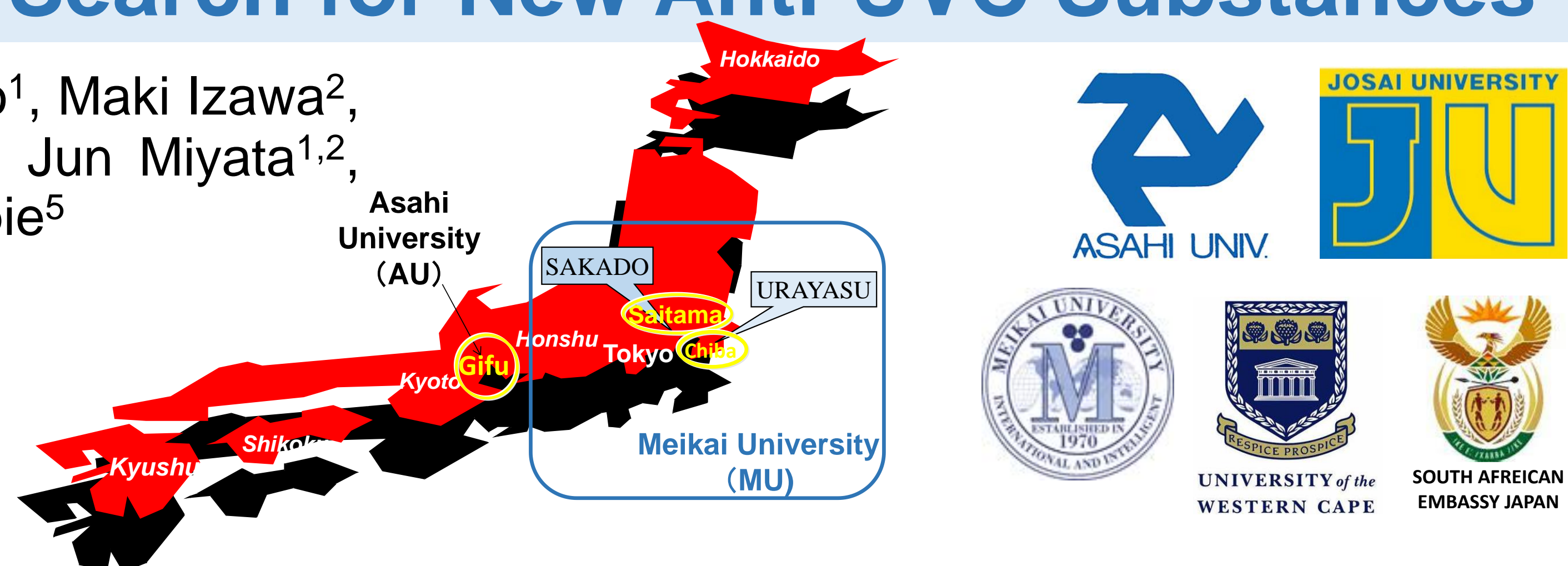


Student/Faculty Exchange Program with the University of the Western Cape: Exceptional industrial and academic development of the resource-rich RSA / Search for New Anti-UVC Substances

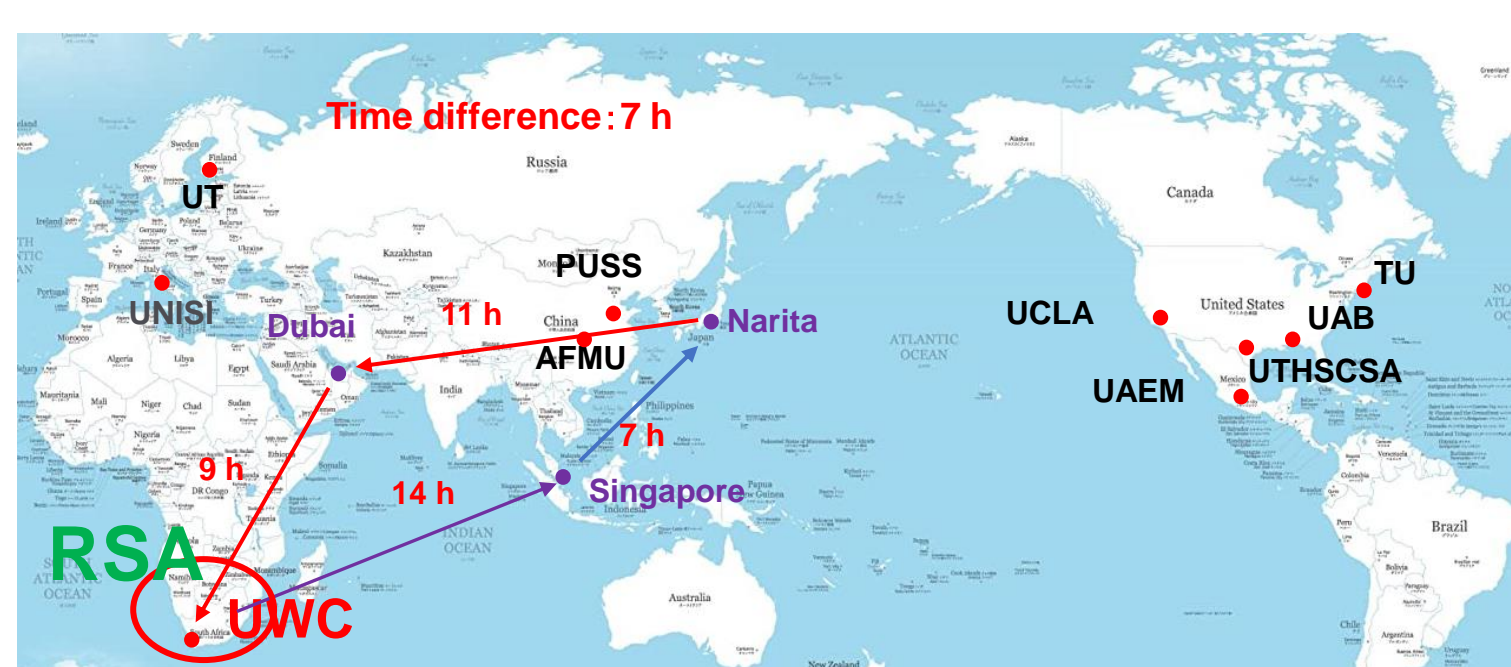
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1. History of joint interaction with UWC

