Selenium Research

International Society for Selenium Research Issue 3, Summer 2016

Welcome Remarks

Gary S. Bañuelos, President, ISSR

Dear Members,

I hope we will all still carry the memories, new knowledge, and new contacts from our 4th International Selenium Conference in Sao Paulo, Brazil of November 2015. With our busy lives, it seems so long ago that we all successfully met and shared our respective knowledge on some aspect of selenium at the conference. Again we thank the local Brazilian organizers for the unselfish efforts and hard work that Professors Moraes, Guilherme, and Rodrigues dos Reis and their students provided to put on a conference that we not only intellectually benefited from but also one that provided positive enjoyable memories. In addition, for those of you who participated in the Post-conference excursion to the selenium-accumulation Brazilian Nut Farm and the piranha-infested Amazon River, the memory of a new adventure supplemented with the fine Brazilian cuisine and the continued conversations on selenium research, left us all with a new appreciation of Brazil, its culture, its beauty and a new knowledge on selenium research efforts. As we slowly but surely look forward to selenium's birthday in 2017, Elias Arner et al., myself and Zhi-qing Lin are prodding forward to co-organize the 5th International Selenium Conference in conjunction with 11th International Symposium on Selenium in Biology and Medicine in Stockholm Sweden. Professor Arner has been relentlessly working on all the unseen foundation pieces that are most important in holding this joint conference at the world-renown Karolinska Institute in Stockholm. Importantly, this first-of-its-kind selenium conference will combine participants from our four International Selenium Conferences with the participants from the Selenium Symposium in Biology and Medicine that takes place every 4 years. This 2017 selenium conference will truly represent all faces of "Selena", and provide an international forum that will cover researchers from every aspect of selenium to share their respective knowledge of Se. This conference dedicated to Selenium's birthday of 200 years is certainly the "Selenium Conference" not to miss. Most importantly, when attempting to organize a conference of this magnitude, the expenses are also magnified. I remind you that contacting interested parties, companies, institutions, who may have an interest in participating as financial sponsors for the conference, is strongly encouraged. I encourage you all to contact Professor Arner at elias.arner@ki.se for more information.

I will also describe and provide more detailed information on logistics, including financial support, and co-organization of the jointly held selenium conference in our next newsletter. Organizing the 2017 Selenium Conference as a bridge between two major groups of selenium research provides a unique opportunity for a true expansion of world-wide selenium research for all of us. In addition, the joint cooperation allows us the opportunity to enhance the multi-faceted growth of the International Selenium Society; that is very exciting. 2017 will be a new opportunistic year for selenium researchers. We all have worked hard as a "selenium group"-we deserve more opportunities to grow, improve and learn more. Using Suzhou, Hefei, and Rio de Janeiro as our building stones for holding our International Selenium Conference, we are all now ready to embrace Stockholm Sweden as our next level of growth for holding our 5th Selenium Conference with the International Symposium on Selenium in Biology and Medicine in Sweden. I look forward to seeing you all there and I look forward to meeting new colleagues and learning about their new facets of selenium research.

The Discovery of Selenium in 1817

Jöns Jacob Berzelius (1779 - 1848)

"Berzelius and Gahn met at Gripsholm in August 1817. Berzelius spent more than one month there, studying, inter alia, technical issues related to the production of sulfuric acid and nitric acid (aqua fortis). The former owner of the factory, M. Bjuggren, had noted that a reddish sludge occurred in the lead chamber, only when pyrite (an iron sulfide) from the mine in Falun was used. The sludge was believed to be an arsenic compound and hence the Falun pyrite was avoided. However, Gahn and Eggertz both came from Falun and considered it interesting and important to use Falun pyrite. Therefore, Gahn and Berzelius—being the experts—tried to analyze the reddish sludge. By roasting 200 kg of sulfur they obtained about 3 g of a precipitate. Their subsequent chemical analysis of the sample indicated the possible presence of tellurium (discovered in mines in Transylvania in the 1780s). However, Berzelius doubted this result since tellurium had never been found in minerals from Falun. Nevertheless, he wrote about tellurium in letters to his close friends Alexandre Marcet and H.G. Trolle Wachtmeister in 1817. In early 1818, Berzelius repeated the experiments in his Stockholm laboratory and concluded that the sludge must contain a new element.

