

Selenium Research

International Society for Selenium Research

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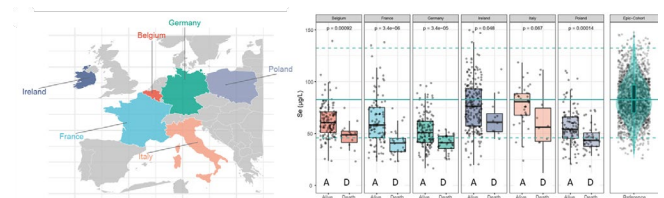
President's Remarks

Dear fellow researchers, scientists, and friends of selenium!

We all thought the crisis would pass; our good old lifestyle would recover; and all would go back to normal. Obviously, that is not the case. We must adjust to a new norm. It is said that Benjamin Franklin coined the saying “Guests, like fish, begin to smell after three days.” This is certainly true of unwanted guests, and the nasty, uninvited virus has now extended its stay to almost three years, and no effort is evident that it is preparing to leave. I am afraid that we will have to cope with the new situation. It could even get worse. In my younger years, when social life was awakening, the issue of HIV/AIDS suddenly appeared on the scene. As we all know, it changed our habits quite a bit, and it also decided to stay and pose a constant risk. Nevertheless, we have learned to live with it and to control it successfully. We have no other choice. A difference probably lies in the nature of the virus. SARS-CoV-2 evolves rapidly; new variants appear and disappear; and it diverges to such an extent that some no longer call it an infectious virus, but rather a “virus soup” or swarm of virus variants. No matter what you call it - “*A Rose Is Still a Rose*” (William Shakespeare).

During the pandemic, supporting our immune system is a research priority, and this is where our selenium society is strong, can contribute decisively, and make a difference. We have all learned from the experience with the Coxsackievirus B where Se deficiency proved to be of major importance in determining who is most at risk and how best to counter the threat. The elegant experiments by Melinda A. Beck and colleagues indicated the importance of Se status and selenoprotein expression in priming and strengthening the immune system to fight the virus. On that note, there have been quite a few contributions from many members of our society highlighting the prominent role of our favorite trace element for surviving the infection, and likely also for avoiding long-lasting consequences that are now being seen everywhere in all different age groups. A study comparing the outcome from a severe infection with the baseline Se status at time of hospital admission is a clear example for our activities. Please find below the bottom line - and I know that none of us are surprised by the clear-cut results; a dramatically low Se status was associated with a high risk of death. The unanswered question relates to the effectiveness

of Se supplementation once infected. From my personal point of view, I would only want to counter the virus if I am well-supplied with Se and Zn, the other obviously essential trace element of high importance for the immune response. Zinc has just demonstrated its effectiveness in reducing mortality and hospitalisation in a well-designed randomized control trial (RCT) conducted in Tunisia ([doi:10.1093/cid/ciac807](https://doi.org/10.1093/cid/ciac807)). A similar RCT for Se is still pending.



Overview of six European countries on the Se status of COVID-19 patients at the time of hospitalization, divided into survivors (A, alive) and non-survivors (D, death). For comparison, the average Se status of healthy adults in Europe are shown (right), with the median indicated (green line). (The figures were adapted from [doi:10.3389/fimmu.2022.1022673](https://doi.org/10.3389/fimmu.2022.1022673).)

Given the current situation, our desire to meet face to face, exchange ideas and present latest concepts and results is severely hampered and restricted. It was a great pleasure to meet many of us at the conference in Hawaii, which was excellently organised and run by Peter R. Hoffmann and his team, but the venue was very far away, while many of us could not attend for various reasons, and this absence was strongly felt and deeply regretted.

However, we have seen other meeting formats flourish and incorporate the well-developed online tools that are available. But time zones pose a problem here, as face-to-face meetings force us all to have the same breakfast and dinner times, which is a pleasure but not done when staying at home and meeting online. A friendly toast via the web is different from a face-to-face smile. Nonetheless, for now, we need to seriously clarify what is possible and necessary to keep our society together and support our younger colleagues who need the exchange most to present their data, get valuable feedback and further motivation. They need to know where in the world Se is being taken seriously, because fascinating research is being conducted that opens up new perspectives.

In this sense, it is great to see the growth and activity of the youth branch of the ISSR in China, which could serve as a model for other regions of the world where travel is limited. New young scientists want to join and be integrated within the ISSR. Perhaps we will soon start such an online meeting here in the Central European time zone to see to what extent it works to further support our society, increase its influence, and provide for more exchanges, additional energy and valuable impulses, especially from the young generation of Se-Aficionados. Again, all constructive ideas are welcome!

