CSIR Biosciences:
Natural Products and Agroprocessing

South Africa’s indigenous biodiversity and knowledge as sources of new natural ingredients for food, nutrition and wellness

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Presentation Outline

- Brief overview of CSIR
- CSIR Research Impact Areas
- Natural Products and Agroprocessing Platform Strategy
- South Africa's plant biodiversity
- Tapping into South Africa's plant biodiversity
- Research and Innovation Process: Value addition
- Value addition towards marketable products
- Research on Food, Nutrition and Wellness
- Research findings
- Regulations on utilising South Africa's biodiversity

The CSIR at a glance

- The Council for Scientific and Industrial Research (CSIR) is a science council, classified as a national government business enterprise
- CSIR is a mandate driven organisation
- CSIR Biosciences is an Operating Unit contributes to a sustainable South African bioeconomy through development of health, agricultural and industrial biotechnology-based technology solutions

69 years in 2014

2411 total staff

1 691 total in SET base

310 doctoral qualifications

~R2.15 bn total operating income

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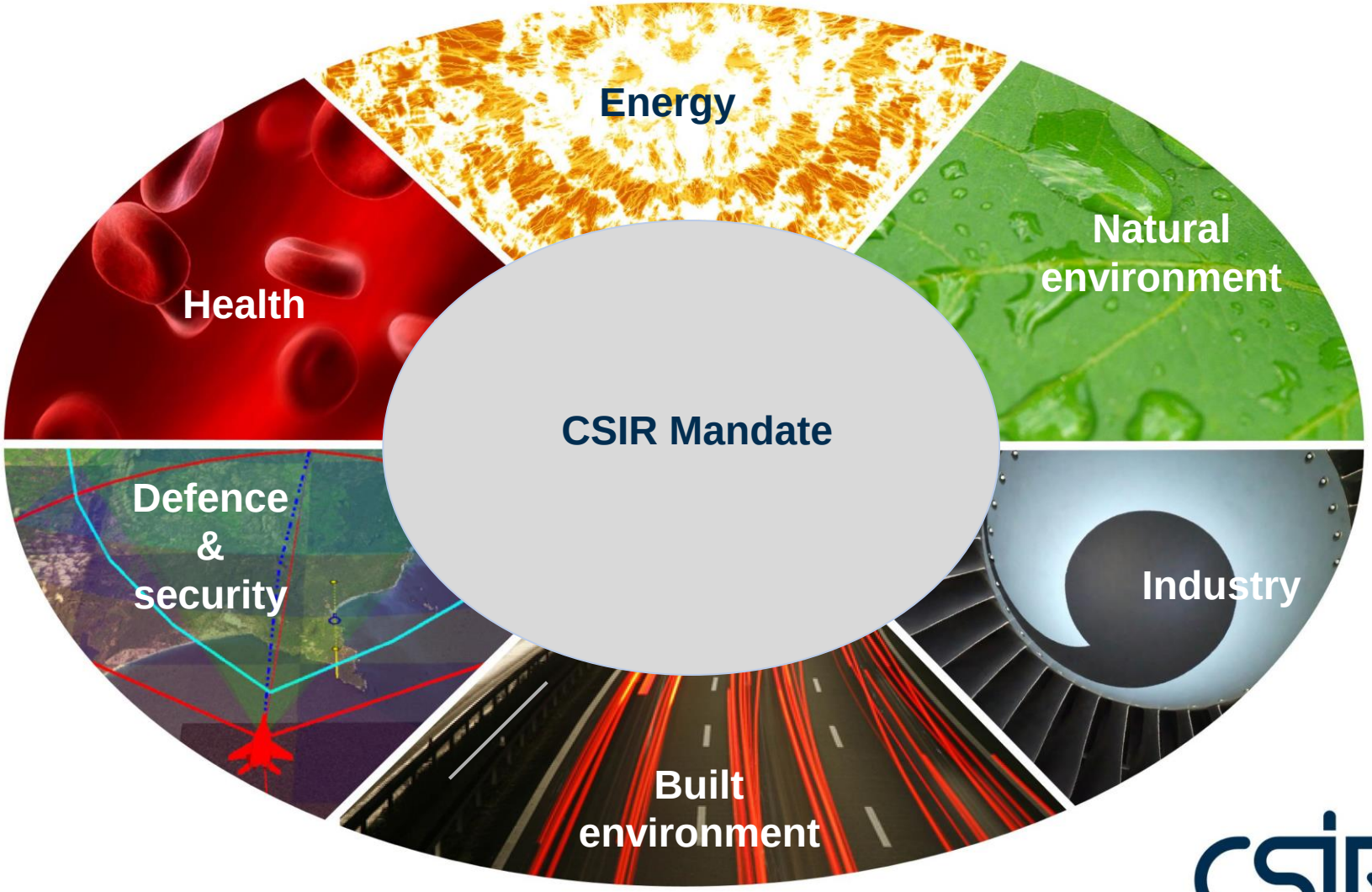
CSIR research impact areas