Our relationship with UWC dates back to March 27, 2012. At that time, Cecil Masoka, Minister of State for Science and Technology at the Japan Embassy, visited Asahi University (AU) upon request by President Katsuyuki Ohtomo (KO) to introduce universities of RSA with school of dentistry. RSA Ambassador Extraordinary and Plenipotentiary Mohau Peko gave a lecture entitled "Does Science and Technology Contribute to Development and Democratization?" (June 5, 2014), and Mr. Chester Williams, a former member of the RSA national team at the Rugby World Cup, taught students the basic movements of rugby in AU (July 5, 2014). On August 29, 2014, AU delegation visited UWC to discuss the academic and sports exchanges with Dean Osman of the Faculty of Dentistry of UWC (ref 1-3). Supported by the Sakura Science Exchange Program of Japan Science and Technology Agency, delegations of UWC staff and students have visited our universities and become acquainted with our founding spirit, education, research, clinical activities, and Japanese traditions and culture. International exchange projects are essential for the continued development of human resources.

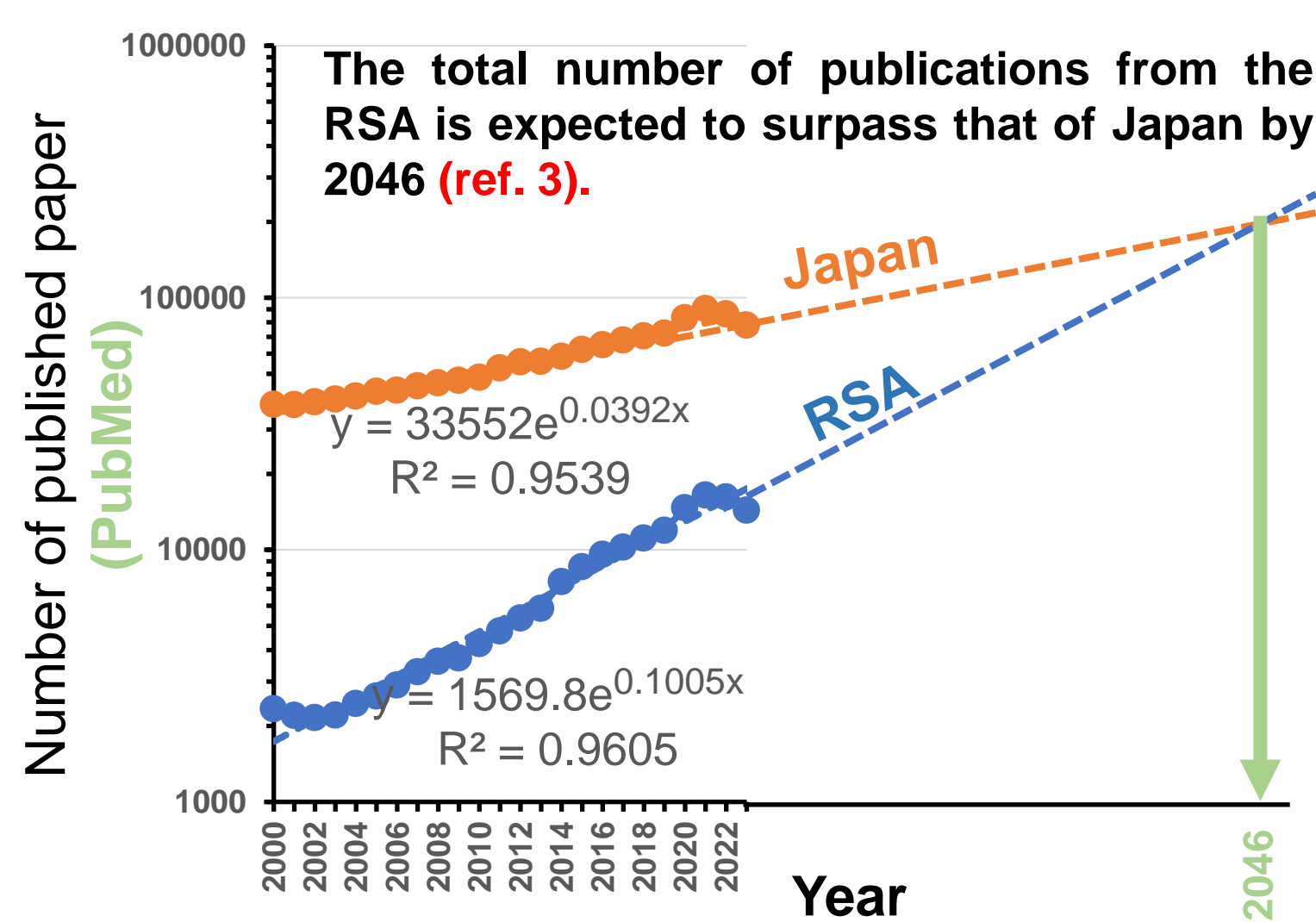


Signing ceremony of collaboration agreement between Dean Osman (UWC), president Katsuyuki Ohtomo (AU), former president Toshikazu Yasui (MU) and Chairman Jun Miyata (March 12, 2015)