The new element had properties of a metal, and was similar to sulfur, initially suggesting it to be a new species of sulfur. In its metallic state, it had a brilliant grayish lustre. When heated by a candle using blowpipe analysis, it burned with an azure-blue flame and emitted a strong odor of horseradish, typical of tellurium. This smell may initially have fooled Berzelius and Gahn.

Klaproth had assigned tellurium (Latin: tellus, earth) to Müller von Rechenstein's new element in 1784. Berzelius chose the name selenium (Greek: selene, moon) for the new element, noting its resemblance to tellurium."

Jan Trofast. 2011. Berzelius' Discovery of Selenium. Chem. Int., 33(5): 16-19.

5th International Conference on Selenium in the Environment and Human Health & 11th International Symposium on Selenium in Biology and Medicine

August 13-17, 2017, Karolinska Institutet, Stockholm, Sweden

Today we know that selenium has a wide range of important functions in nature, and to celebrate 200 Years of Selenium Research an international selenium conference will be held at Karolinska Institutet in Stockholm on August 13-17, 2017. The conference will cover all fields of current selenium research, with a special focus on biology, medicine, biomedicine and the environment. The conference will officially be composed of two serial symposia; for the first time held in parallel at the same site and having overlapping plenary sessions, poster sessions and social events. The two symposia are The 11th International Symposium on Selenium in Biology and Medicine, which is the continuation of a meeting held in Berlin in 2013 (http://selenium2013.com) and The 5th International Conference on Selenium in the Environment and Human Health, as continued from a meeting held in Brazil in 2015. (www.seleniumresearch.org).

Conference Web Page:
www.Se2017.SE

Conference Language: English

Conference Venue

The Se2017 symposium will be held at the Karolinska Institutet Campus Solna, in Aula Medica and in the three lecture halls of the Berzelius laboratory. Directions and map to the Karolinska Institutet Campus Solna is found on the following website: ki.se/en/about/contact-and-visit-us. More information about and history of Karolinska Institutet at: ki.se/en/about/the-history-of-karolinska-institutet.

Tentative Conference Program

Selenium chemistry and geochemistry

- Inorganic selenium chemistry
  Chemical reactions, synthesis and characterization of inorganic selenium compound
- Imaging of selenium and analytical methodologies
  Novel methodologies to assess, determine and measure aspects of selenium chemistry, selenium speciation and imaging techniques
- Local geological selenium sources and global cycling
  Factors affecting selenium content, chemical speciation and fractionation, transport and fate, and flux measurement, identification of excessive and deficient distribution, bio-and geochemistry, and global cycling.
- Relationships of selenium between soils, water, and vegetation
  Selenium accumulation and factors affecting selenium bioavailability, accumulation, tolerance, including hyperaccumulators and evolutionary aspects, soil chemistry, ecology, natural accumulation, i.e., high Se-accumulating communities.
- Excessive selenium accumulation from natural or anthropogenic sources and remediation technologies
  Selenium pollution sources, remediation technologies.
- Strategies to improve selenium accumulation and biofortification
  Selection of favorable cultivars, agronomic practices, e.g. Se fertilizers and biofortification, nano-particles, microbial participation, molecular and genetic engineering, Se-enriched plants, animal and fish products, societal selenium economics.
- Selenium interactions with other elements in the environment
  Selenium interactions with other elements, including mercury, arsenic and other heavy metal pollutants, in the environment, marine and land ecosystems.

Selenium in the molecular life sciences

- Metabolism of selenium in living cells
  Selenium metabolism in different species from microbes to human, enzyme catalyzed reactions, organismal metabolism of selenium compounds, uptake and excretion
- Molecular mechanisms of selenium toxicity
  Mechanisms of selenium toxicity, metabolic consequences of excessive selenium levels, toxicity of specific selenium compounds.
- Molecular consequences of selenium deficiency
  Biochemical studies of signaling events or metabolic consequences triggered in living cells and organisms by selenium deficiency.
- Selenoprotein synthesis pathways
  Studies of processes, mechanisms and molecular factors involved in synthesis of selenoproteins, including elongation factors, mRNA structures, tRNA species as well as novel methods for synthetic production of selenoproteins.
- Selenoprotein genetics
  Non-medical studies of selenoprotein genetics.
- Selenoprotein function
  Molecular studies of selenoprotein function, including enzymology, biochemical properties, structural studies and cellular functions of specific selenoproteins.
- The systems biology of selenium and selenoproteins
  Selenium metabolism and selenoproteins studies by methods of systems biology, such as genome wide studies, bioinformatics, proteomics.
- Selenium based biotechnological applications
  Novel methodologies in biotechnology based upon or involving the unique physicochemical features of selenium or selenocysteine.
- Additional and emerging topics of selenium in molecular life science
  Other non-medical topics of selenium and selenoproteins in molecular life sciences.