Natural Products and Agroprocessing Platform

Aim: Beneficiate South Africa's natural biodiversity derived from plants and indigenous knowledge to grow the economy by developing novel foods, additives, herbal and cosmetic ingredients for industrial uptake

Competitive Positioning

- The Platform has access to over 30 000 plant extracts

Establish the library of compounds

- Provide companies with pure natural compounds to screen for efficacy
- Compound structures identified
- Screen for new products

Development of new natural ingredients ready for commercialisation

- Licensed to industry

Human Capacity development

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South Africa's Plant biodiversity

- 24 000 indigenous plant species
- High endemism, 10% world's plants
- Unique Biomes
- Mainly unexplored e.g. source of natural medicines, nutraceuticals and food ingredients
- Many more plants are used as food

Marula (*Sclerocarya birrea*) fruits

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Tapping into South Africa's indigenous plants biodiversity for food, nutrition and wellness ingredients

- South African biodiversity can be used to help reduce malnutrition
  - **Vitamin A deficiency (VAD) is a serious health problem in South Africa**
- Source of new food ingredients that have health benefits
- Multidisciplinary collaborations
  - Department of Science and Technology: **Indigenous knowledge systems**
  - Agricultural Research Council (ARC): **Develop cultivation methods**
  - CSIR – **develops value chain to commercialisation**
  - Universities: human capacity development
  - Communities

