Juice at Room Temperature

At room temperature, the degradation rates of vitamin C in strawberry juice were about ten times faster than those in the orange juice. Vitamin C degradation rate in orange juices were slightly increased with the sugar addition which were contrary to that in strawberry juices. Interestingly, the degradation of Vitamin C was retarded up to about 50% with sugar addition in the strawberry juice.

Table 2. Zero order rate constant for orange and strawberry juices in refrigerated temperature

Juice	Storage temperature [°C]	Initial ascorbic acid concentration [mg AA/100 ml]	zero order rate constant [mg AA/100 ml juice/hour]	
			without sugar	with sugar
concentrated orange	13±2	22-23	0.086	0.083
orange	13±2	9-10	0.067	0.037
strawberry	8±3	21-35	3.631	1.854

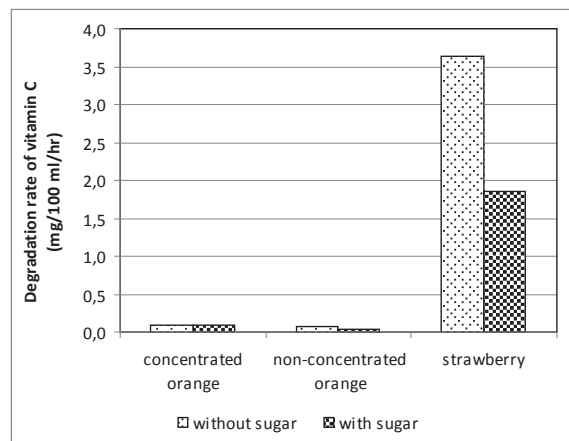


Fig. 2. Vitamin C Degradation Rate in Concentrated Orange Juice, Orange Juice and Strawberry Juice at Refrigerated Temperature

At refrigerated temperature, the degradation rates of vitamin C in strawberry juice were about fifty four times faster than those in the orange juices. The degradation rates of vitamin C in orange juices were much repressed at refrigerated temperatures compared to those obtained at room temperatures. In contrast, the degradation rate of vitamin C were only slightly decreased in strawberry juices stored at refrigerator in comparison to those stored at room temperatures. In this temperature, the degradation rates of vitamin C in orange and strawberry juices with sugar were twice lower than theirs without sugar addition.

Table 3. Zero order rate constant for frozen juice degradation rate at -5°C

Frozen Juice	Storage temperature [°C]	Initial ascorbic acid concentration [mg AA/100 ml]	zero order rate constant [mg AA/100 ml juice/hour]	
			without sugar	with sugar
concentrated orange	-5±1	20-22	0.033	0.035
orange	-5±1	12-13	0.018	0.021

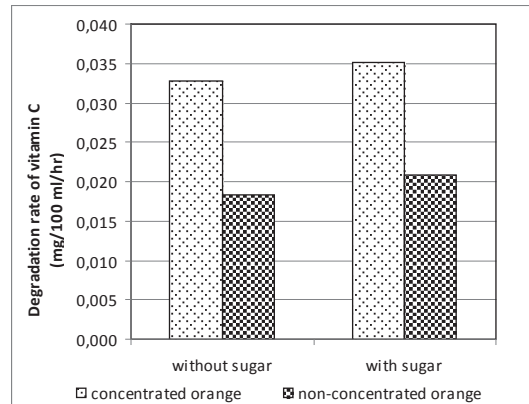


Figure 3. Frozen juice degradation rate of concentrated orange and non-concentrated orange juices at -5°C

In general, vitamin C in strawberry juices were much more easily degraded than the vitamin C in orange juices. The activation energy of ascorbic acid degradation were 1.653 kcal/mol and 1.902 kcal/mol for the fresh strawberry juices prepared without and with sugar [3], respectively whereas those estimated in sugar added and without sugar added orange juices were 14.3 kcal/mol and 15 kcal/mol [8], respectively. The activation energy of vitamin C degradation in orange juices were about ten times higher than those in strawberry juices. This proved that vitamin C in orange juices were more stable and less sensitive towards temperature changes. On the other hand, vitamin C in strawberry juices were much more degraded which might be due to the inherent properties of strawberry fruits. They were easily getting ripened and prone to physical damages which could accelerate the degradation of vitamin C.

At frozen temperatures, the degradation rates of vitamin C in concentrated orange juice were about twice higher than those in non-concentrated orange juice. The sugar addition slightly increased the vitamin C degradation rates. Interestingly, the degradation rate of vitamin C in concentrated orange juices stored at room and refrigerated temperatures were not significantly different compared to their corresponding non-concentrated ones. It seemed that there were chilling injuries occurred in the concentrated ones at frozen temperatures. However, the degradation rates of vitamin C in orange juices were decreased with decreasing storage temperatures (Table 1 vs. Table 2 vs. Table 3).

## Summary

The degradation rates of vitamin C in fresh homemade orange juices and strawberry juices obtained using zero order kinetics were compared. It turned out that the degradation rates of vitamin C in strawberry juices were much higher than those in orange juices at any storage temperatures. This has been proved by the lower energy activation obtained for strawberry juices, indicating their high sensitivity towards temperature changes, leading to vitamin C degradation at higher rates. At frozen temperature, the vitamin C decreased significantly in concentrated orange juices in comparison to that in the non-concentrated ones.

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