

Shaken, not stirred

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Department of Agriculture and Animal Health

September 2022



Define tomorrow.

UNISA



Shaken not stirred

- Vodka Martini - Vodka, Vermouth with an olive or lemon twist
- Shaking?
- Compounds from plants in everyday lives
- Extremely diverse variety in various products

ASPIRIN
from the willow tree to a wonder drug

BAYER

ASPIRIN

THE WONDER DRUG

Safe Pain Relief Plus
Life-saving Benefits

100 TABLETS

GUINNESS WORLD RECORDS

ASPIRIN

120ml

ACT

100 TABLETS

This advertisement features a green background with the word "ASPIRIN" in large yellow letters. Below it, the text "from the willow tree to a wonder drug" is written in a smaller font. The Bayer logo is prominently displayed in the center, with the word "BAYER" written vertically. To the left of the logo is a portrait of a man in a bowler hat. To the right is a box of Bayer Aspirin with the text "THE WONDER DRUG" and "Safe Pain Relief Plus Life-saving Benefits". Below the box is a red heart icon with the number "325". The Guinness World Records logo is also visible. The advertisement is surrounded by various images of natural products and medicines.



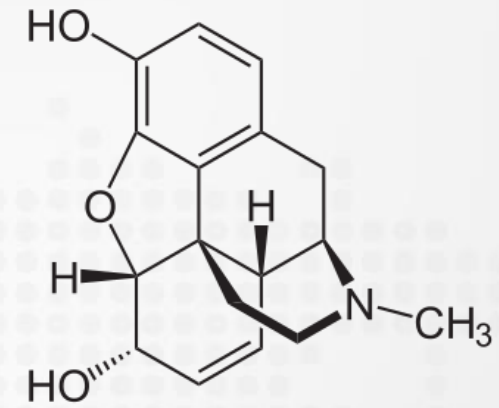
The perfect cup of tea

- Tea is particularly rich in 3 flavonoid classes each contributing to the taste of tea.
- Milk will also cool down the water
- Catch the aromatic flavours before they disappear

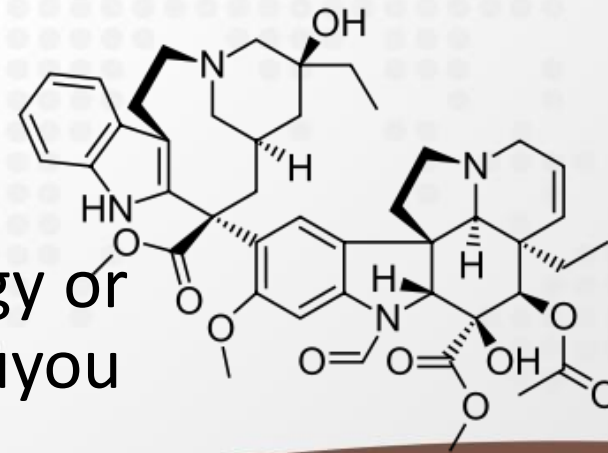


Plant compounds

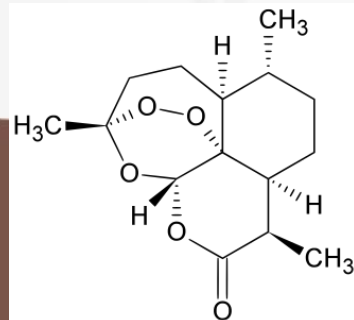
- Morphine – the first alkaloid ever isolated in 1803



- Rosy Periwinkle – vincristine



- Artemisinin - 2015 Nobel Prize in Physiology or Medicine was awarded to Professor Tu Youyou



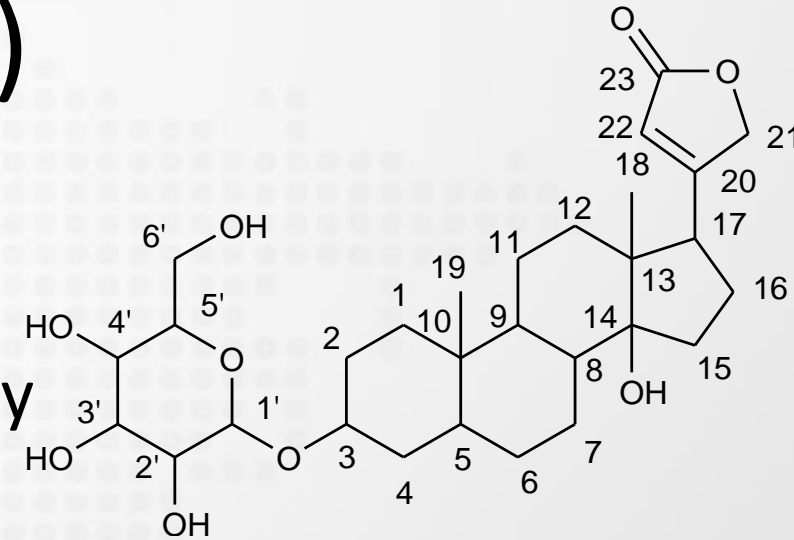
Viruses

- 37.7 million people globally were living with HIV in 2020
- 680 000 people died from AIDS-related illnesses in 2020
- 4.2 billion people have HSV-1 and HSV-2 in 2016
- 18 million active COVID19 cases
- 3.5 million people died from COVID 19 in 2021
- 80% of Africans – or more than half billion people
- 300 000 plant species in South Africa – less than 30 commercialised



Human Immunodeficiency Virus (HIV)

- **Digitoxigenin-glucoside**
- Cardiac glycosides
- Potent cardiotonic activity also known for their toxicity
- New class of compounds
- 90% inhibition of a HI pseudovirus
- Concentration of 100 ng/ml or 0.2 mM



Natural Product Research
Vol. 24, No. 18, 10 November 2010, 1743–1746



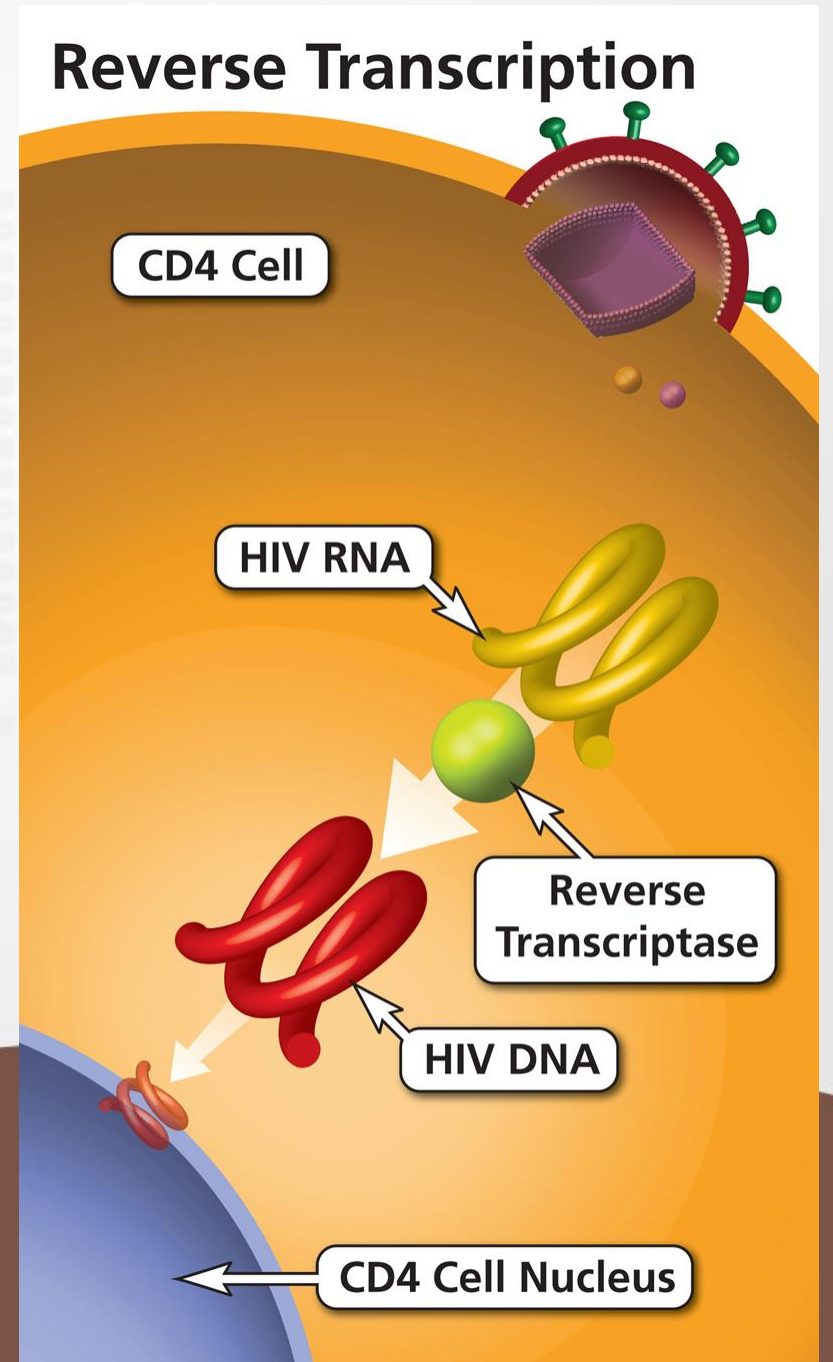
A cardiac glucoside with *in vitro* anti-HIV activity isolated from *Elaeodendron croceum*