The Research and Innovation process

Biodiversity

Scientific innovation

Indigenous Knowledge

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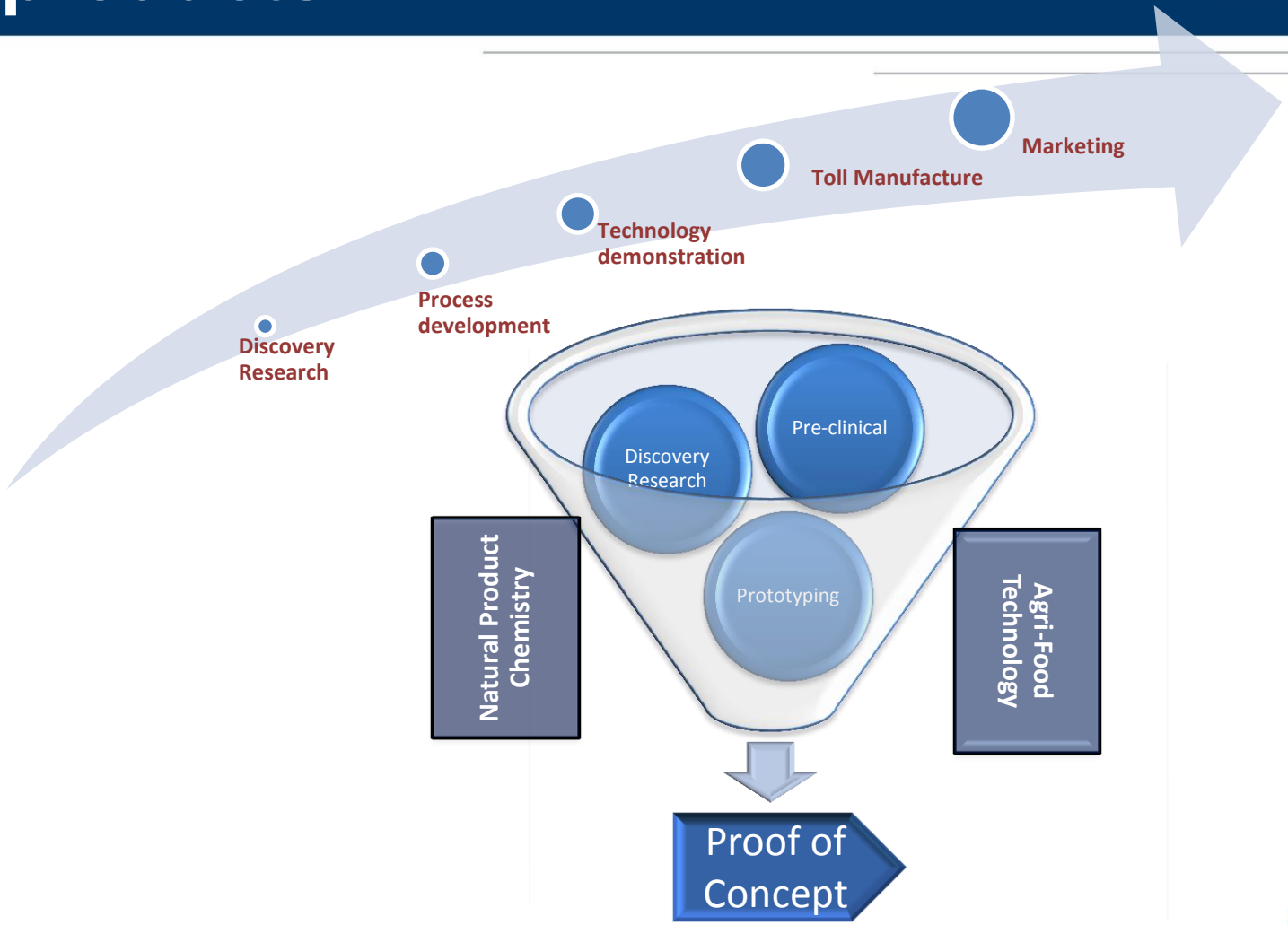
Value addition towards marketable products



Process Design → Process Optimization → Product Development and Efficacy → Techno-Economic Assessment → Technology Packaging → Market

History of Food research at CSIR based on Biodiversity

FOOD FROM THE VELD

Edible wild plants of southern Africa botanically identified and described by

FRANCIS WILLIAM FOX

and MARION EMMA NORWOOD YOUNG

In collaboration with

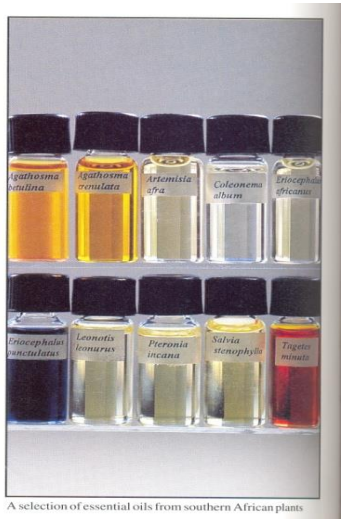
DESMOND HALLOWES

RENA SEGAL

RUTH WUSTROW

With botanical descriptions by

GERRIT GERMISHUIZEN



A selection of essential oils from southern African plants

- **1963-1971**
- National Food Research Institute (NFRI) of CSIR launched a project to investigate foods from the “veld”
- Nutritional value and long term toxicity studies was the focus of study
- Prepared several hundreds of extracts of the plants
- *In vivo* toxicity studies, nutritional analysis
- Several publications/books
- Archival system for data

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Research in Food, Nutrition and Wellness: Indigenous leafy vegetables