Ten sister universities of MU and AU

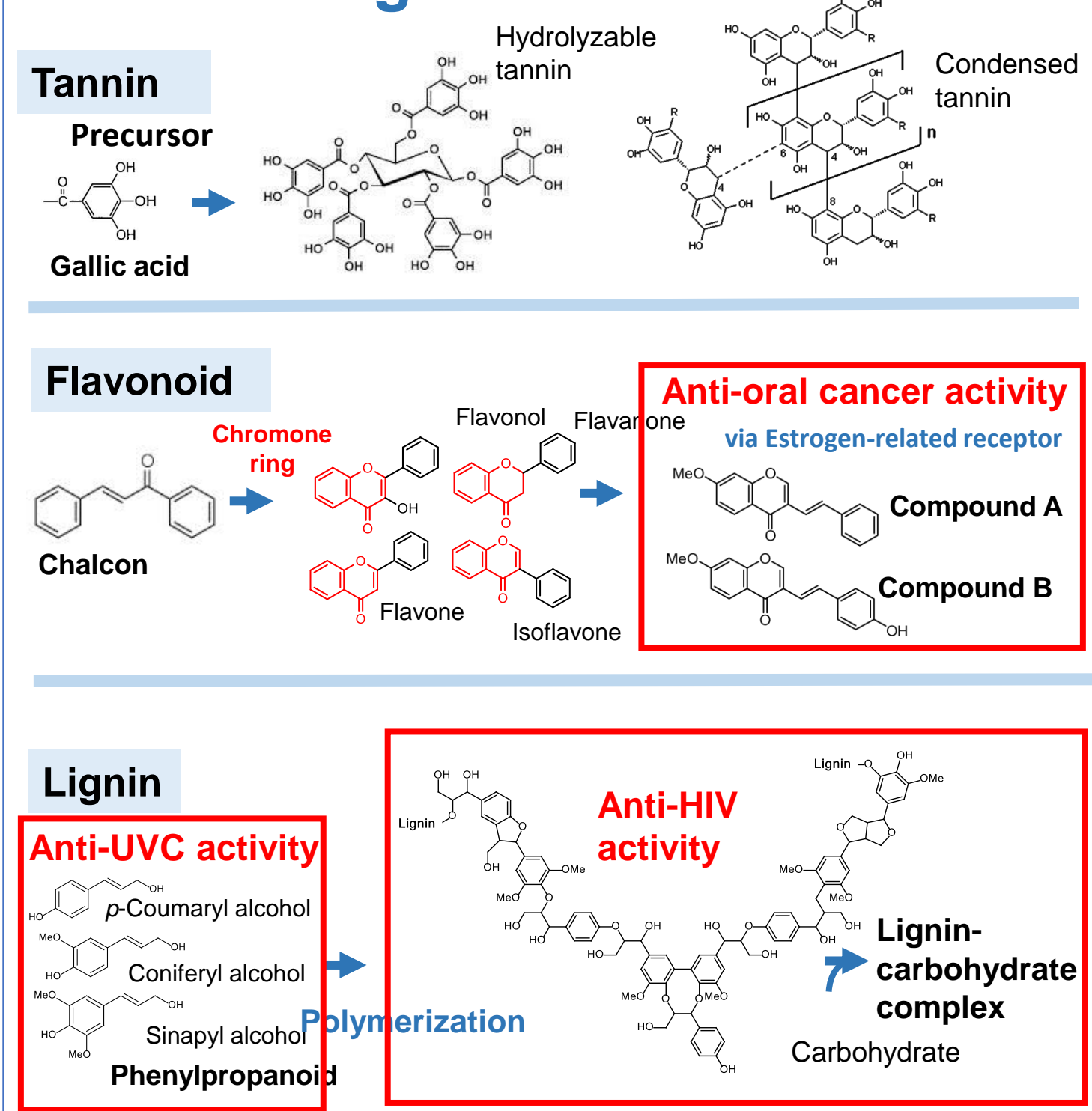
2. Huge natural resources & academic productivity of RSA

RSA is experiencing exceptional industrial and academic development. RSA is one of the world's leading mineral resource countries, operating the continent's only nuclear power plant in Koeberg. Energy consumption, electricity distribution, number of Internet users, and the literacy rate are very high. RSA is a member of BRICs with Brazil, Russia, India and China. PubMed search for the recent 23 years demonstrated that the increase in the number of published (6.1-fold) in RSA is about three times that of articles in Japan (2.1-fold). When the number of published papers was plotted in a logarithmic scale, highly significant straight lines. To date, RSA has produced seven Nobel Prize winners.