Gerhard Prinsloo^a, J.J. Marion Meyer^{a*}, Ahmed A. Hussein^b, Eduardo Munoz^c
and Rocio Sanchez^c



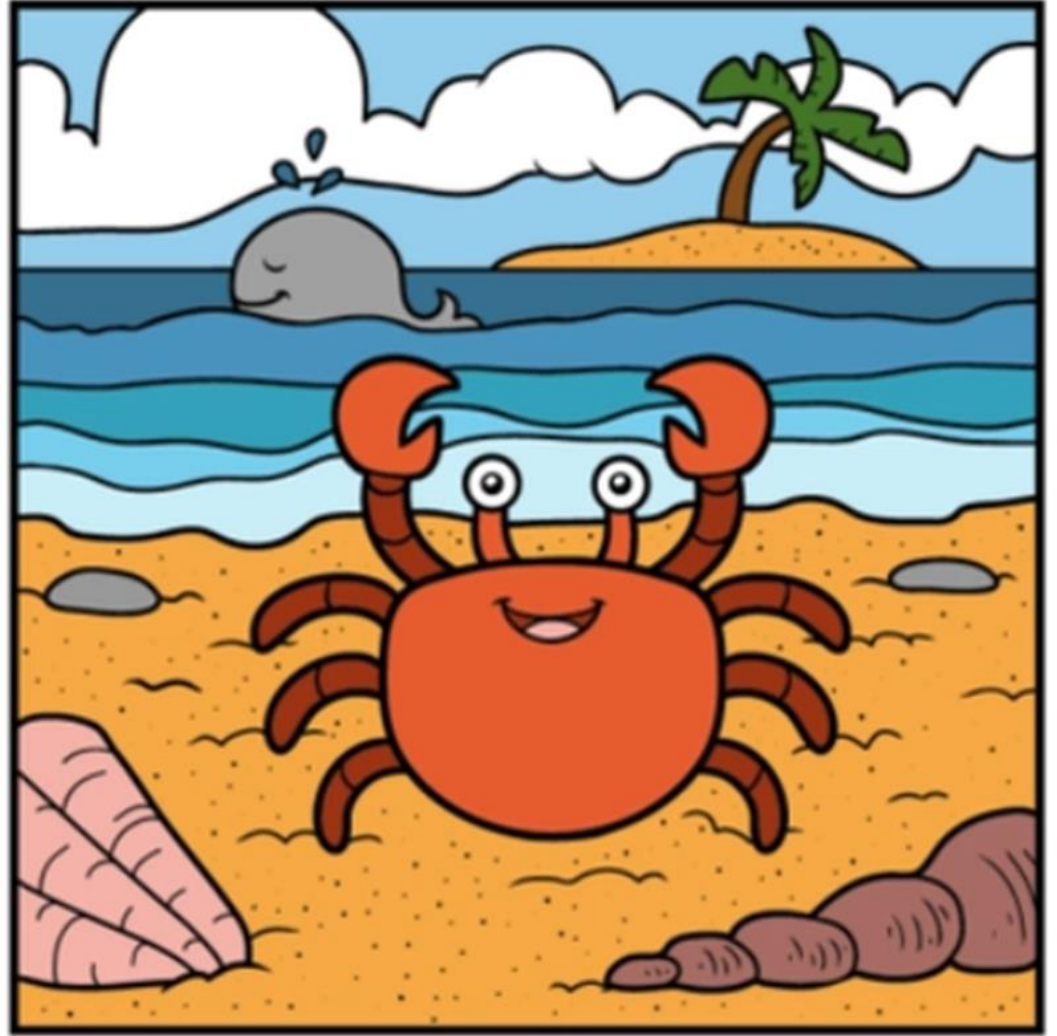
Reverse transcriptase (RT)

- HIV is a retrovirus
- RT enzyme converts RNA to DNA
- Incorporate all the information in the host cell



Plant metabolomics

- Relatively new technique in South Africa
- Attempting to extract, classify and identify compounds from any organism
- Snapshot
- UNISA, NMR-based metabolomics established in 2013
- Comparison of profiles



Helichrysum mimetes

- Metabolomic analysis
- RT
- RT with an IC₅₀ value of 53.82 µg/ml



Contents lists available at [ScienceDirect](#)

South African Journal of Botany

journal homepage: www.elsevier.com/locate/sajb

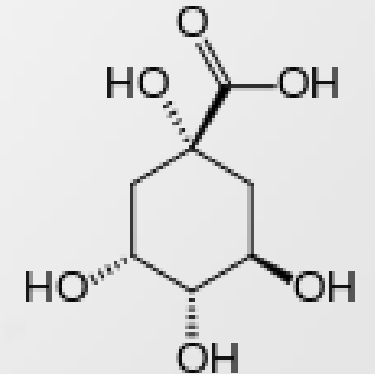
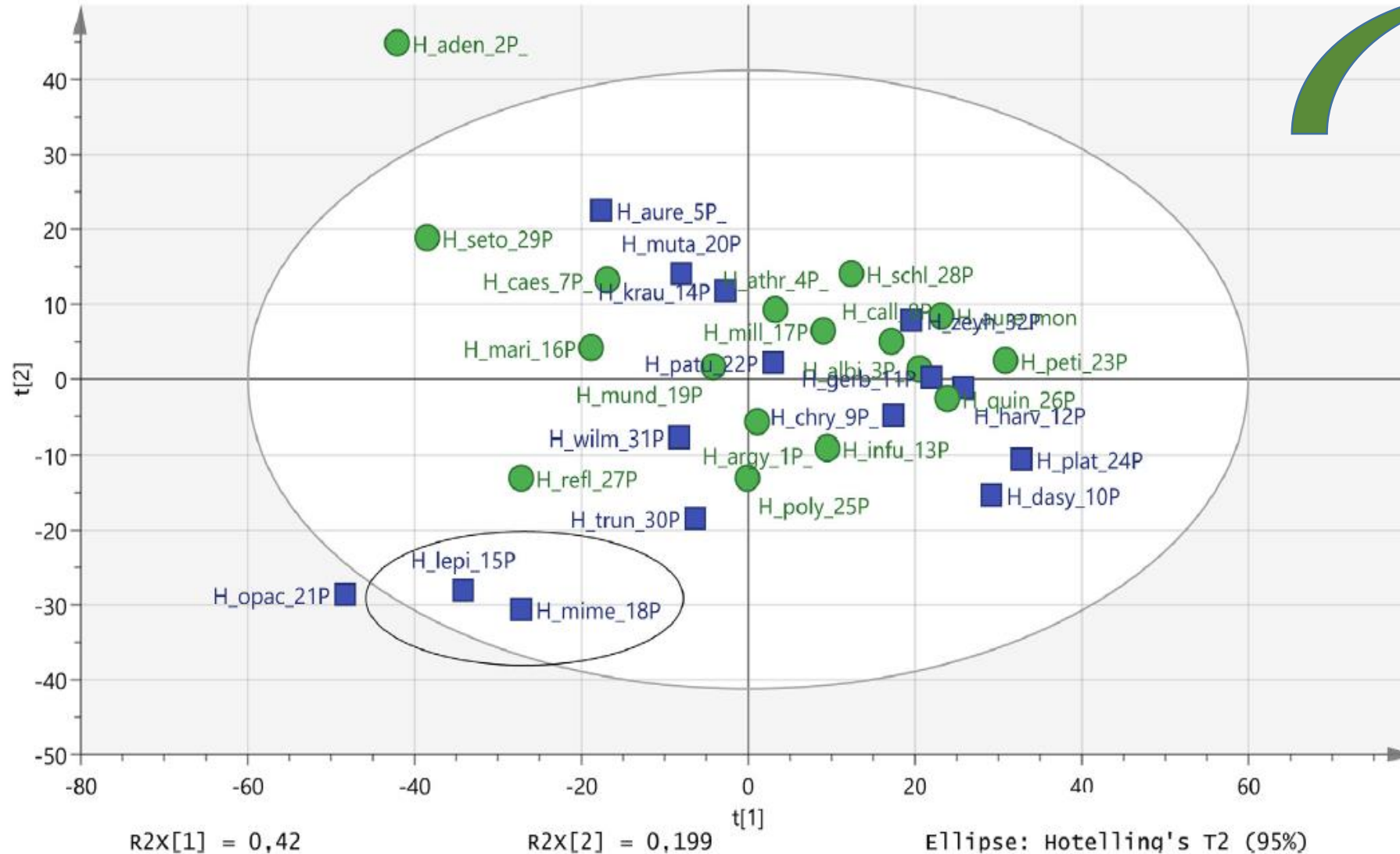