Selenium in animal and human health and disease

- Selenium supplementation for animal and livestock health
  Use and impact of selenium supplementation for improved animal health, including veterinary usage and maintenance of healthy livestock.
- Epidemiology of selenium related health and disease
  Correlations of nutritional selenium intake levels with health or disease in animals and human.
- Nutritional selenium intervention studies in human
  Impact of selenium supplementation trials on human disease spectra.
- Selenium based medical therapeutics
  Studies of selenium compounds utilized as novel therapeutics for treatment of disease in humans.

Registration

Registration will open in February 2017. Detailed instructions for on-line registration will be available at the conference website in Fall 2016. For regular delegates, the registration fee will be SEK 4 500 ex. VAT (approx. EUR 480), but SEK 3 000 ex. VAT (approx. EUR 320) for students.

Conference Excursion

A boat trip will be arranged on August 14 (Tuesday, 7 PM) to Mariefred with dinner on boat. Mariefred lies roughly 50 km west of Stockholm. It is a tiny, quintessentially Swedish village, and whose peaceful attractions are bolstered by one of Sweden's finest castles, Gripsholm.

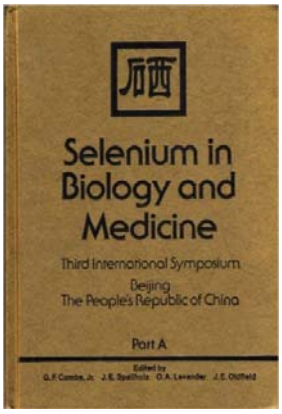
Conference Organizers

Chair

- Elias Arnér, Karolinska Institutet, Sweden (Elias.Arner@ki.se)

Executive Committee

- Elias Arnér, Karolinska Institutet, Sweden (Elias.Arner@ki.se)
- Gary Banuelos, USDA, USA (Gary.Banuelos@ARS.USDA.GOV)
- Arne Holmgren, Karolinska Institutet, Sweden (Arne.Holmgren@ki.se)
- Zhi-Qing Lin, Southern Illinois University, Illinois, USA (zhlin@siue.edu)



International Symposium on Selenium in Biology and Medicine

The International Symposium on Selenium in Biology and Medicine has a long tradition. It started in 1976 in Oregon (USA), followed by the 2nd meeting in 1980 in Texas (USA), the 3rd in 1984 in Beijing (China), the 4th in 1988 in Tübingen (Germany), the 5th in 1992 in Nashville (USA), the 6th in 1996 in Beijing (China), the 7th in 2000 in Venice (Italy), the 8th in 2006 in Madison (Wisconsin, USA), the 9th in 2010 in Kyoto (Japan), and the 10th International Symposium on Selenium in Biology and Medicine which was held in 2013 in Berlin (Germany).

The 10th International Symposium on Selenium in Biology and Medicine was held on Sept 14-18, 2013 in Berlin, Germany. More than 150 abstracts had been submitted, 120 posters were shown, and more than 230 participants joined in Berlin for a wonderful, scientifically stimulating and enjoyable meeting. In Berlin, this symposium was linked to the Annual Meeting of the German Society of Trace Elements, which directly proceeded the international meeting at the same conference centre, enabling the national and international participants to attend both events.

The International Scientific and Programme Organizing Committee in Berlin, 2013 included Elias Arnér, Sweden; Gary Banuelos, USA; Marla Berry, USA; Ohad Birk, Israel; Raymond Burk, USA; Gerald Combs, USA; Nobuyoshi Esaki, Japan; Vadim Gladyshev, USA; Dolph Hatfield, USA; Kaixun Huang, China; Alain Krol, France; Byeong Jae Lee, South Korea; Xingen Lei, USA; Matilde Maiorino, Italy; Bernhard Michalke, D; Margret Rayman, GB; Michael Rother, D; Roger Sunde, USA; Anatoly Skalny, RU. The Local Organizing Committee: Josef Köhrle & Lutz Schomburg, Charité Berlin; Ulrich Schweizer, University Bonn; Regina Brigelius-Flohé & Anna Kipp, DIfE, Potsdam.