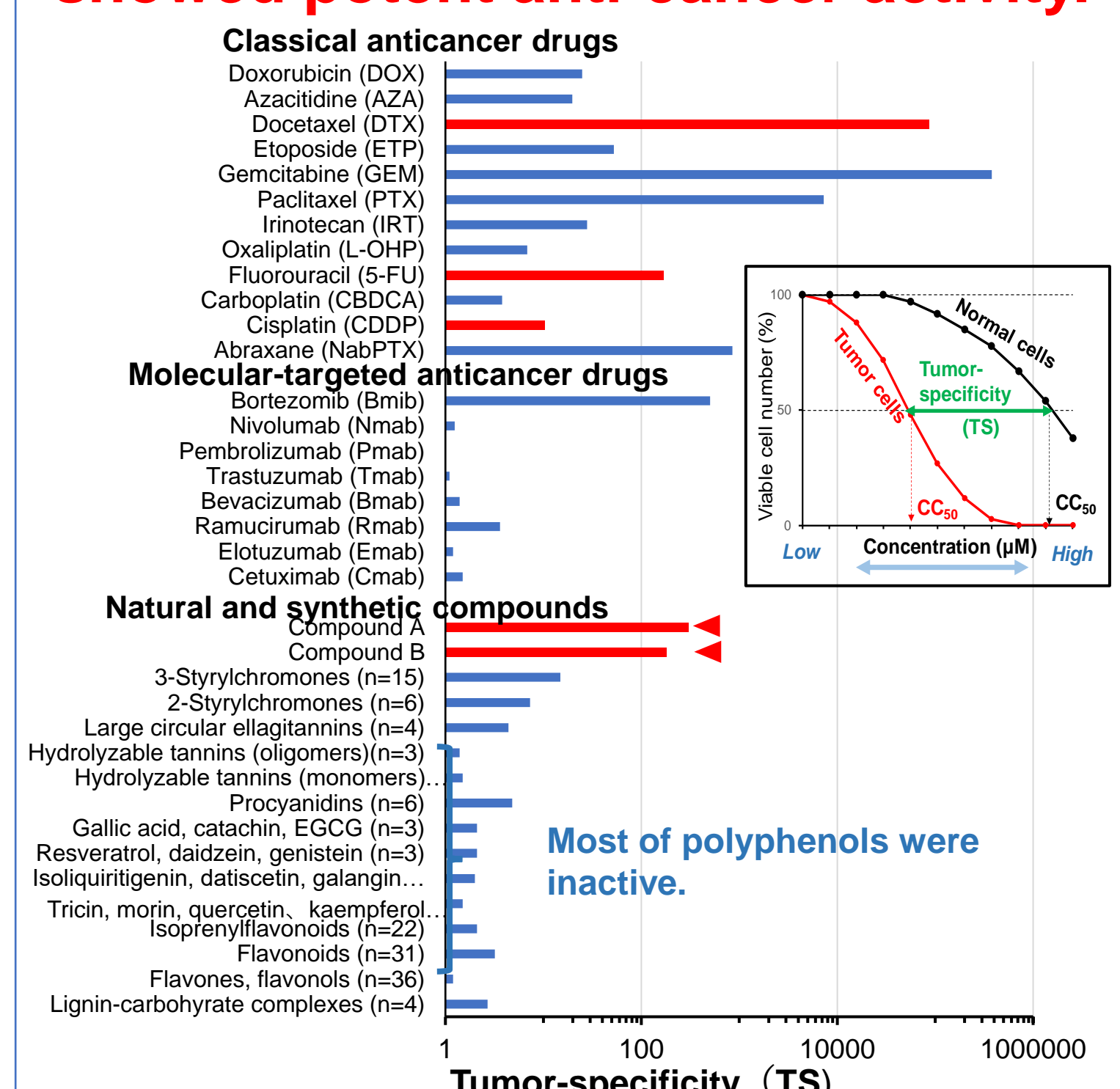


3. Identification of three new activities of Polyphenols

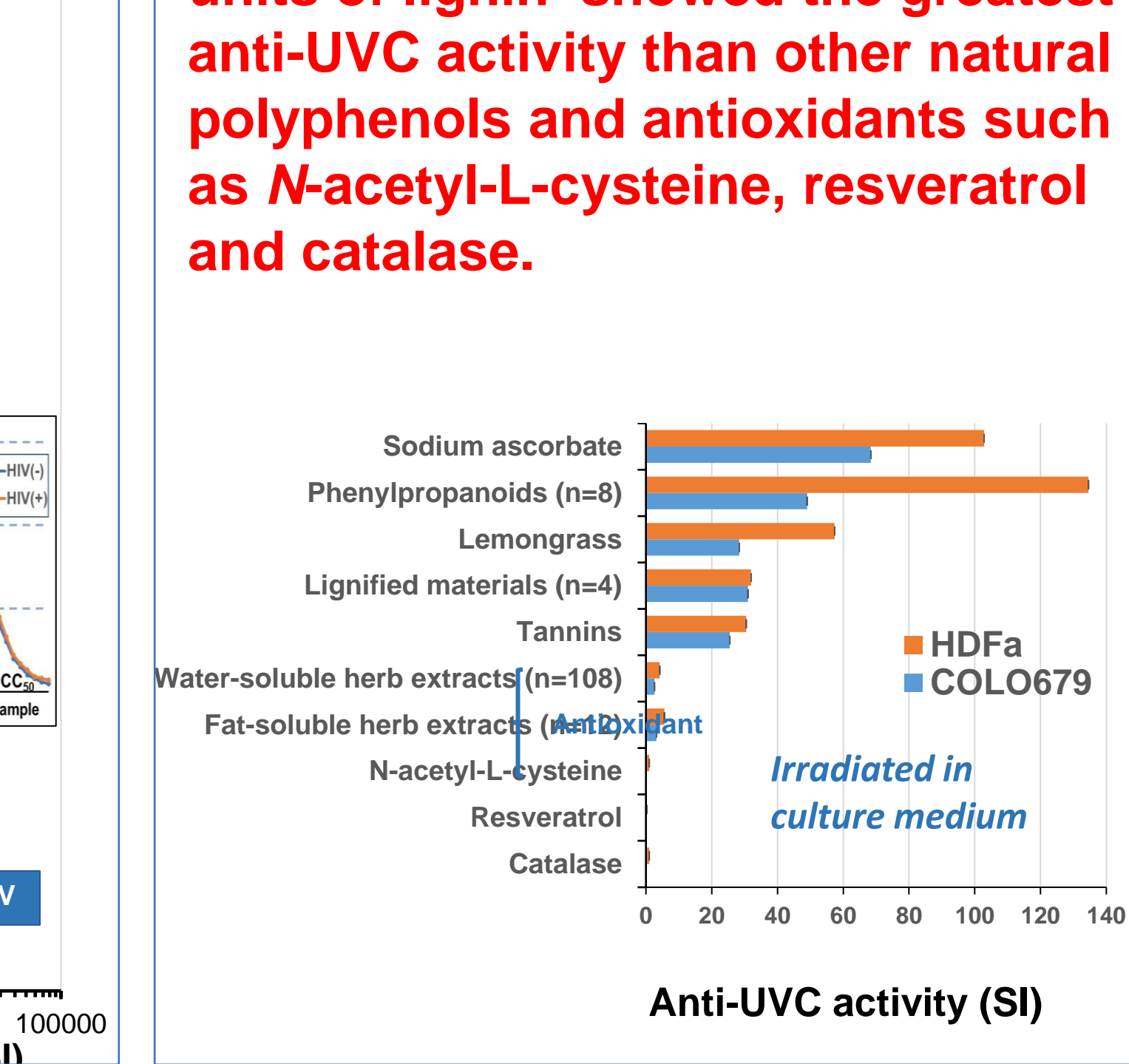
Three major polyphenols in the natural kingdom



