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)

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 Alkaloid Structure](http://www.phytochemicals.info/phytochemicals/)

- Stimulant

**Phytosterol**

![Beta-sitosterol Phytosterol Structure](http://www.phytochemicals.info/phytochemicals/)

- 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)

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

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*


South Africa’s success stories

- 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://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
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

<table>
<thead>
<tr>
<th>Plant segment</th>
<th>β-Carotene (mg/100 g)</th>
<th>Lutein (mg/100 g)</th>
<th>Lycopene (mg/100 g)</th>
<th>Canthaxanthin / Zeaxanthin (mg/100 g)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Amaranthus</em> spp</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaves</td>
<td>28.5±1.0</td>
<td>20.2±1.2</td>
<td>ND</td>
<td>47.8±1.4</td>
</tr>
<tr>
<td>Seeds</td>
<td>4.2±0.1</td>
<td>4.2±0.1</td>
<td>ND</td>
<td>10.5±0.6</td>
</tr>
<tr>
<td>Stems</td>
<td>1.8±0.1</td>
<td>2.0±0</td>
<td>ND</td>
<td>4.1±0.2</td>
</tr>
<tr>
<td>Roots</td>
<td>0.1±0</td>
<td>0.2±0</td>
<td>ND</td>
<td>0.3±0</td>
</tr>
<tr>
<td>Tomato</td>
<td>Fruit</td>
<td>3.7±0.1</td>
<td>0.6±0</td>
<td>14.6±0.7</td>
</tr>
</tbody>
</table>

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 (β-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