But for now, let's stay positive, cheerful, avoid unnecessary risks and meet in person and/or online wherever possible so as not to lose contact until times change, and travel opportunities improve again and comprehensive meetings can resume. One of the teachers in German history advised us: "Even if I knew that the world would end tomorrow, I would still plant my apple tree" (Martin Luther). If we look at the situation here at the Charité in Berlin, we are closed, many are absent due to illness, and children's department in particular, is struggling. The above saying sounds rather gloomy, the version of this thought known from a Chinese philosopher sounds much nicer - "The Best Time to Plant a Tree was 20 Years Ago. The Second-Best Time is Now." [前人栽树, 后人乘凉. 霍灏 (清)]. With that, we would like to wish you all the best, stay spiritually positive and active.

With warm greetings and best wishes from Berlin, Ghent and Nanjing!

Sincerely yours,



*Lutz Schomburg, President
(Germany)*



*Gijs Du Laing, Vice President
(Belgium)*



*Xuebin Yin, Vice President
(China)*



12th International Symposium on Selenium in Biology and Medicine

The 12th International Symposium on Selenium in Biology and Medicine was successfully held on February 16-20, 2022 at the Hilton Hawaiian Village in Honolulu, Hawaii, USA. This conference embraced a One Health theme focusing on the intersection and interdependence of human, animal, and environmental health related to selenium biology. The Organizing Committee assembled an exciting scientific program featuring five plenary speakers:

- **Vadim Gladyshev:** *Genomics of Selenium Utilization*

- **Margaret Rayman:** *The Relevance of Selenium to Viral Disease with Special Reference to SARS-CoV-2 and COVID-19*
- **Roger Sunde:** *Fifty Years of Selenium Biochemistry, Transcriptomics, and Metabolism*
- **Lenny Winkel:** *Marine Biogenic Emissions as a Source of Terrestrial Selenium*
- **Lutz Schomburg:** *The Role of Selenoprotein P in Human Health and Disease*

All talks were presented at the Hilton Hawaiian Village in beautiful Waikiki on the island of Oahu, which is known as the "gathering place." Attendees of this symposium shared timely and exciting science on Selenium Biology, while taking in the balmy island breezes, swaying palm trees, and blue oceans. Indeed, it is a meeting to remember.

(Peter Hoffmann, University of Hawaii, USA)



*The participants and the oral presentation award winners at the 12th International Symposium on Selenium in Biology and Medicine.
(Photos provided by Peter Hoffmann)*

7th International Conference on Selenium in the Environment and Human Health: Planning Update

Considering the progress of current pandemic of COVID-19 and the situation of our changing world, the 7th International Conference on Selenium in the Environment and Human Health has been tentatively scheduled in October 2023 in Bangkok, Thailand. Drs. Rochana Tangkoonboribun, Khanok-On Amprayn, and Rattana Ngamvisitsil at Thailand Institute of Scientific and Technological Research will be the local conference organizers. The conference venue has been proposed at Queen Sirikit National Convention Center or with one of the several established hotels in the vicinity. The tentative program will be 2.5-3 days including an exciting excursion. Discussion will continue with our goal on keeping the registration cost as low as feasible. This conference will also be co-organized with financial support by Dr. Xuebin Yin at Institute for Functional Agriculture Science & Technology (iFAST), China. Programming is still in the

early developing stage, and more conference information will become available on the Society website in the near future.



Conference Venue: Queen Sirikit National Convention Center



Meeting with local organizers - Rattana Ngamvisitsil (right), Gary Banuelos (center), and Khanok-On Amprayn (left) in Thailand. (Photo provided by Gary Banuelos)

(Gary Banuelos, USDA-ARS, USA)



News from the Society

The China Youth Branch

The local Branch has successfully recruited/received 85 new membership applications in 2022, including 87% from research institutes, 13% from industry, and 19% as graduate students who are conducting Se research. The executive committee of the Branch has proposed a research symposium on “One Health Perspective on Selenium” that will be held in June 2023 in Wuhan, China. A postgraduate Workshop on Se research was also organized in December 2022 in Suzhou, China.

The China Youth Branch has made effort to promote members’ collaborative research on Se, which has resulted in two collaborative research articles published in peer-reviewed journals in 2022:

Hao, S., G. Bañuelos, and X. Zhou. 2022. Can As concentration in crop be controlled by Se fertilization? A meta-analysis and outline

of As sequestration mechanisms. Science of The Total Environment, 10(838) (Pt 1): 155967.

Yuan, X., Li, C.Y., Xie J.T., Li K.Y., Chen, S.Q., Yuan, L.X., Hu, C.X., Wang, X., Zhao, X.H. 2022. Combination of selenium and methyl jasmonate controls postharvest tomato gray mold by damaging the membrane system. Horticulturae, 8(9): 782.