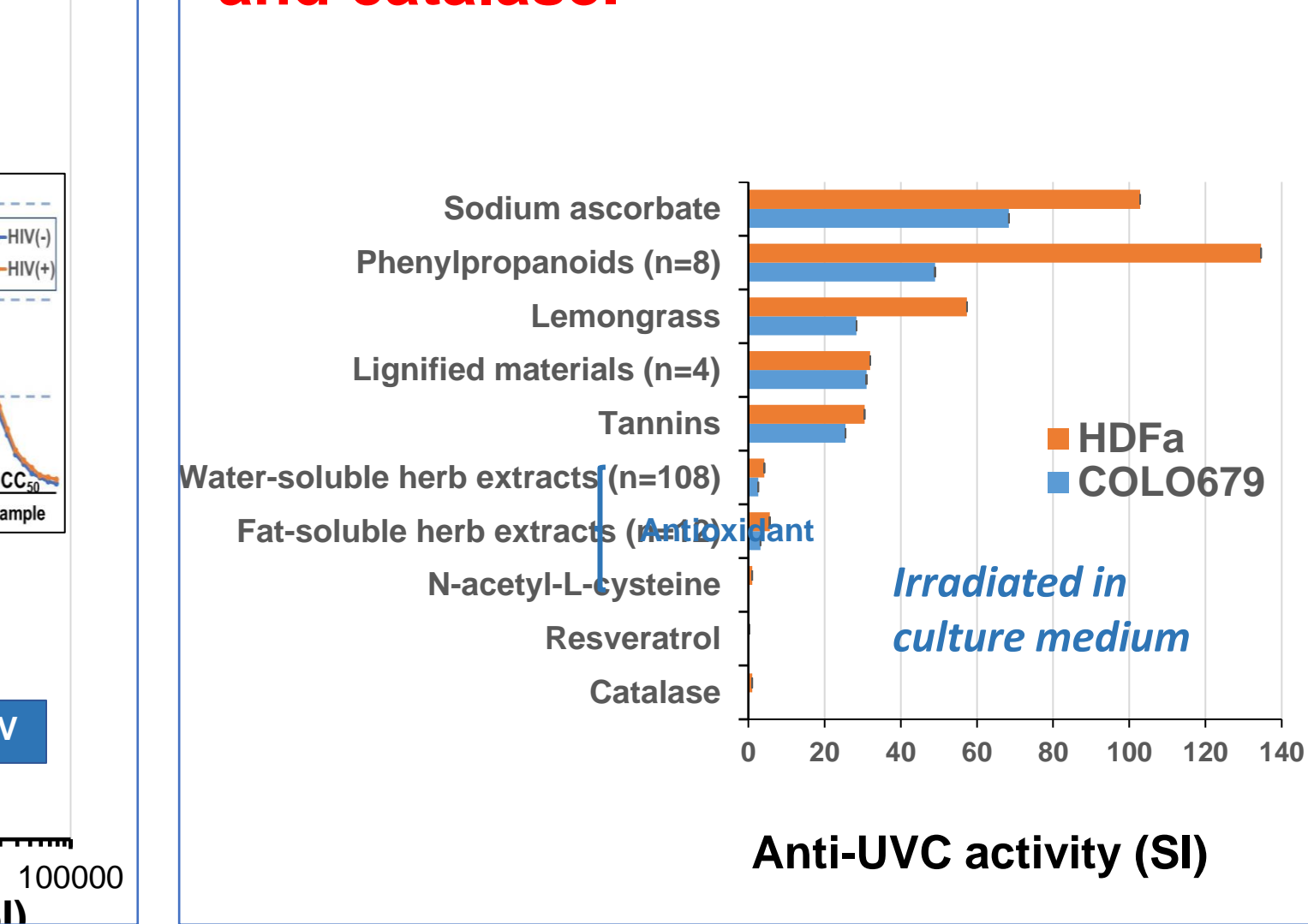
① 3-Styrylchromone derivatives showed potent anti-cancer activity.



② Lignin showed prominent anti-HIV activity.