Anti-HIV-1 activity of quinic acid isolated from *Helichrysum mimetes* using NMR-based metabolomics and computational analysis

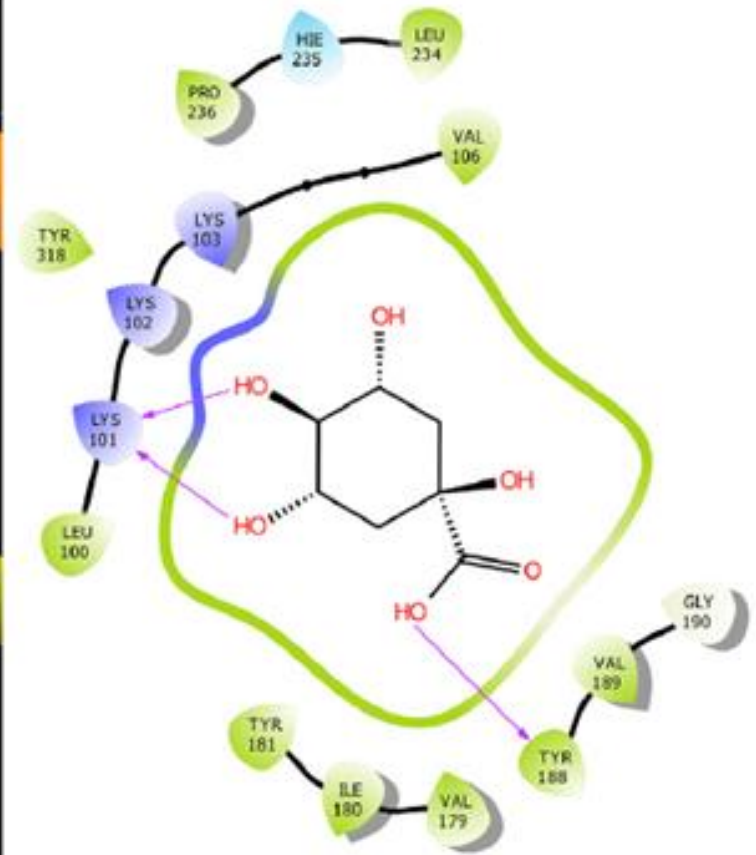
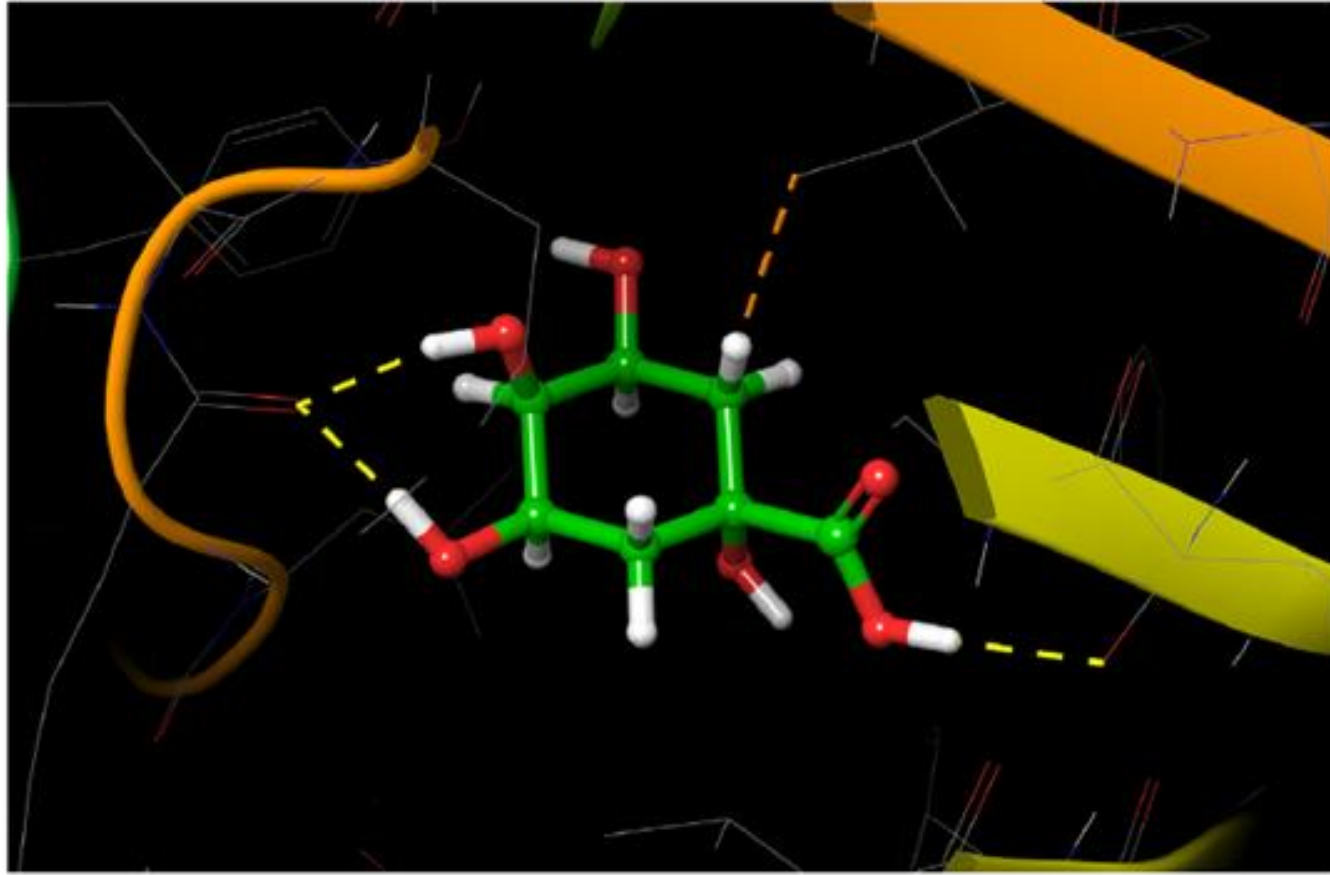
S.E. Yazdi ^a, G. Prinsloo ^b, H.M. Heyman ^{a,c}, C.B. Oosthuizen ^a, T. Klimkait ^d, J.J.M. Meyer ^{a,*}



