

# Indigenous edible plants as sources of nutrients and health benefitting components (nutraceuticals)

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# Outline of presentation

- Introduction and definitions
- Nutraceuticals in plants
- Global market for nutraceuticals
- South African situational analysis – success stories and other lessons to be learnt
- The future – collaborations and work at ARC, CSIR.  
Role of DST
- Case study
- Conclusion

# Introduction

- The term nutraceutical was coined from the words “nutrition” and “pharmaceutical”
- It was first described by Stephen DeFelice, MD, the founder and chairman of the foundation for innovation medicine in Cranford, New Jersey, USA
- Summary of the definition of the term is as follows:  
**“any non-toxic food extract supplement that has scientifically proven health benefits for both disease treatment and prevention”** (Dillard and German, 2000)

Dillard, C.J. & German, J.B. 2000. Review: Phytochemicals: nutraceuticals and human health. *Journal of the Science of Food and Agriculture* 80, 1744-1756

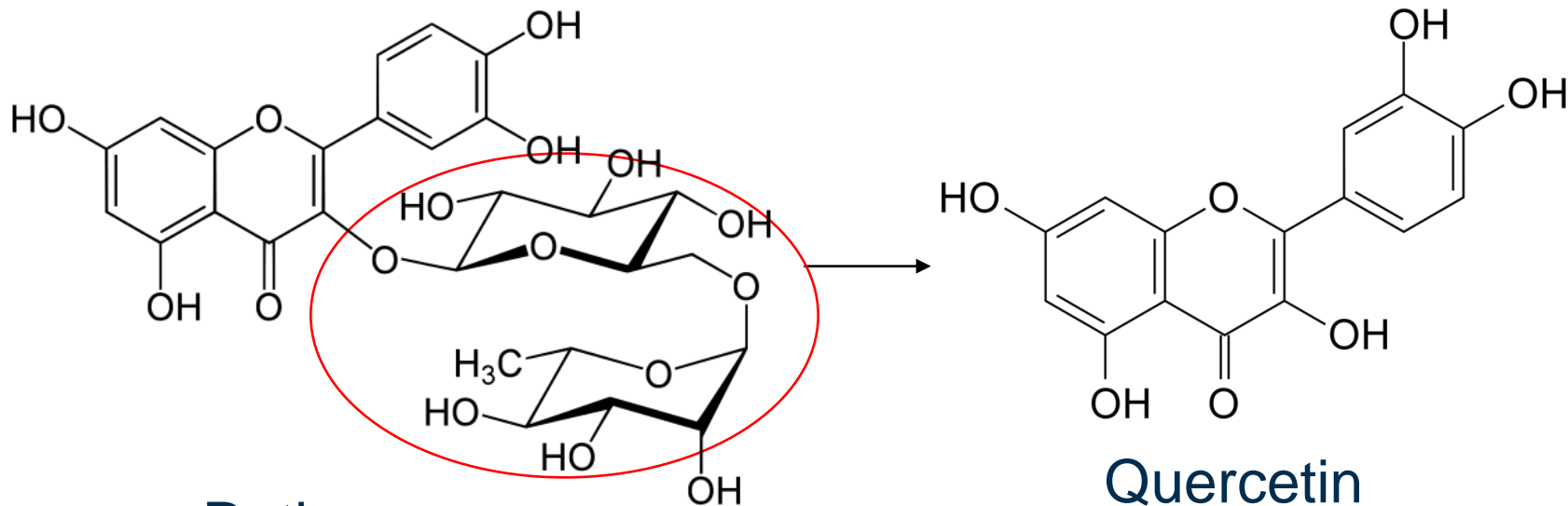
# What are nutraceuticals

- Many edible plants are rich in specific constituents, referred to as phytochemicals that may have health promoting effects
- These phytochemicals have the potential to be incorporated into foods or food supplements as **nutraceuticals**
- The health promoting effects of nutraceuticals and other functional foods are **likely** due to biochemical and cellular interactions which together promote overall health of the individual