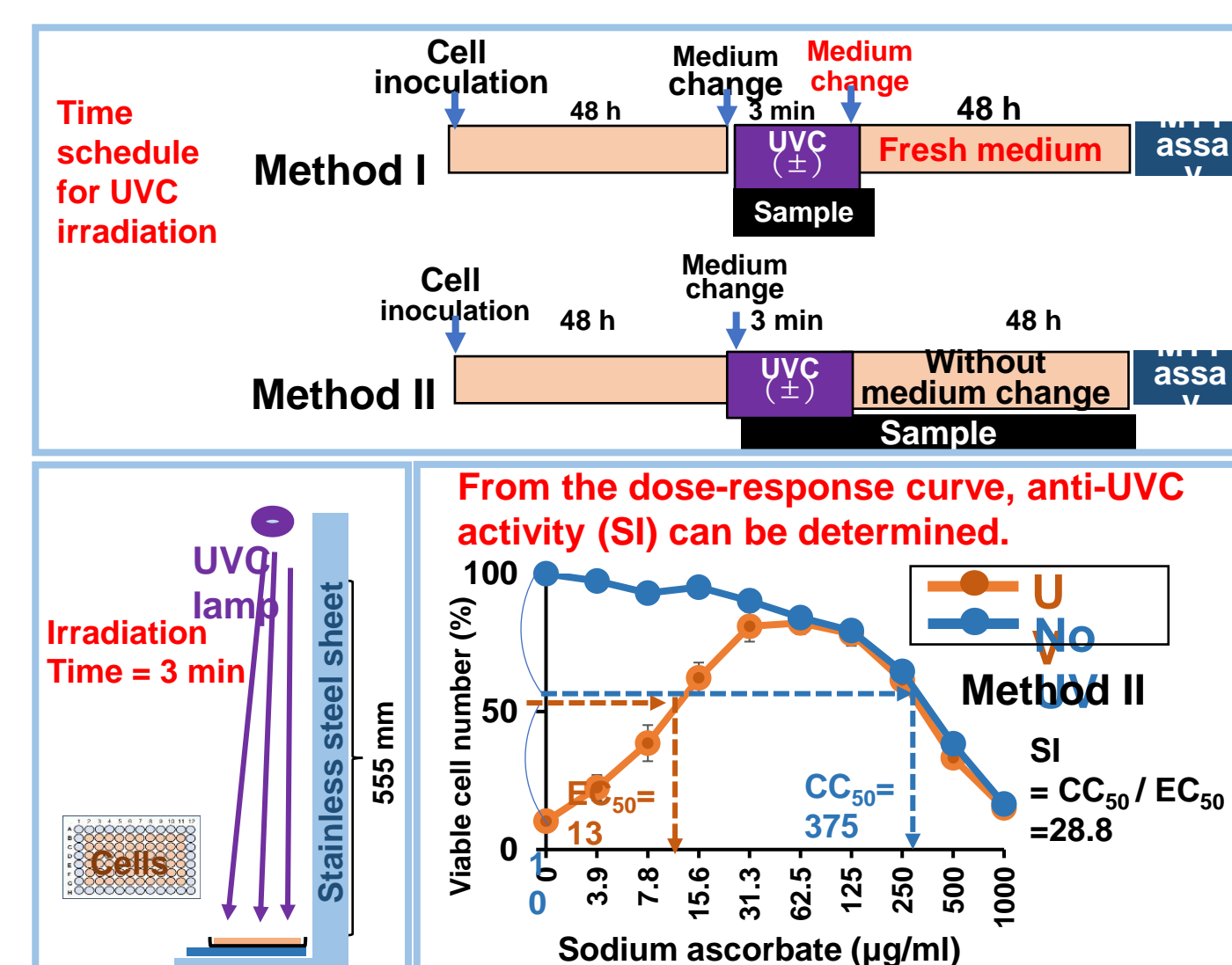
③ Phenylpropanoids, component units of lignin showed the greatest anti-UVC activity than other natural polyphenols and antioxidants such as N-acetyl-L-cysteine, resveratrol and catalase.



Then, how about Rooibos?

4. Importance of Searching for UVC Protective Substances in the Coronavirus Pandemic

As a countermeasure against COVID-19, virucidal UVC devices are rapidly spreading in public facilities. However, prolonged exposure to UVC is harmful to humans, and therefore, it was important to search for substances that reduce the toxicity of UVC for users of such devices. We have conducted a comprehensive search for UVC protective substances using human skin fibroblast HDFa and human melanoma cell COLO679 (ref. 4-13). In the present study, we compared anti-UVC activity of Rooibos tea extract with various natural products.