The China Youth Branch was initiated by the council member Dr. Linxi Yuan, Associate Professor at Xi’an Jiaotong-Liverpool University in early 2021. The goal of this local organization is to (1) foster academic exchange and collaboration among members and lead members to grow together by providing a youth forum and other online/onsite conferences for selenium research in China; (2) to collect and share the demands of selenium research and industry, encourage and foster industry-university-research collaboration among members, and promote the development of Se industry in China; and (3) to encourage and foster members to carry out social service activities such as science popularization and training on selenium, and serve for the Healthy China strategy.



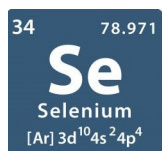
The Executive Committee of the China Youth Branch had meetings for recruiting new members and promoting collaborative research on Se. (Photos: Linxi Yuan)

(Linxi Yuan, XJTLU, Suzhou, China)

How to Become a Member?

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. For a lifelong membership the membership due is \$300 (USD).

The membership due of \$50 (for a regular member for two years), \$20 (for a student member for two years), or \$300 (for lifelong membership) can be paid via the following approaches: (1) The payment can be made in cash at the selenium conference; (2) The fund can be transferred through Western Union or other companies with money transfer service; or (3) Remitting the payment in the form of a cashier's check, certified check, or money order payable to: *International Society for Selenium Research*. A personal check in US currency will also be acceptable. Please send your check or fund transfer notice to: Dr. Zhi-Qing Lin, Department of Environmental Sciences, 2165 Science West, Southern Illinois University, Edwardsville, Illinois 62026-1099, USA; Tel.: 1-618-650-2650; Email: zhlin@siue.edu.



Selenium Research Highlights



Research Topic Collection (Update):
**Selenium in Soil-Plant-Animal Systems
 and its Essential Role for Human Health**

Editors: Gary Banuelos, USA; Zhi-Qing Lin, USA; Joel Caton, USA

This research topic collection has 13 articles published in the participating journals in 2022, with two others currently in reviews. The editors intend to bring together contributions from internationally recognized Se researchers, including members of the ISSR, and selected speakers from the 12th International Symposium on Selenium in Biology and Medicine that was held in Honolulu, Hawaii in 2022. The topics of the published articles are:

- Seleno-amino acids in vegetables: A review of their forms and metabolism;
- Selenium biofortification of soybean sprouts: Effects of selenium enrichment on proteins, protein structure, and functional properties;
- Selenium effect threshold for soil nematodes under rice biofortification;
- Separate foliar sodium selenate and zinc oxide application enhances Se but not Zn accumulation in pea (*Pisum sativum* L.) seeds;
- Uptake and translocation mechanisms of different forms of organic selenium in rice (*Oryza sativa* L.);
- Foliar selenium fertilization alters the content of dietary phytochemicals in two rocket species;
- Selenium biofortification of soybean genotypes in a tropical soil via Se-enriched phosphate fertilizers;
- Soil and foliar selenium application: Impact on accumulation, speciation, and bioaccessibility of selenium in wheat (*Triticum aestivum* L.);

- Prediction models for monitoring selenium and its associated heavy-metal accumulation in four kinds of agro-foods in seleniferous area;
- *Salsola soda* as selenium biofortification crop under high saline and boron growing conditions;
- Selenium enhances chilling stress tolerance in coffee species by modulating nutrient, carbohydrates, and amino acids content;
- Beyond antioxidants: Selenium and skeletal muscle mitochondria;
- Selenium supplementation and pregnancy outcomes;

The published articles represent different but interrelated research disciplines involving physiochemical and biological behaviors of Se within the larger foundation topics of agricultural soil, bioavailability, plant uptake, physiological responses, genetics, molecular biology, microbial communities, Se-biofortification strategies worldwide, and animal health. The editors hope that recognizing the multi-disciplinary approaches in Se research can help us develop and implement effective strategies to mitigate Se deficiencies in the world. The participating journals include *Frontiers in Plant Science*, *Frontiers in Nutrition*, *Frontiers in Veterinary Science*, and *Frontiers in Soil Science*. All published articles are open access at the research topic collection website: <https://www.frontiersin.org/research-topics/26102/selenium-in-soil-plant-animal-systems-and-its-essential-role-for-human-health>