# Some plant-derived chemical groups that have potential health promoting effects

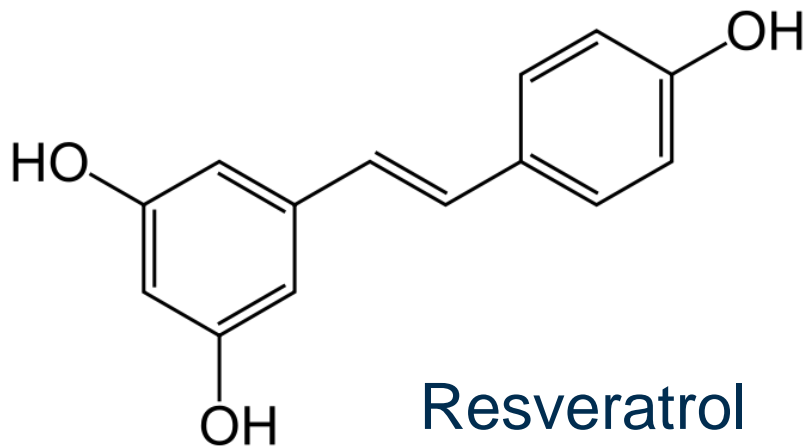
- The major plant-derived chemical groups now recognized as having potential health promoting effects, at least under some circumstances are the:
  - flavonoids
  - alkaloids
  - carotenoids
  - phytosterols
  - tannins
  - terpenoids
  - saponins
  - soluble and insoluble dietary fibres

# Flavonoids



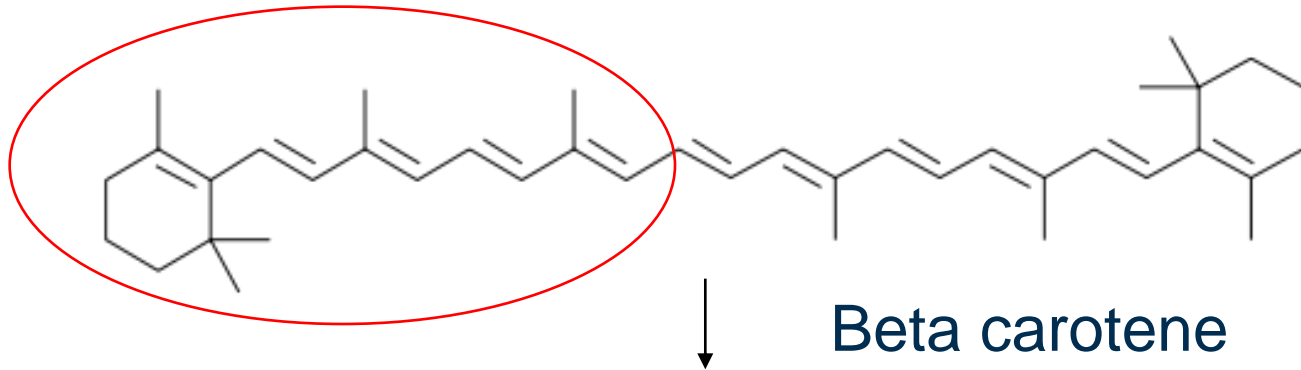
Rutin

Quercetin

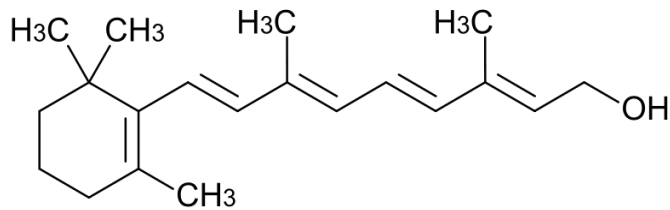


Resveratrol

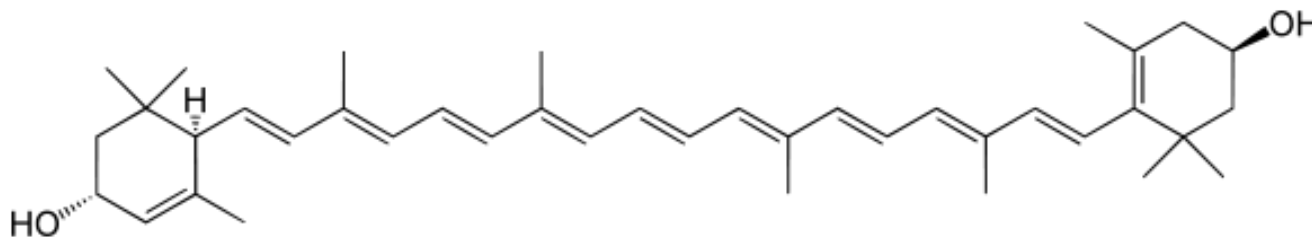
# Terpenoids (Carotenoids)