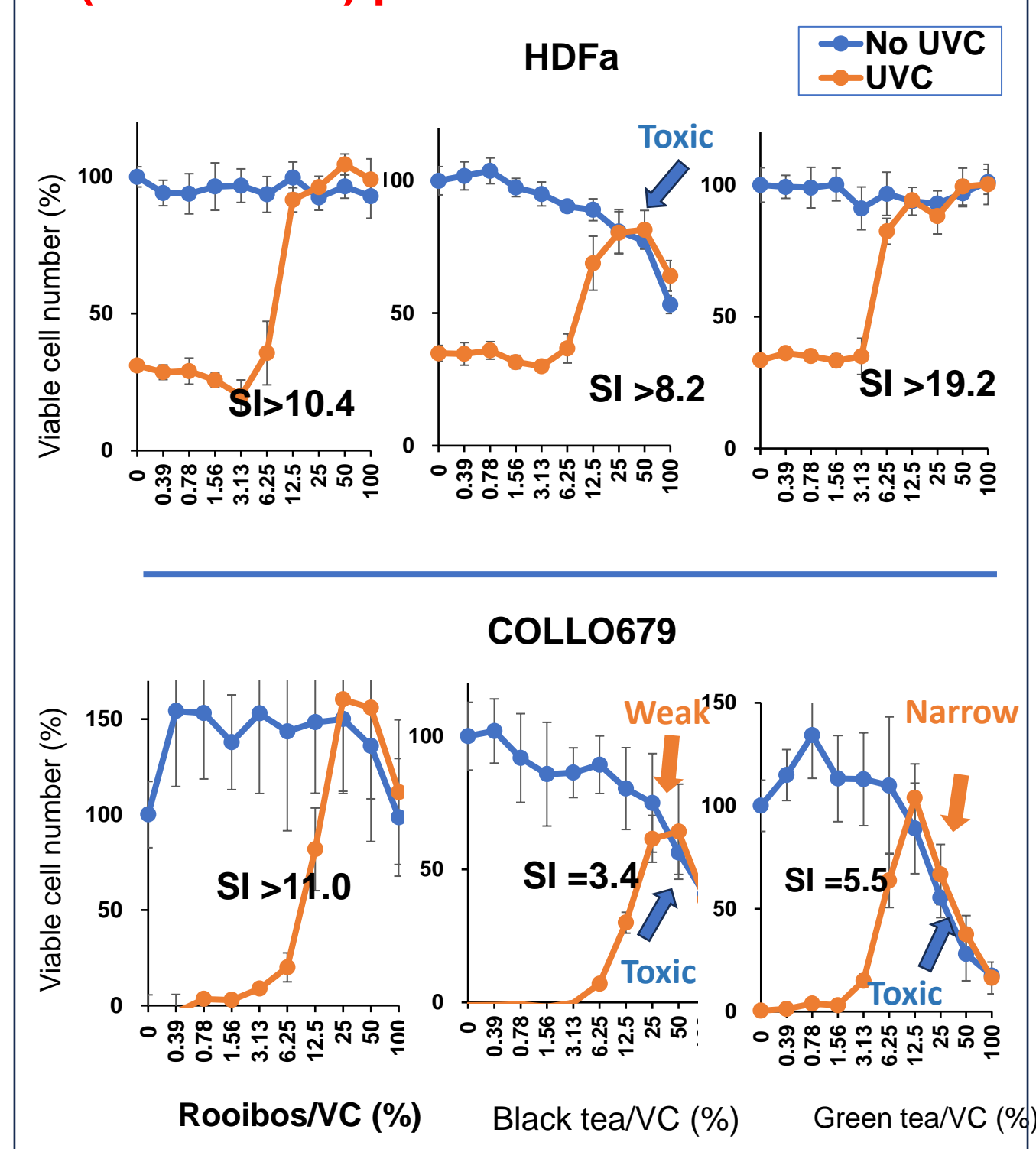


5. Rooibos is rich in anti-UVC substances

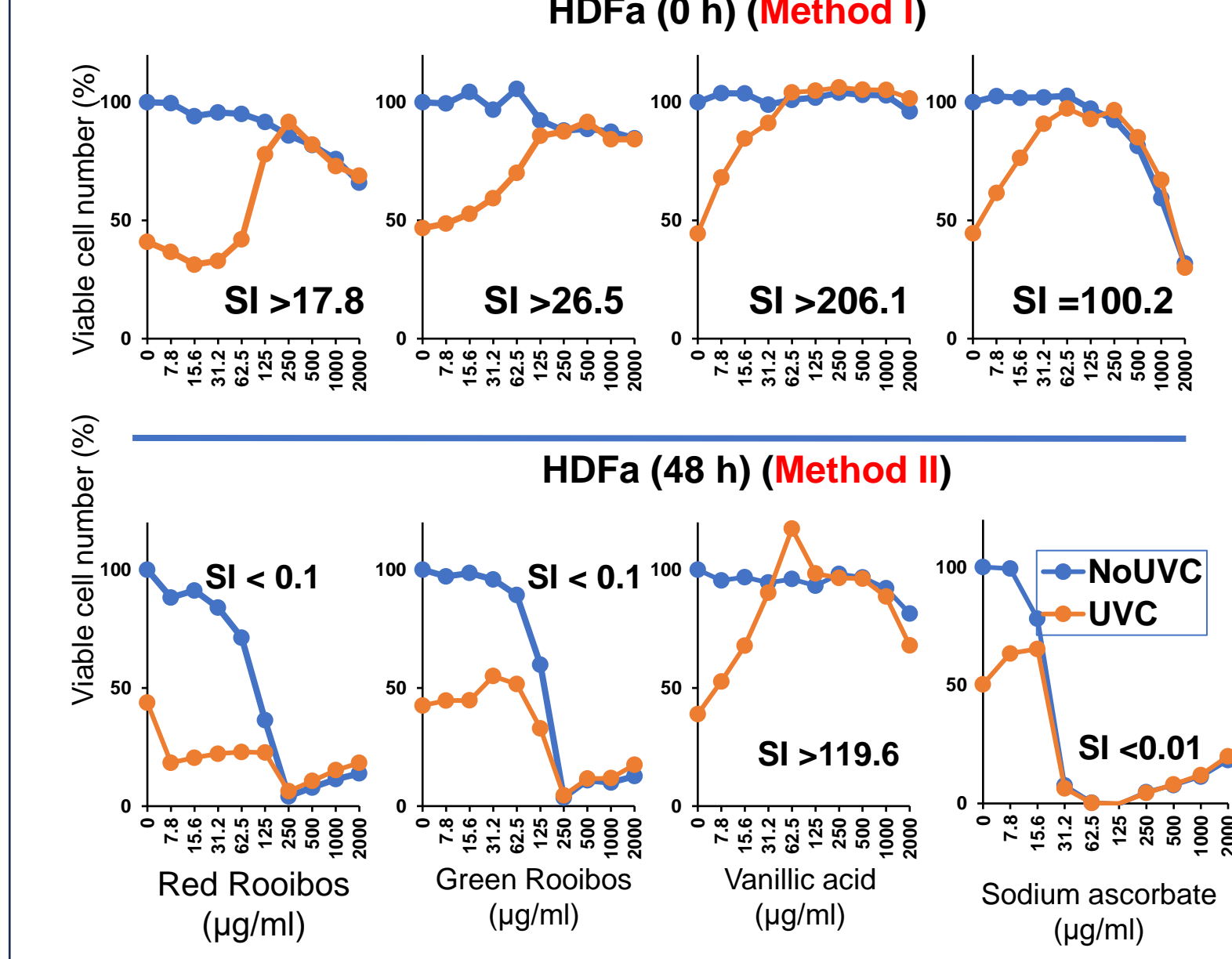
Among 108 plant hot-water extracts, Butterbur, Cloves, Curry Tree, Evening Primrose, and Rooibos showed higher anti-UVC activity.