Group photo (above) of the 10th International Symposium on Selenium in Biology and Medicine which was held in 2013 in Berlin, Germany. (Lutz Schomburg)

RESEARCH HIGHLIGHTS

Understanding the Biogeochemical Dynamics of Selenium in Tropical Soils and the Effects of Soil Management in Malawi

Selenium deficiency is one of the most pressing micronutrient deficiency (MND) risks in Malawi (Hurst et al., 2013; Joy et al., 2015). Soil management strategies to address selenium deficiency are feasible, although recent work from our wider consortium (in Malawi and UK) predicts that the fixation of selenium in both temperate and tropical soils plays a major role in controlling selenium availability to plants (Chilimba et al., 2012a, b). Thus, following rainfall or fertiliser inputs, potentially only a narrow window of opportunity for selenium uptake by plant roots exists. Anionic/oxyanionic selenium species are likely to be fixed rapidly into inert humus-bound forms and/or inorganic colloids (e.g. Fe/Al hydrous oxides). Other losses of Se occur through leaching and volatilisation. The relative importance of these processes on Se availability has not yet been studied directly in tropical soils. Resolving selenium fixation rates will inform tropical soil management strategies for optimising the supply of selenium to crops.

This study is at an early stage and is seeking to understand the mechanisms of selenium (and iodine) dynamics in three different tropical soil types under different soil management approaches. In one experiment, we are exploring the behaviour of selenium in soils under long-term conservation agriculture (CA) regimes. During this past season (2015/16), there was a severe drought in many parts of Malawi, including at the Chitedze Research Station where those plots are located. The control plots, in which maize was grown using a conventional "ridge and furrow" system, in which stovers had been removed, experienced complete crop failure. Plots, which had been under CA for nine years, had good crop yield, even under identical water and fertiliser regimes. This effect of the CA treatment on maize yield can be seen clearly in the attached photographs during growth in early March and in mid-April at maturity. Despite complete crop failure on the control plots this year, we will be able to study the dynamics of selenium in soils of contrasting organic matter content over the next two seasons, including using stable isotopes.

This research project is funded by the Royal Society and UK Department for International Development (RS-DFID) as part of a large doctoral student training programme - Soil Geochemistry for Agriculture and Health. The programme runs from 2015-2020, and includes other PhD projects based at partner institutions in Zambia (University of Zambia, University of the Copperbelt, Zambian Agricultural Research Institute), and Zimbabwe (University of Zimbabwe, Chemistry & Soils Research Institute). I am also working with another Malawian PhD student, who is studying human selenium deficiency risks in Malawi. We look forward to updating the International Society for Selenium Research with our recent research findings in the near future.

References

Chilimba ADC, Young SD, Black CR, Meacham MC, Lammel J, Broadley MR (2012a). Agronomic biofortification of maize with selenium (Se) in Malawi. Field Crops Research, 125, 118–128.

Chilimba ADC, Young SD, Black CR, Meacham MC, Lammel J, Broadley MR (2012b). Assessing residual availability of selenium applied to maize crops. Field Crops Research, 134, 11–18.

Hurst R, Siyame EWP, Young SD, Chilimba ADC, Joy EJM, Black CR, Ander EL, Watts MJ, Chilima B, Gondwe J, Kang'ombe D, Stein AJ, Fairweather-Tait SJ, Gibson RS, Kalimbira AA, Broadley MR (2013). Soil-type influences human selenium status and underlies widespread selenium deficiency risks in Malawi. Scientific Reports, 3, 1425.

Joy EJM, Kumssa DB, Broadley MR, Watts MJ, Young SD, Chilimba ADC, Ander EL (2015). Dietary mineral supplies in Malawi: spatial and socioeconomic assessment. BMC Nutrition, 1, 42.