Metabolomic analysis of active vs non-active

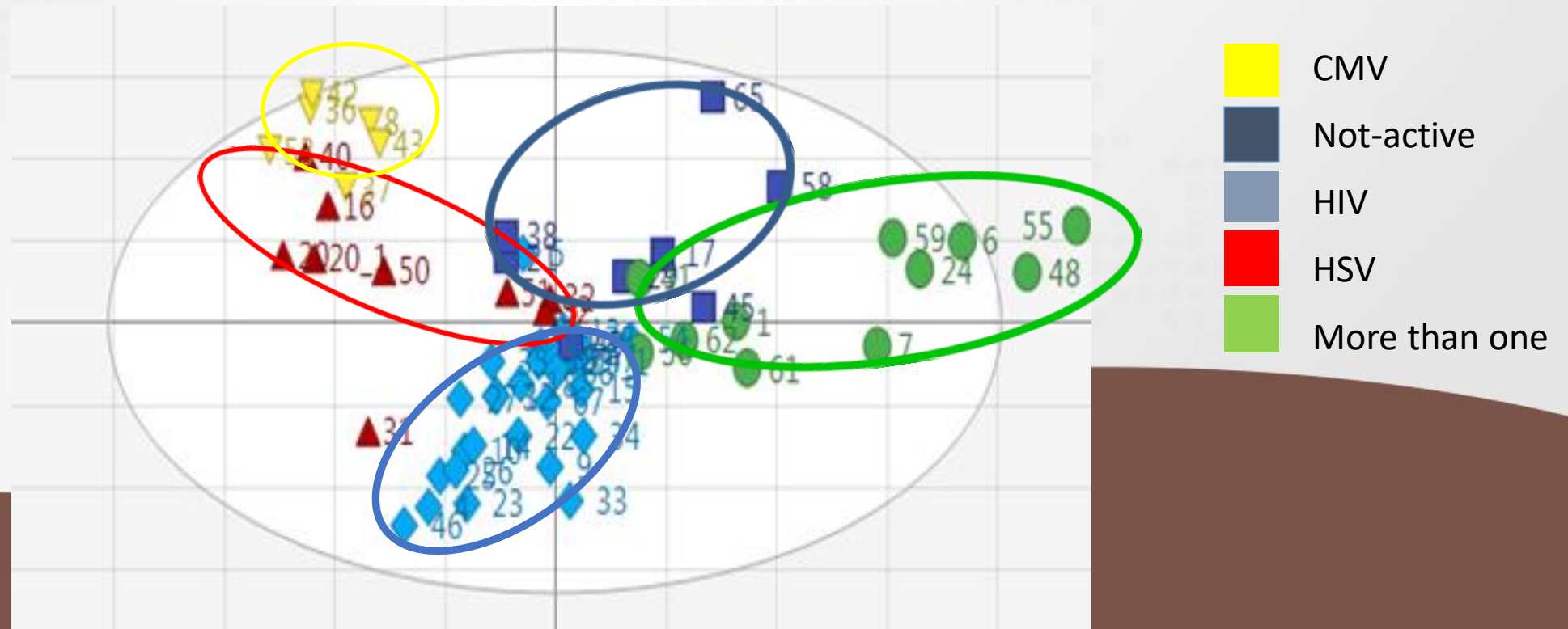


Molecular docking in RT active site

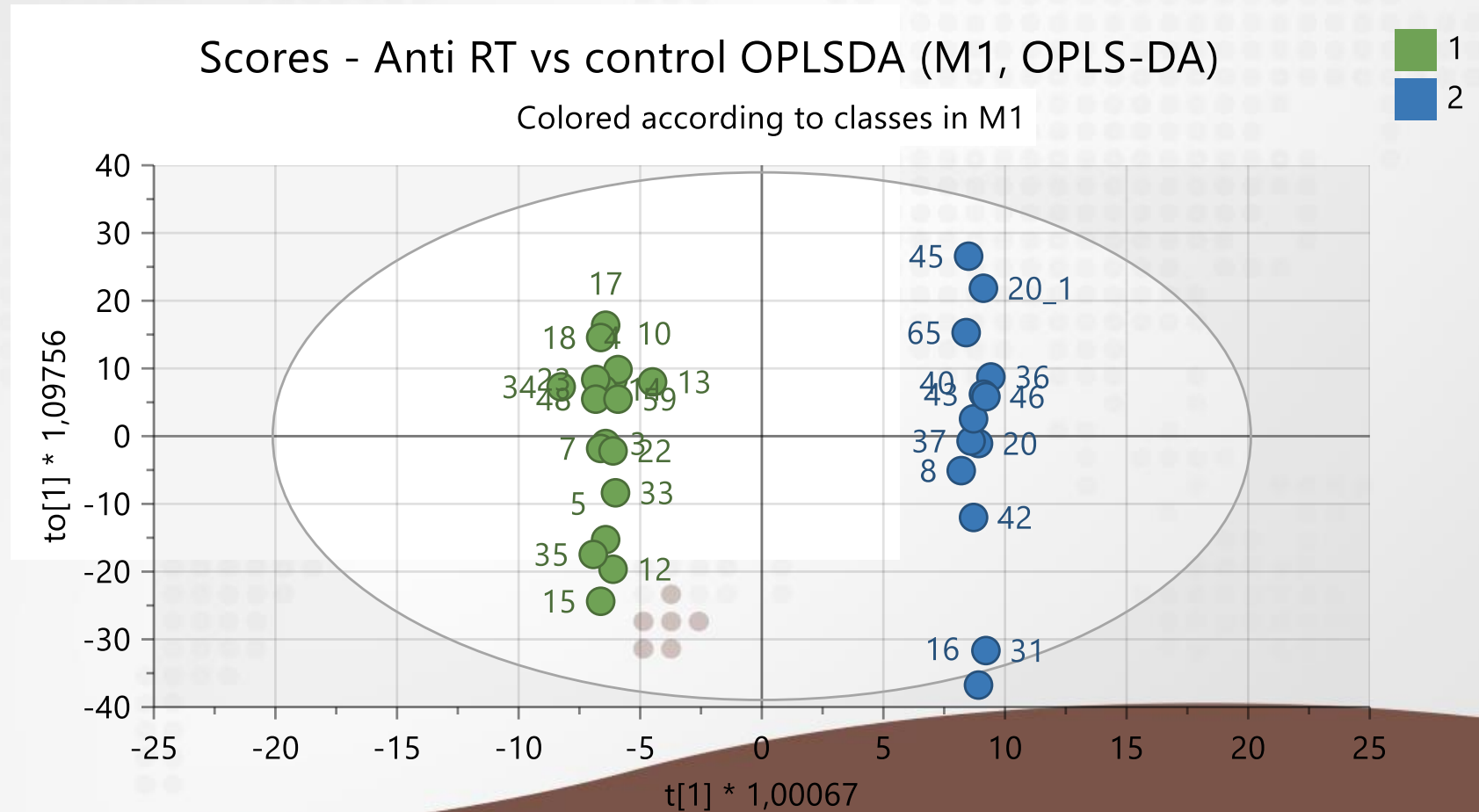


Metabolomics – unrelated plants

- Published antiviral activity
- Collected 43 species, 25 families, 32 genera
- Herpes Simplex Virus (HSV), HIV, Cytomegalovirus (CMV) and Influenza