Anti-UVC activity (SI = CC_{50} / EC_{50}) of 49 herb extracts recommended by JAMHA					Anti-UVC activity (SI = CC_{50} / EC_{50}) of other 59 herb extracts						
Herb	HDFa	COLO	HDFa	COLO	Herb	HDFa	COLO	HDFa	COLO		
Artichoke	1.0	1.0	1.0	1.0	Ajowan	2.8	1.4	Coriander	1.5	1.1	
Bilberry	1.0	1.0	1.0	1.0	Allspice	5.5	3.6	Cumin seed	3.7	2.7	
Black cohosh	2.0	2.1	Lemon balm	5.7	4.5	Angelica	2.1	2.0	Curry Tree	15.9	3.3
Calendula	3.7	1.5	Lemon verbena	8.1	3.5	Anise	4.5	2.6	Eucalyptus, Blue	1.0	1.0
Chamomile	6.4	2.2	Linden flower	3.4	2.1	America flowers	3.0	1.6	Fenugreek	6.3	4.5
Cat's claw	3.1	1.8	Malva flowers	2.3	1.3	Bearberry leaf	5.4	2.9	Grossenor Momordi	3.4	2.7
Chasteberry	3.8	3.6	Marshmallow	1.0	1.0	Bell pepper	2.3	1.0	Guarana	5.0	3.1
Cloves	17.1	9.4	Milk thistle	4.0	2.2	Birch	2.8	1.3	Gynemna sylvestre	2.7	2.9
Cranberry	1.0	1.0	Mullein	5.5	3.3	Bitter melon	1.0	1.0	Heath	4.8	2.3
Dandelion	1.0	1.0	Mullein	2.4	2.1	Bitter orange peel	1.4	1.0	Hemp	1.1	1.0
Devil's claw	1.4	1.2	Nettle	5.2	1.9	Black currant	6.9	2.8	Hyssop	3.9	3.4
Echinacea	5.3	2.5	Orange flowers	1.5	1.2	Bladderwrack	1.0	1.0	Juniper berry	1.0	1.0
Elder flower	3.3	2.9	Paraguay tea (dried)	8.0	6.5	Borage	2.9	2.3	Laurel	2.4	1.6
Evening Primrose	12.7	8.8	Paraguay tea (roast)	9.8	5.5	Burdock root	1.0	1.0	Lavender	8.6	4.7
Fennel	1.0	1.0	Passion flower	1.4	1.0	Butterbur	12.8	5.8	Lemon peel	1.3	1.0
Feverfew	3.7	3.6	Peppermint	6.6	4.1	Black currant	6.9	2.8	Lemongrass	4.9	2.8
Flaxseed	1.0	1.0	Roseberry leaf	9.3	4.8	Celery	6.1	2.9	Liquorice	4.7	2.5
Ginger	1.0	1.1	Red Sorrel	1.0	1.0	Chervil	3.1	1.5	Maca	1.0	1.0
Ginkgo	1.4	1.0	Rose	5.9	3.3	Chives	1.0	1.2	Mace	1.0	1.0
Hawthorn	2.8	1.2	Rose hip	1.0	1.0	Common gardenia	8.2	3.9	Maltake	1.0	1.0

Figure Rooibos tea (+vitamin C) pet-bottle showed higher or more stable anti-UVC activity than black tea and green tea (+vitamin C) pet-bottles



Hot-water extracts of Red and Green Rooibos leaves showed one order lower anti-UVC activity (SI > 17.8-26.5) as compared with vanillic acid and sodium ascorbate (SI > 206.1, 100.2) (upper column). Anti-UVC activity disappeared after 48 h, possibly due to their cytotoxicity. On the other hand, anti-UVC activity of vanillic acid was stable (SI > 199.6) (lower column).



6. Future direction

- Rooibos tea has gained popularity in Japan thanks to its potential health benefits. This provides the basis for studies that can reveal additional functions of the alkaline extract of rooibos, as well as other natural products of the RSA.
- Removal of cytotoxic substance(s) from Rooibos may prolong the stability of its anti-UVC activity. Alkaline extraction of Rooibos leaf may be another choice to produce more potent anti-UVC substances at higher yield. Anti-aging capability of Rooibos extract is underway.
- We propose collaborative research among the three universities to take full advantage of our comprehensive academic partnership agreement.

7. References

- Exchange program between UWC and MU/AU
1. School cafeteria of UWC. *New Food Industry* 61 (8): 637-647, 2019.
 2. Alpine plants live robustly in Table Mountain. *New Food Industry* 62 (9): 695-699, 2020.
 3. Student/Faculty Exchange Program with UWC. *New Food Industry* 66 (4): 229-241, 2024.
- Research about anti-UVC activity of natural products including Rooibos leaf extract
4. Anti-UV/HIV activity of Kampo medicines and constituent plant extracts. *In Vivo* 26 (6): 1007-1013, 2012.
 5. Anti-UV activity of lignin-carbohydrate complex and related compounds. *In Vivo* 27 (1): 133-140, 2013.
 6. Structural characterization of anti-UV components from *Sasa senanensis* Rehder extract. *In Vivo* 27 (1): 77-84, 2013.
 7. Biological activities and possible dental application of three major groups of polyphenols. *J Pharmacol Sci* 126(2): 92-106, 2014
 8. Prominent Anti-UV Activity and Possible Cosmetic Potential of Lignin-carbohydrate Complex. *Review. In Vivo* 30(4): 331-339, 2016.
 9. Comparison of UVC Sensitivity and Dectin-2 Expression Between Malignant and Non-malignant Cells. *In Vivo* 36(5): 2116-2125, 2022.
 10. Prominent Anti-UVC Activity of Lignin Degradation Products. *In Vivo* 36(6): 2689-2699, 2022.
 11. Comprehensive Study of Anti-UVC Activity and Cytotoxicity of Hot-water Soluble Herb Extracts. *In Vivo* 37(4): 1540-1551, 2023.
 12. UVC-protective activity of Lemongrass Among 12 fat-soluble herbal extracts: Rapid decay due to cytotoxicity. *In Vivo* 37(6): 2464-2472, 2023
 13. Identification of potent anti-tumor, anti-HIV and anti-UVC entities among hundreds of natural and synthetic products. *New Food Industry* 66(6): 359-368, 2024.

6th South Africa Japan University Forum
Conflict of Interest

Hiroshi Sakagami^{1,2}, ○Koji Sakiyama², Satoshi Kawano¹, Katsuyuki Ohtomo¹, Maki Izawa², Yusei Otaka², Shinji Kito², Hiroshi Nakajima², Shu Fujiwara¹, Izumi Den¹, Jun Miyata^{1,2}, Katsuyoshi Sunaga³, Ryuichiro Suzuki³, Bawa Umesh Laloo⁴, Ghaleeb Jeppie⁵

The authors declare no conflicts of interest associated with this manuscript.