New Environmental Bioindicator Developed for Rice Se Biofortification

Institute for Functional Agriculture Science & Technology (iFAST) led by Dr. X. Yin has recently published a research paper entitled “Selenium effect threshold for soil nematodes under rice biofortification” in *Frontiers in Plant Science* ([doi:10.3389/fpls.2022.889459](https://doi.org/10.3389/fpls.2022.889459)). The study revealed the potential risk of rice Se biofortification on soil nematodes. Rice Se biofortification with selenite is considered to be effective in improving global Se deficiency issue. However, the information about the risk of Se on soil fauna is rare. Soil nematodes were used as bioindicator to assess the ecotoxicological effects of rice selenium biofortification. The researchers found that selenite supply (5-200 mg/kg) generally increased the rice yield and Se concentrations in rice grains but decreased the number of total nematodes and sensitive nematodes, and changed the nematode community structure. The calculated effective concentrations for total Se (1.45 mg/kg) and bioavailable Se (0.21 mg/kg) to soil nematode abundances at 20% level (EC20) were suggested to be soil Se thresholds. This study provided a reference for the evaluation of the potential environmental risk of soil Se biofortification, and were of great significance for the sustainable development of functional agriculture and the revision of environmental standards for Se-rich soil. This study was supported by the Guangxi Major Special Project of Science and Technique (Guike AA17202026-6) and the Special Fund for Functional Agricultural Development of

Nanjing National Agricultural Innovation Park (NJGJNCY-FAST01).

(Xuebin Yin, iFAST, Nanjing & Chuzhou, China)

Molecular Mechanism of Enhancing Flavonoid Contents in Wheat Grain via Se Biofortification

Shanxi Agricultural University has recently published a paper entitled “Selenium application enhances the accumulation of flavones and anthocyanins in bread wheat (*Triticum aestivum* L.) grains” in *Journal of Agricultural and Food Chemistry* ([doi:10.1021/acs.jafc.2c04868](https://doi.org/10.1021/acs.jafc.2c04868)). The paper sheds new light on the molecular mechanism underlying the enhancement of flavonoid accumulation in wheat grains by Se biofortification. Biofortification in wheat can increase Se contents in grains, but also increase other health-promoting compounds, such as anthocyanins. It is not well known whether Se biofortification can enhance flavonoids other than anthocyanins, and further stimulates the molecular mechanisms underlying the accumulation of flavonoids in wheat grains. In this study, the researchers found that Se fertilization enhanced the biosynthesis of not only anthocyanins but also flavones, as well as other flavonoids in wheat grains. Integrated analysis of metabolites and transcriptome revealed that Se application enhanced the accumulation of flavones, dihydroquercetin, anthocyanins, and catechins by increasing the expression levels of seven key structural genes in flavonoid biosynthesis (two TaF3Hs, two TaDFRs, one TaF3'5'H, one TaOMT, and one TaANR). This study was supported by National Key R&D Program of China (2021YFD1901102-2), and Modern Agriculture Industry Technology System Construction (CARS-03-01-24).

(Zhiqiang Gao, Shanxi Agricultural University, China)

Potential Use of Se-enriched Microalgal Biomass as Biofertilizer, Biostimulant, and Feed Supplement

The selenium (Se)-enriched microalgae biomass was first produced in a pilot-scale raceway pond treating domestic wastewater. Afterwards, its effect was assessed through soil and foliar application of the produced microalgal biomass and the produced extract on green bean (*Phaseolus vulgaris*), a protein-rich crop commonly grown in moderate climates. Presoaking seeds in the Se-enriched microalgae extract at low concentration (1%) enhanced their germination, as measured by the significant increase of seedling length and vigor index. Application of the Se-enriched microalgae

extract as foliar spray was more effective in stimulating the growth of beans and increasing the Se concentration in the seeds compared to its application as a soil drench. Foliar spray resulted in 3.5-time increase of the seed dry biomass at 1% extract concentration and 1.8-time increase in seed Se accumulation at 5% extract concentration. Additionally, the soil amended with Se-enriched microalgae biomass (at 5%) enhanced the growth of beans (3.2 times for seeds) and the Se concentration in the bean plants (1.8 times for seeds) simultaneously. Clearly, Se-enriched microalgae could be used as a microalgae-based biofertilizer or biostimulant to improve the bean seed yield and the Se content in the beans, potentially with a higher market value. This may also offer an environmental-friendly and sustainable approach to biofortify food crops in Se-deficient regions. This study was published by the Laboratory of Analytical Chemistry and Applied Ecochemistry (Dr. Gijs Du Laing group) at Ghent University in *Journal of Applied Phycology*, entitled “Evaluation of Selenium-enriched Microalgae Produced on Domestic Wastewater as Biostimulant and Biofertilizer for Growth of Selenium-enriched Crops” ([doi:10.1007/s10811-021-02523-y](https://doi.org/10.1007/s10811-021-02523-y)).

(Gijs Du Laing, Ghent University, Belgium)

Season's Greetings and Best Wishes for 2023

Editors: Lutz Schomburg, Zhi-Qing Lin & Gary S. Banuelos

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