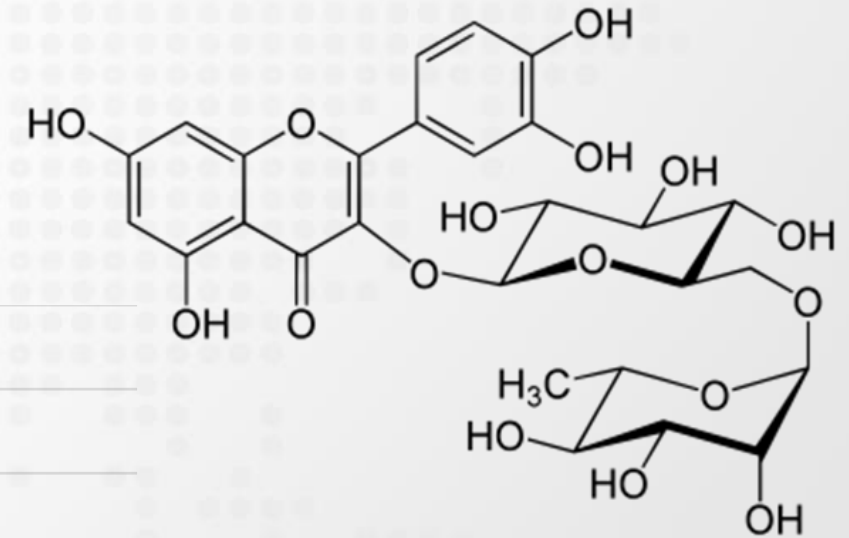


OPLS-DA: anti-HIV RT vs control

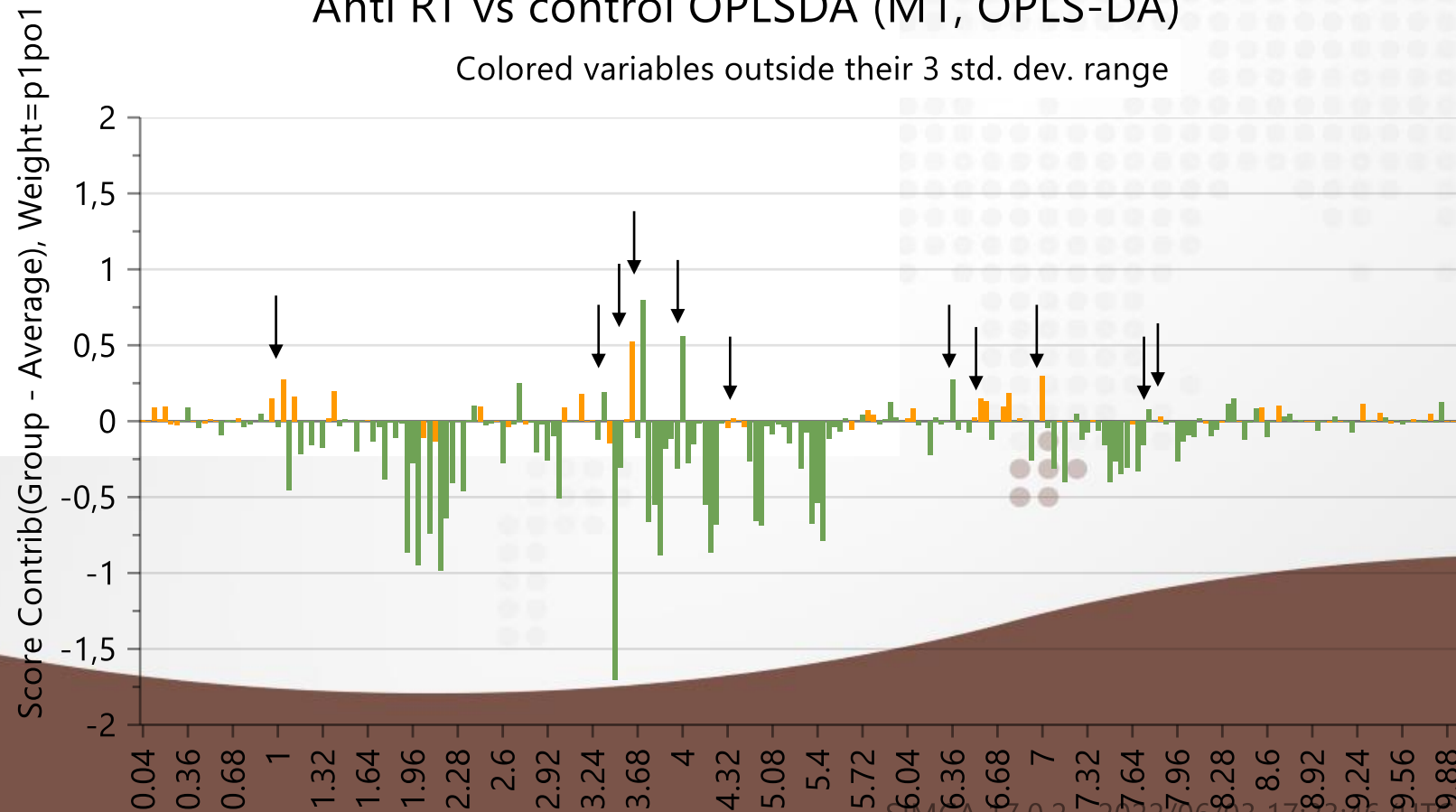


Scaled proportionally to R2X, R2X[1] = 0,0499, R2Xo[1] = 0,187,
Ellipse: Hotelling's T2 (95%)

Contribution plot of anti-HIV RT

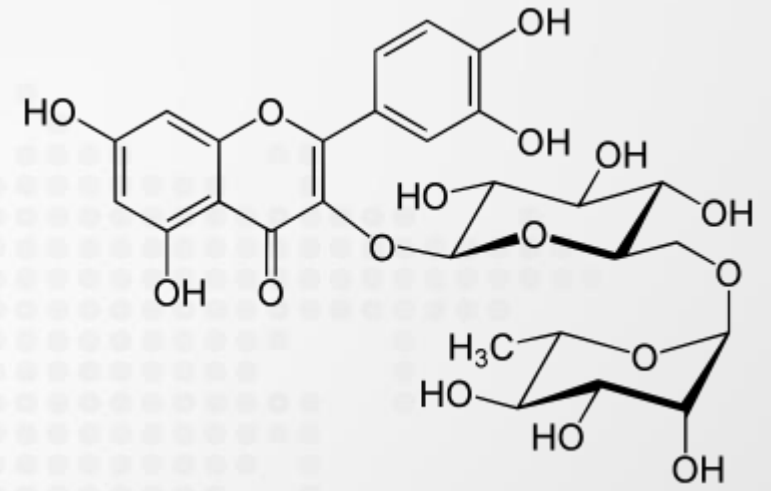


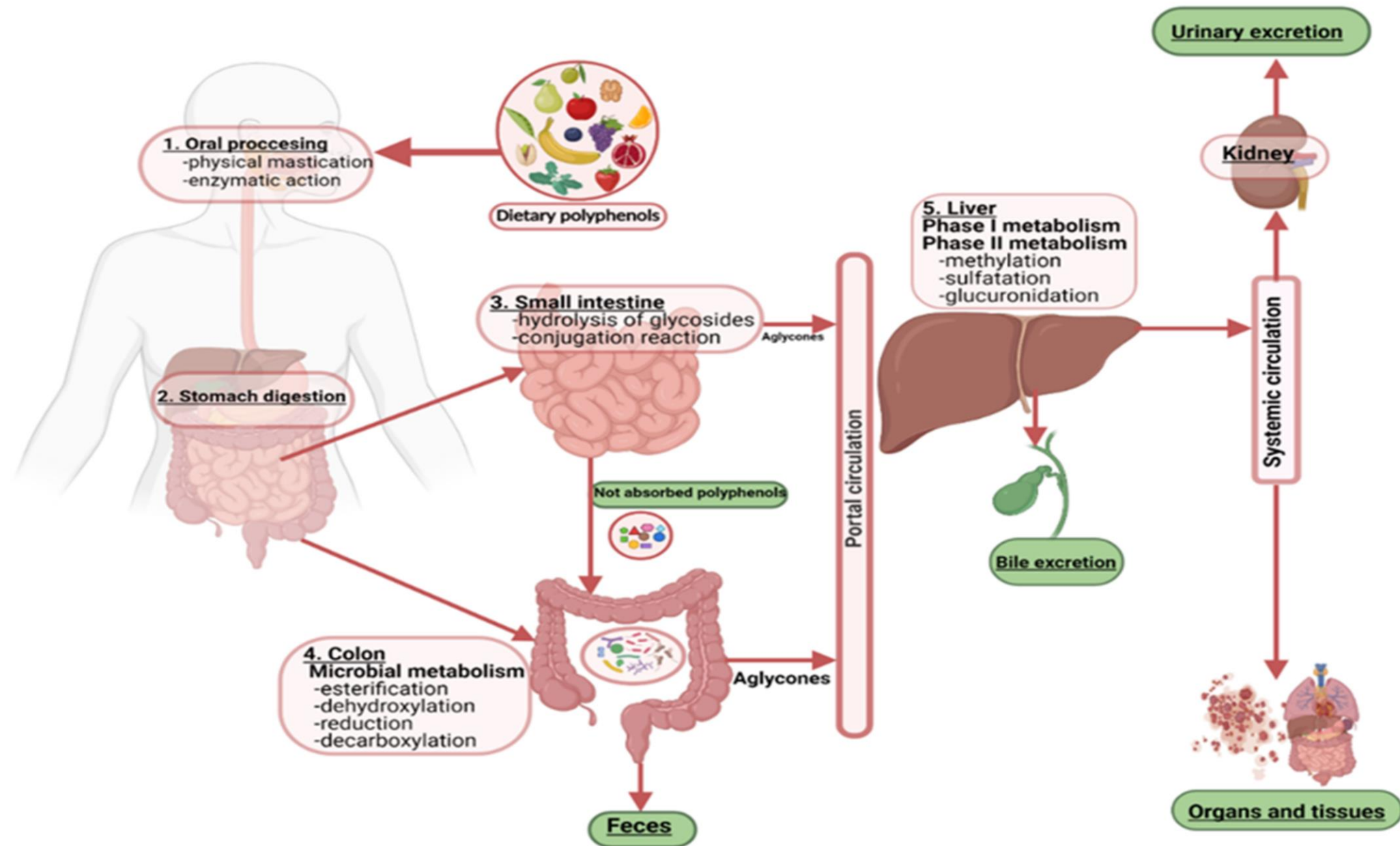
Score contribution Group 2 vs. Average
Anti RT vs control OPLSDA (M1, OPLS-DA)
Colored variables outside their 3 std. dev. range