The bottom photo at crop maturity (mid-April 2016) is of Mrs Ivy Ligowe (PhD student) at Lilongwe University of Agriculture and Natural Resources, LUANAR and her mentor Dr. Allan Chilimba (Department of Agricultural Research Services, Malawi). This experiment is in its ninth year. The plot on the right is a control plot, in which the crop was grown using standard "ridge and furrow" practices with crop residues (stovers) from the previous crop removed. The maize crop on the control plots failed completely in 2015/16 because of the drought. The plot on the left yielded well, despite receiving exactly the same rainfall and the same applications of fertilisers as the control plots.

Contributed by Ivy Ligowe, PhD candidate at Lilongwe University of Agriculture and Natural Resources, LUANAR, Malawi. *This graduate research was conducted under the supervision of Drs. Patson Nalivata and Vernon Kabambe (LUANAR), Allan Chilimba (Department of Agricultural Research Services, Malawi), Louise Ander (British Geological Survey, UK), Liz Bailey and Scott Young (University of Nottingham, UK).*

Exploration for Selenium in Amazon

Our post conference excursion brought us to Manaus where we visited for the first time (for most of us), a Brazilian nut farm. The tall slender trees are loaded with natural earrings called Brazilian nuts! We observed the majestic plantation of Brazil nut tree *Bertholletia excelsa* at Fazenda Aruanã, a famous and successful Brazil nut farm plantings in the world! We were exposed to processing, packaging, exporting, and tasting of the great nut! And because of our professionals, we were inspired to know that the Brazilian nut is one of nature's natural Se-biofortified food products.

Ana Luiza Vergueiro (center), Director of Fazenda Aruanã and President of Excelsa Institute, was the host of this visit.

What is the Brazilian experience if one does not visit piranha-infested Amazon River? The Brazilian organizers also organized a river trip and provided us with once-in-a life opportunity to fish for piranha. As one would expect when fishing for piranhas, a small piece of meat is placed on the hook, which gently dangles on a fishing line connected to a long bamboo-like pole. One sets the loaded hook into the water and waits for the meat-eaters to devour the meat. As I pondered the question "now what do I do?" I waited holding my meat-eater until a native came and removed the teeth-laden fish from the hook. The native then carefully opened the mouth and showed me the pointed and razor-like teeth. I asked the naïve question "are they Se-enriched?"

The confluence between the Rio Negro (dark water) and the Amazon River or Rio Solimões (lighter color water).

Piranhas with red-bellies have incredibly sharp teeth, one row on each of their powerful upper and lower jaws.

Participants on this excursion left with memories and developed precursory thoughts of what will be the next chapter and remember the continued conversations on Se-related stories. Thank you Brazil for the opportunities and meet you again in Stockholm in 2017. (G.S. Banuelos)

Society News

Awards for Students

At the 4th International Conference on Selenium in the Environment and Human Health that was held on 18-21 October 2015 in São Paulo, Brazil, two student presenters were recognized with the following awards:

Ediu Carlos da Silva *Junior (Brazil) – Best Student Oral Presentation Award;*

Yanyun Zhu *(China) – Best Student Poster Presentation Award*

Offices for both Natural Biofortification Program and Selenium 200 Year Anniversary Were Opened at USTC, China

After preparation for more than one year, two official administrative offices were established on July 14th, 2016 at University of Science and Technology of China (USTC) for executing activities related to the future projects *Natural Biofortification Program* and *Selenium 200 Year Anniversary* in Suzhou, China. The president of International Society for Selenium Research (ISSR) Dr. Gary Banuelos announced to the secretary of the ISSR Dr. Xuebin Yin that the ISSR will cooperate with the newly established offices in promoting cooperative research related to selenium and in applying for financial support to conduct cooperative research.

The Natural Biofortification Program is currently seeking financial grants within China to pursue research on selenium. With funding, the new office will be used to help coordinate the establishment of an international group of selenium researchers to jointly explore the relationships between selenium intake and human health in China. During 2016-2020, the International Society for Selenium Research (ISSR) will help promote the execution of "Natural Biofortification Program (NBP)" in natural and man-made selenium-rich areas in China. In addition, selenium will have its 200 year old birthday in 2017. To celebrate its 200 anniversary, the new office can be used by the International Society for Selenium Research (ISSR) to help support a series of activities (e.g., information dissemination, forum, public workshops) to attract more public attention to understanding the health concerns associated with maintaining an adequate selenium in the human diet.