Beta carotene



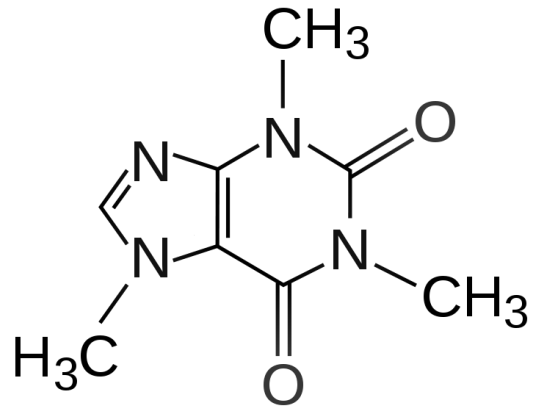
Retinol (vitamin A)



Lutein

# Alkaloids and Phytosterols

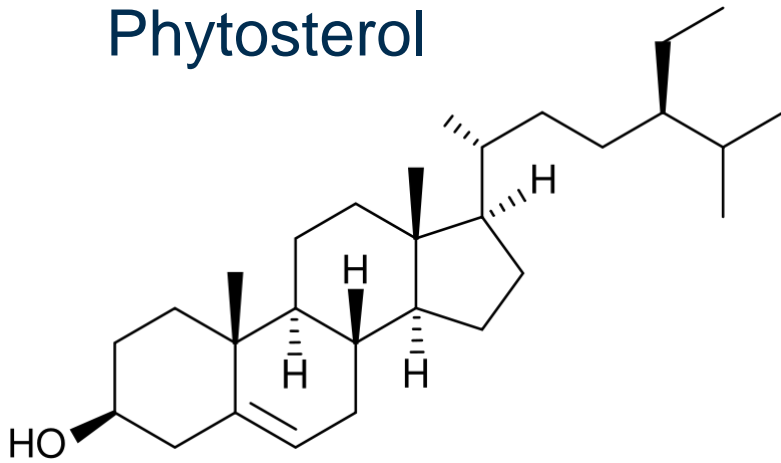
## Alkaloid



## Caffeine

- Stimulant

## Phytosterol



## Beta-sitosterol

- Cholesterol lowering

<http://www.phytochemicals.info/phytochemicals/>



# Global nutraceutical and functional food market



The circular dots represent niche markets, while the triangles represent the areas with the most expanding markets

• Nutraceuticals and functional foods are a multi-billion dollar industry with projected sales for 2010 being estimated to reach between US \$167 billion and US \$187 billion ([www.StrategyR.com](http://www.StrategyR.com))

Basu, S.K., Thomas, J.E. & Acharya, S.N. 2007. Prospects for growth in global nutraceutical and functional food markets: A Canadian perspective. *Australian Journal of Basic and Applied Sciences*, 1 (4), 637-649

# Factors contributing to worldwide use of nutraceuticals

- An increase in public health consciousness
- An aging population
- Escalating health costs
- Recent advances in research and technology:
  - providing consumers with fresh access and often supplemented produce with recognizable health benefits that previously were not available.
- Changes in government regulations and accountability
- Expansion of the global market place
- In South Africa:
  - Successful activities of major market players
  - Growth of health and fitness centres

# South African indigenous plants as sources of nutraceuticals

- South Africa is exceptionally rich in plant diversity with 22 000 species (Coetzee et. al., 1999)
- The region also has great cultural diversity, with many people still using a variety of plants in their daily lives
- The nutraceutical industry has a potential of providing an opportunity for economic growth for many developing countries endowed with a **rich biodiversity** and **traditional knowledge** of the health effect of certain indigenous plant species

Coetzee, C., Jefthas, E. & Reintein, E. 1999. Indigenous plant genetic resources of South Africa, p 160-163. In J. Janick (ed), *Perspectives on new crops and new uses*. ASHS Press, Alexandria, VA

# South Africa's success stories



- South Africa has several successes in the production of health supplements that may be termed nutraceutical
  - Indigenous herbal tea products have made their way into the market, for example Buchu tea (*Agathosma betulina*), Honey Bush Tea (*Cyclopia genistoides*) (Van Wyk, 2008)

*Agathosma betulina*

Moolla, A. & Viljoen, A.M. 2008. "Buchu" – *Agathosma betulina* and *Agathosma crenulata* (Rutaceae): A review. *Journal of Ethnopharmacology* 119, 413-419