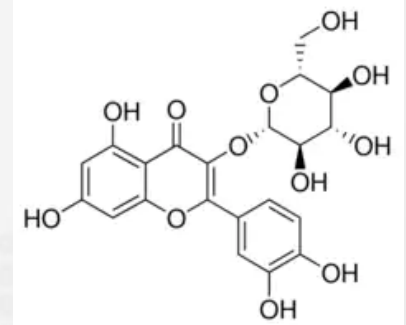
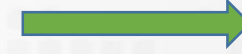
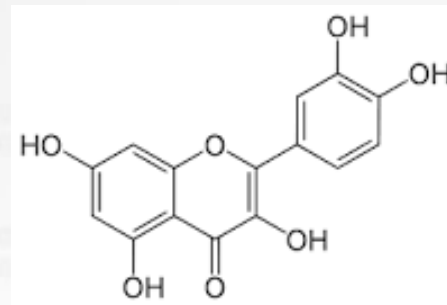
Rutin

- Rutin – flavonol glycoside
- Parsley, grapes, sweet red peppers, nectarines, peaches, broccoli etc.
- anticancer, analgesic, antiarthritic, α -glucosidase, anti-inflammatory and antiviral
- After oral administration, rutin is hydrolyzed in the GI tract to release quercetin





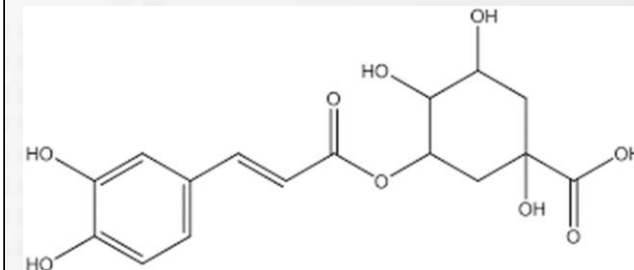
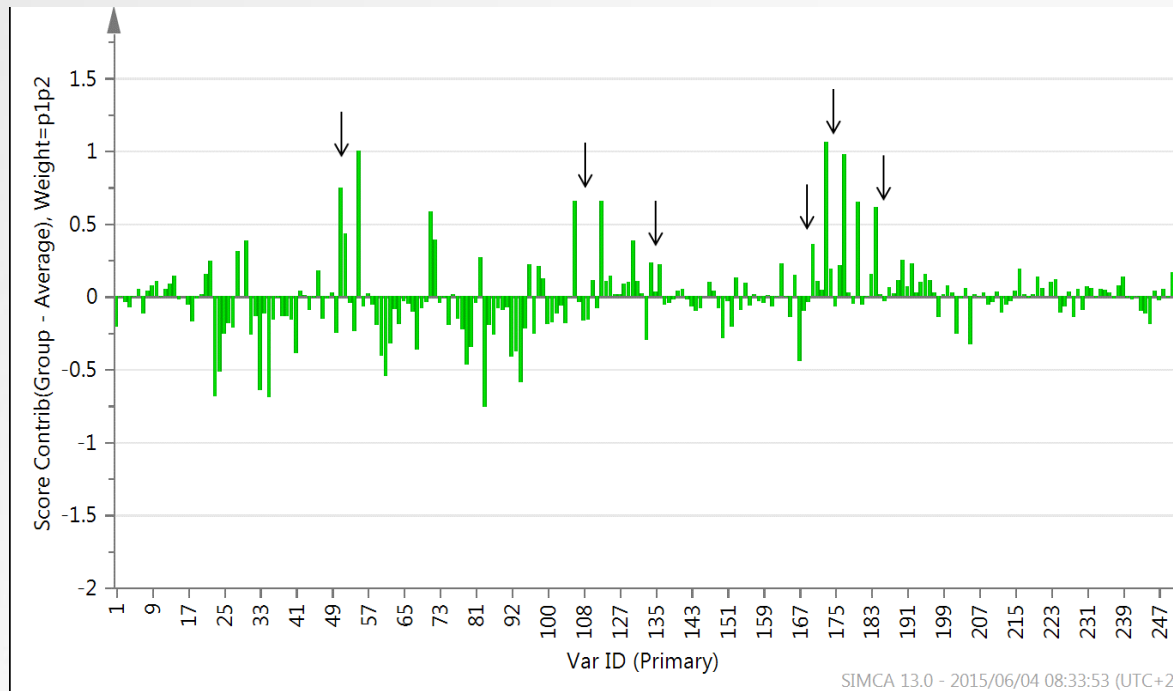
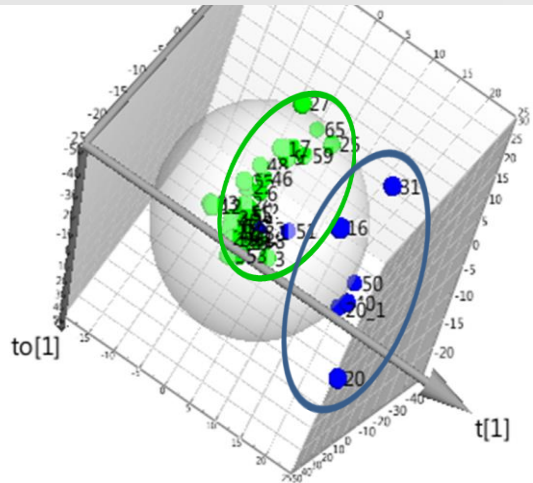
Quercetin



- Anticarcinogenic and anti-inflammatory, antidiabetic, antimicrobial, anti-Alzheimer's, antiarthritic, cardiovascular and wound-healing
- Lipophilic
- glucuronidation, methylation, sulfation or hydroxylation
- Rutin and quercetin 3-O- β -D-glucoside protease inhibitors of SARS-CoV-2
- Dengue virus, Zika virus, Hepatitis C