(L.X. Yuan & G.S. Banuelos)

International Society for Selenium Research

Membership

Membership is open to all who are interested in fostering the expansion of communication and scientific exchange of new and emerging concepts centered within the multi-disciplines associated with current and future worldwide selenium research efforts. The membership will include regular, student and honorary members. A regular member has the right to elect, or to be elected, as an officer of the ISSR. To join the ISSR, individuals will need to complete the membership application form. The membership due for a regular member is $50 (USD) for a two-year membership, and $20 (USD) for a student member.

The current list of members can be found at the Society's webpage: www.seleniumresearch.org/

How to Pay Your Membership Fee?

The membership due of $50 (for a regular member for two years) or $20 (for a student member for two years) can be paid via the following approaches:

(a) The payment can be made in cash at the selenium conference;

(b) The fund can be transferred through Western Union (www.westernunion.com) or other companies with money transfer service;

(c) Remitting the payment in the form of a cashier's check, certified check, or money order payable to *International Society for Selenium Research*.

Please send your check or fund transfer notice to:

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Publications by Members

(Citations submitted by members for the time period of October 2015 – May 2016)

Becker NP, Martitz J, Renko K, Stoedter M, Hybsier S, Cramer T, Schomburg L.. Hypoxia reduces and redirects selenoprotein biosynthesis. Metallomics. 2014, 6(5):1079-86.

Cebula M, Schmidt EE, Arnér ES. TrxR1 as a potent regulator of the Nrf2-Keap1 response system. Antioxid Redox Signal. 2015, 23(10): 823-53.

Dermauw V, Dierenfeld E, Du Laing G, Buyse J, Brochier B, Van Gucht S, Duchateau L, Janssens G. Impact of a trace element supplementation programme on health and performance of cross-breed (Bos indicus x Bos taurus) dairy cattle under tropical farming conditions: a double-blinded randomized field trial. Journal of Animal Physiology and Animal Nutrition, 2015, 99: 531–541.

Dóka É, Pader I, Bíró A, Johansson K, Cheng Q, Ballagó K, Prigge JR, Pastor-Flores D, Dick TP, Schmidt EE, Arnér ES, Nagy P. A novel persulfide detection method reveals protein persulfide- and polysulfide-reducing functions of thioredoxin and glutathione systems. Sci Adv. 2016, 22(1): e1500968.

Eskes SA, Endert E, Fliers E, Birnie E, Hollenbach B, Schomburg L, Köhrle J, Wiersinga WM. Selenite supplementation in euthyroid subjects with thyroid peroxidase antibodies. Clin Endocrinol (Oxf). 2014, 80(3): 444-451.

Johansson K, Cebula M, Rengby O, Dreij K, Carlström KE, Sigmundsson K, Piehl F, Arnér ES. Cross Talk in HEK293 Cells between Nrf2, HIF, and NF-κB Activities upon Challenges with Redox Therapeutics Characterized with Single-Cell Resolution. Antioxid Redox Signal. 2015, PubMed PMID: 26415122.

Jun Li, Qin Peng, Dongli Liang, Sijie Liang, Juan Chen, Huan Sun, Shuqi Li, Penghui Lei. The aging effect on the fraction distribution and bioavailability of Selenium in soils. Chemosphere, 2016, 144:2351-2359.

Lavu RVS, Van De Wiele T, Pratti VL, Tack F, Du Laing G. Selenium bioaccessibility in stomach, small intestine and colon: comparison between pure Se compounds, Se-enriched food crops and food supplements. Food Chemistry, 2016, 197: 382-387.

Lei XG, Zhu JH, Cheng WH, Bao Y, Ho YS, Reddi AR, Holmgren A, Arnér ES. Paradoxical Roles of Antioxidant Enzymes: Basic Mechanisms and Health Implications. Physiol Rev. 2016, 96(1): 307-364.

Liqin Zhang, Zunyi Yang, Kwame Sefah, Kevin M. Bradley, Shuichi Hoshika, Myong-Jung Kim, Hyo-Joong Kim, Guizhi Zhu, Elizabeth Jiménez, Sena Cansiz, I-Ting Teng, Carole Champanhac, Christopher McLendon, Chen Liu, Wen Zhang, Dietlind L. Gerloff, Zhen Huang, Weihong Tan, and Steven A. Benner. Evolution of functional six-nucleotide DNA. Journal of the American Chemical Society, 2015, 137:6734-6737.