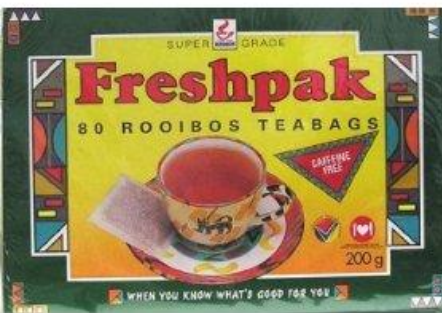
Van Wyk B.E. 2008. A broad review of commercially important southern African medicinal plants. *Journal of Ethnopharmacology*, 119, 342-355

# South Africa's success stories



*Aspalathus linearis*

- Rooibos Tea, from the plant *Aspalathus linearis* (which is rich in antioxidants)
- Naturally grows in the Cederberg region of the Western Cape
- The plant was used by the Khoisan as a herbal remedy for many different ailments



[http://www.bushmanskloof.co.za/reserve\\_botanical.php](http://www.bushmanskloof.co.za/reserve_botanical.php)

<http://sasnacks.com/images/FreshpakRooibosTea80.jpg>



# South Africa's success stories



- *Aloe ferox* was also consumed by the Khoisan
- It is well known for its laxative action
- Several product are produced from *Aloe ferox*

[http://www.feroxaloe.com/Aloe\\_ferox3.jpg](http://www.feroxaloe.com/Aloe_ferox3.jpg)

# Lessons for South Africa

- South Africa could also use experiences from other developing countries that are important producers of nutraceuticals
- In India and China, functional foods and nutraceuticals are available and used as part of traditional diets and medicines
- There are no strict pharmaceutical regulations and control, and most of the products are available to the consumer directly over the counter
- **The lack of strict regulations has enabled the nutraceutical industry to grow in the host countries, which has further stimulated trade into other countries**

# Tapping into SA indigenous plants

- Multidisciplinary collaborations
- Department of Science and technology (DST): **Indigenous knowledge systems**
- Agricultural Research Council (ARC): **Develop cultivation methods of indigenous plants**
- CSIR – **value chain to commercialisation**
  - Screening methods (potential bioactivity)
  - Discovery and identification (chemistry)
  - Product development (agroprocessing)/ consumer
  - Plant propagation methods (tissue cultures)-plant transformation
- Mintek



# The Amaranthus project

- Amaranthus has been identified as part of the group of species that have potential to be developed as crops. The other species include *Cleome gynandra* (spider flower).
- A study was conducted in order to gain an insight into production practices of vegetable amaranth (*Amaranthus cruentus* (Arusha) under different spacing, transplanting time and harvesting method.
- This work was done at ARC
- The work at CSIR was to characterise the plant material and develop consumer products

# The carotenoid content of amaranth (*Amaranthus cruentus*) plant segments

Plant	Plant segment	<u>Carotenoid content (mg/100 g)</u>			
		$\beta$ -Carotene	Lutein	Lycopene	Canthaxanthin / Zeaxanthin
<i>Amaranthus</i> spp	Leaves	28.5 $\pm$ 1.0	20.2 $\pm$ 1.2	ND	47.8 $\pm$ 1.4
	Seeds	4.2 $\pm$ 0.1	4.2 $\pm$ 0.1	ND	10.5 $\pm$ 0.6
	Stems	1.8 $\pm$ 0.1	2.0 $\pm$ 0	ND	4.1 $\pm$ 0.2
	Roots	0.1 $\pm$ 0	0.2 $\pm$ 0	ND	0.3 $\pm$ 0
Tomato	Fruit	3.7 $\pm$ 0.1	0.6 $\pm$ 0	14.6 $\pm$ 0.7	ND

ND- not detected

# Antioxidant and carotenoid content of *Amaranthus* spp



- Analysis of *Amaranthus cruentus* showed that the leaves are potentially a good dietary source of antioxidants and the pro-vitamin A carotenoid ( $\beta$ -carotene)
- Amaranth is also a good source of “carotenoid” and other nutraceuticals, which include:
  - Canthaxanthin which is reported to be an antitumor agent
  - Lutein, which is reported to slow down the development of age-related eye diseases.
  - Antioxidants have also been shown to be beneficial in HIV/AIDS



# Conclusion

- For South Africa to make a mark in the field of nutraceuticals, advances need to be made in terms of **preserving** our indigenous knowledge and ensure that it is used for the **benefit of peoples of South Africa**, not only to address health problems and malnutrition, but also to **create employment** through establishment of industries

# The Team at CSIR

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**Thank You**