Other groups - HSV





Metabolomics (2018) 14:134
<https://doi.org/10.1007/s11306-018-1432-y>

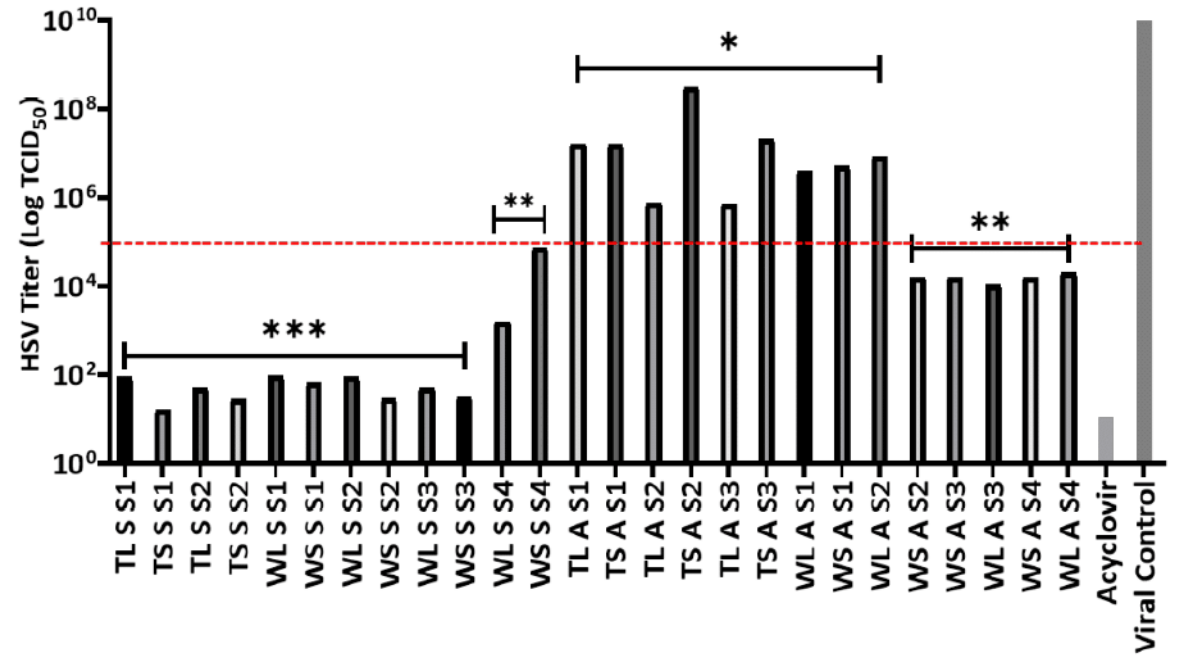
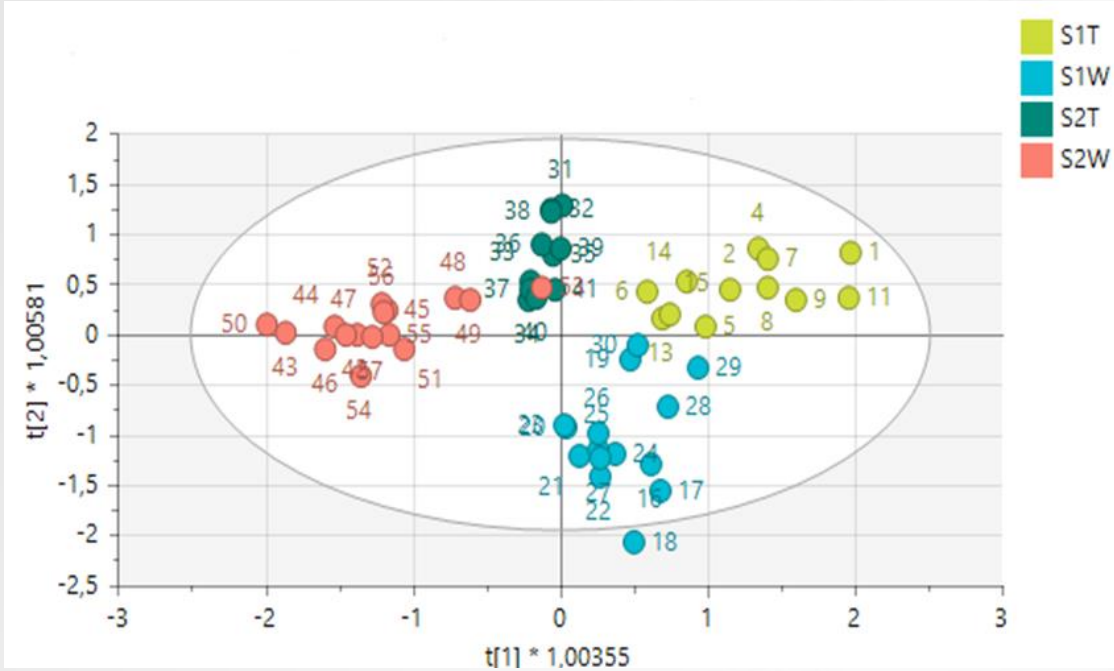
ORIGINAL ARTICLE

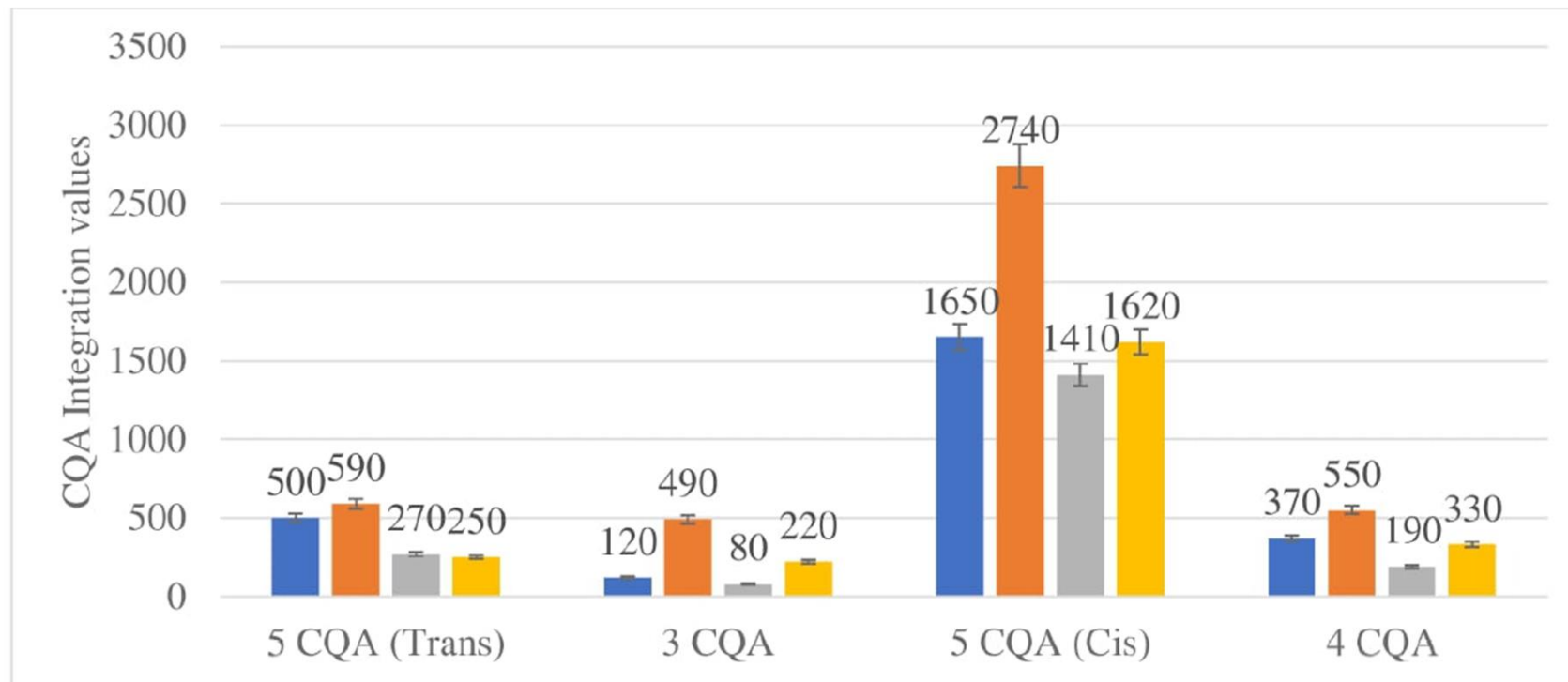


Identifying anti-HSV compounds from unrelated plants using NMR and LC-MS metabolomic analysis

Gerhard Prinsloo¹ · Jacques Vervoort^{1,2}

Helichrysum aureonitens





Influence of Seasonal and Geographic Variation on the Anti-HSV-1 Properties and Chlorogenic Acids Content of *Helichrysum aureonitens* Sch.Bip.