Lyons G, Goebel RG, Tikai P, Stanley K-J, Taylor M. Promoting nutritious leafy vegetables in the Pacific and Northern Australia. Acta Horticulturae 1102: XXIX International Horticultural Congress on Horticulture: Sustaining Lives, Livelihoods and Landscapes (IHC2014): International Symposium on Indigenous Vegetables 2015, DOI: 10.17660/ActaHortic.2015.1102.31

Michaelis M, Gralla O, Behrends T, Scharpf M, Endermann T, Rijntjes E, Pietschmann N, Hollenbach B, Schomburg L. Selenoprotein P in seminal fluid is a novel biomarker of sperm quality. Biochem Biophys Res Commun. 2014, 17; 443(3): 905-910.

Muecke R, Micke O, Schomburg L, Buentzel J, Adamietz IA, Huebner J; German Working Group Trace Elements and Electrolytes in Oncology (AKTE). Serum selenium deficiency in patients with hematological malignancies: is a supplementation study mandatory? Acta Haematol. 2014, 132(2):256-8.

Muecke R, Micke O, Schomburg L, Glatzel M, Reichl B, Kisters K, Schaefer U, Huebner J, Eich HT, Fakhrian K, Adamietz IA, Buentzel J; German Working Group Trace Elements and Electrolytes in Oncology-AKTE. Multicenter, phase III trial comparing selenium supplementation with observation in gynecologic radiation oncology: follow-up analysis of the survival data 6 years after cessation of randomization. Integr Cancer Ther. 2014, 13(6): 463-467.

Otieno SB. Selenium and HIV Epidemiology. Lambert Academic Publishing, 2016, 978-3-659-82509-5: 128

Otieno SB, TS Jayne, M Muyanga. The Effect of soil chemical characteristics on accumulation of native selenium by Zea mays grains in Maize Belt in Kenya. International Journal of Nutrition and Food Science, 2015, 5 (1).

Boldrin PF, de Figueiredo MA, Yang Y, Luo HM, Giri S, Hart JJ, Faquin V, Guilherme LRG, Thannhauser TW, Li L. Selenium promotes sulfur accumulation and plant growth in wheat (*Triticum aestivum*). Physiologia Plantarum, 2016, DOI: 10.1111/ppl.12465

Pietschmann N, Rijntjes E, Hoeg A, Stoedter M, Schweizer U, Seemann P, Schomburg L. Selenoprotein P is the essential selenium transporter for bones. Metallomics. 2014, 6(5): 1043-1049.

Qin Peng, Lu Guo, Fayaz Ali, Jun Li, Siyue Qin, Puyang Feng, Dongli Liang. Effect of exogenous selenite and selenate on selenium fraction distribution, transformation, and bioavailability in soil. Plant and Soil. 2016, 403(1):331-342.

Van Gisbergen MW, Cebula M, Zhang J, Ottosson-Wadlund A, Dubois L, Lambin P, Tew KD, Townsend DM, Haenen GR, Drittij-Reijnders MJ, Saneyoshi H, Araki M, Shishido Y, Ito Y, Arnér ES, Abe H, Morgenstern R, Johansson K. Chemical reactivity window determines prodrug efficiency toward glutathione transferase overexpressing cancer cells. Mol Pharm. 2016. PMID: 27093577.

Van Zelst M, Hesta M, Alexander LG, Gray K, Bosch G, Hendriks WH, Du Laing G, De Meulenaer B, Goethals K, Janssens GPJ. In vitro selenium accessibility in pet foods is affected by diet composition and type. British Journal of Nutrition, 2015, 113: 1888-1894.

Van Zelst M, Hesta M, Gray K, Beech K, Cools A, Alexander LG, Du Laing G, Janssens GPJ. Selenium digestibility and bioactivity in dogs: what the can can, the kibble can't. PlosOne, 2016, 11: e0152709.

Van Zelst M, Hesta M, Gray K, Staunton R, Du Laing G, Janssens GPJ. Biomarkers of Selenium status in dogs. BMC Veterinary Research, 2016, 12:15.

Xu J, Cheng Q, Arnér ES. Details in the catalytic mechanism of mammalian thioredoxin reductase 1 revealed using point mutations and juglone-coupled enzyme activities. Free Radic Biol Med. 2016. 94: 110-120.