Bamise W. Adeosun^{1*}, Garland More¹, Paul A. Steenkamp², Gerhard Prinsloo¹

Metabolomics – animal virus

- Rift Valley Fever Virus



Contents lists available at [ScienceDirect](#)

Heliyon

journal homepage: www.cell.com/heliyon



Research article

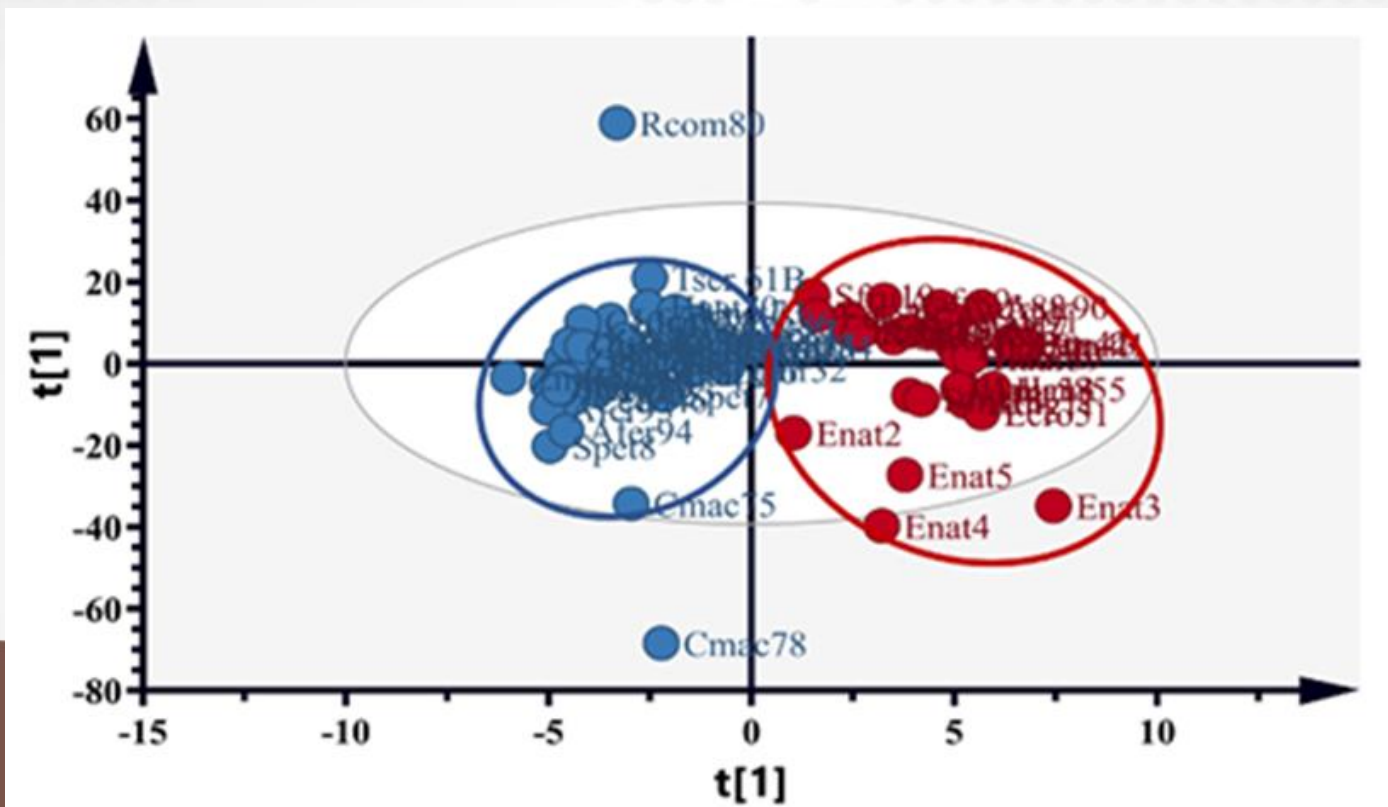
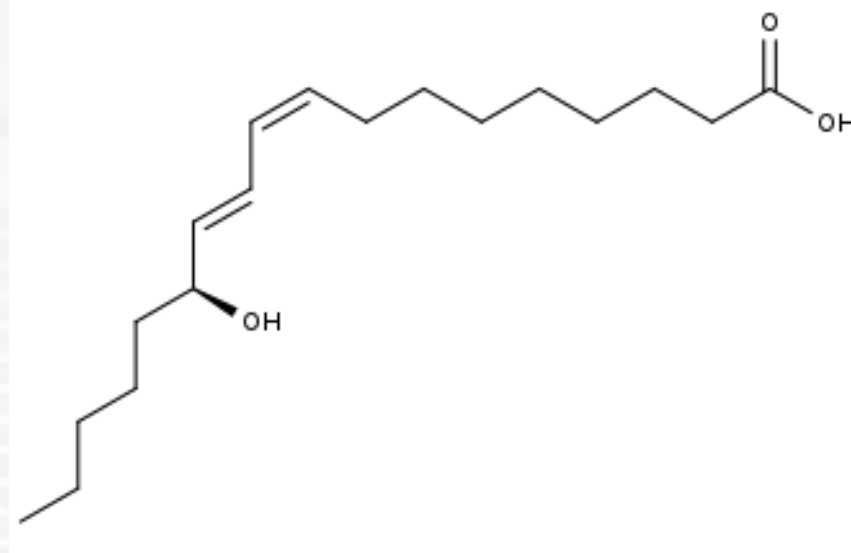
Metabolomic profile of medicinal plants with anti-RVFP activity

Garland Kgosi More^{a,*}, Jacques Vervoort^{b,c}, Paul Anton Steenkamp^d, Gerhard Prinsloo^b




- 13S-Hydroxy-9Z,11E,15Z-octadecatrienoic acid

- Antimicrobial, anti-inflammatory, anti-allergic and anticancer activities



Article

$^1\text{H-NMR}$ and LC-MS Based Metabolomics Analysis of Wild and Cultivated *Amaranthus* spp.

Nolitha Nkobole* and Gerhard Prinsloo 

 frontiers
in Pharmacology

ORIGINAL RESEARCH
published: 05 March 2020
doi: 10.3389/fphar.2020.00219



ELSEVIER

Contents lists available at

Biochemical Systemat

journal homepage: www.elsevier.com

NMR-based metabolomic analysis of the seasonal and regional variability of phytochemical compounds in *Curtisia dentata* stem bark

A.S. van Wyk^{a,*}, G. Prinsloo^b

$^1\text{H-NMR}$ Metabolomics and LC-MS Analysis to Determine Seasonal Variation in a Cosmeceutical Plant *Leucosidea sericea*

Phophi Freda Sehlakgwe¹, Namrita Lall^{2,3} and Gerhard Prinsloo^{1*}

¹ Department of Agriculture and Animal Health, University of South Africa, Johannesburg, South Africa, ² Department of Plants and Soil Sciences, Plant Science Complex, University of Pretoria, Pretoria, South Africa, ³ School of Natural Resources, University of Missouri, Columbia, MO, United States



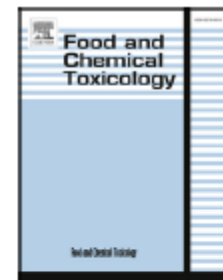


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Food and Chemical Toxicology

journal homepage: www.elsevier.com/locate/foodchemtox



The use of plants containing genotoxic carcinogens as foods and medicine

Gerhard Prinsloo^{a,*}, Noluyolo Nogemane^a, Renee Street^{b,c}

CRITICAL REVIEWS IN TOXICOLOGY

<https://doi.org/10.1080/10408444.2019.1686456>






Taylor & Francis
Taylor & Francis Group

REVIEW ARTICLE



Risk assessment of herbal supplements containing ingredients that are genotoxic and carcinogenic

Gerhard Prinsloo^{a,b} , Francois Steffens^c, Jacques Vervoort^{b,d}  and Ivonne M.C.M. Rietjens^a 

Adverse effects

- Therapeutic vs adverse
- Aristolochic acids, alkenylbenzenes and pyrrolizidine alkaloids
- Margin of exposure (MOE) – 10 000
 - Nutmeg MOE = 53.62 and in another product MOE = 7.26
 - Parsley and dill containing products MOE = 141
 - Basil containing supplements MOE = 1.44
 - Basil containing pesto sauce MOE = 4750
 - Herbal medicinal samples MOE = 0.78
- Lifetime vs two weeks every year
- Combination



MOE lifetime		5	10	25	50	75	90	95
	AA	0.00	0.00	0.00	0.01	0.04	0.09	3
	AB	0.01	0.02	0.08	1	3	8 019	10 552
	PA	0.39	1	209	801	3 698	9 285	16 254
MOE 2 weeks intake every year over a 70 year period								
	AA	0.01	0.03	0.06	0.32	0.94	2	78
	AB	0.30	0.50	2.13	29	98	208 509	274 374
	PA	10	33	5450	20 839	96 151	241 419	422 619

Conclusion

- Consume, use and abuse compounds from plants.
- Tested - improvement in analytical techniques and knowledge.
- Scientific development, especially in the field of toxicology.
- Better information on what is healthy, safe and beneficial to us.
- Plants contain thousands of compounds that we know is beneficial to us, and there are certainly thousands more to discover.
- Explore the rich biodiversity of South Africa.



**My family
Lord Almighty**