- African leafy vegetables have long been known in South African rural communities as essential foods that are consumed with carbohydrate staples
  - **Vitamin A deficiency (VAD) is a serious health problem in South Africa**
- These leafy vegetables have high nutritional value that could play an important role in the prevention of malnutrition
- Unlike other vegetables and legumes, some of these indigenous food plants have never been produced at a commercial scale

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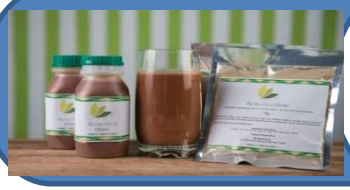
Research Approaches

ID ind. Plants used as foods in communities

Collection and identification

Journals, books

Research and Development



Product Development

Processing

Farmers and communities

Supply of raw material

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Food and Nutracetical Ingredient Product Development Approaches

Fresh produce markets, supermarket

Popularisation vegetable

Food processing companies eg Nestle

Nutraceutical and functional food

Food ingredients, Food supplements

Replace with food

Pharmaceutical companies, speciality food processing

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Nutrient content of indigenous leafy vegetables

- The leafy vegetables have been analysed for their nutrient and phytochemical content, and compared with other vegetables.

Nutrient component (g/100g) (%)	***A. Cruentus* (Amaranthus)**	***A. Cruentus* (Amaranthus)**	***V. Unguiculata* (Cowpea)**	***C. Gynandra* (Cleome)**
Energy (KJ/100g)	860	690	1 160	1 250
Protein (Nx6.25)	20.3	31.6	32.4	42.0
Total fat	1.8	3.4	2.8	3.0
Ash	16.2	18.6	10.2	13.2
Total dietary fibre Φ	24.0	43.4	15.5	7.3
Carbohydrates	28	3.1	32	26

Proximate composition, expressed on dry basis
*One serving is approximately 30 g, dry basis

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Phytochemicals in Leafy vegetables

Leafy vegetable	**Carotenoids** (mg/100 g, dry basis)		**Flavonoids** (mg/100 g, dry basis)	**ABTS Antioxidant activity** (µmol Trolox equivalent/ g
	Beta carotene	**Lutein**	**Rutin**	
C. gynandra	35	51	1 028	743
A. cruentus	23.5	42	768	250
V. unguiculata	27	45	18.6	738

- Carotenoids are important as vitamin A precursors
- Carotenoids also have health promoting effects as nutraceuticals – antioxidants quench free radicals, prevent cancer, **lutein** promotes eye health
- Flavonoids have been shown to have anti-inflammatory properties

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From Plant Material to Ingredient

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Application examples of some indigenous leafy vegetables like Cleome and Cow pea leaves in food products

Nagoya Protocol on Access and Benefit Sharing

Promotion of fair and equitable sharing of benefits arising from the utilisation of biodiversity and associated indigenous knowledge, led to the adoption of the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the CBD in Nagoya, Japan in 2010

Primary objectives:

- Fair and equitable sharing of the benefits arising from the utilisation of genetic resources and indigenous knowledge
- Appropriate access to genetic resources
- Transfer of technologies from genetic resources and associated indigenous knowledge to advance fair and equitable benefit sharing
- Protection of indigenous knowledge and the rights of the holders of indigenous knowledge

SA ratified to the Protocol on 10 January 2013

(Nagoya Protocol on Access and Benefit Sharing, 2010, www.cbd.int)

National Environmental Management: Biodiversity Act of 2004

- This is a Legislation requiring prior informed consent and benefit sharing agreements with, indigenous communities which contribute to research and agroprocessing
- Compliance with the legislation is by submitting a notification and bioprospecting permit application with the intension to do basic research and commercialise.
- Applications may only be submitted by South African research institutions or companies or by foreign entities jointly with South African persons or companies

The Act was amended in 2010 to make a distinction between: **bioprospecting discovery phase (basic research)** and **commercial phase**
Recognition of the practitioners as owners of indigenous knowledge

Bioprospecting, Access and Benefit Sharing Regulations of 2008

Basic research:

- Exploratory phase and ultimate findings of the scientific research are often unknown
- Prior informed consent
- Submitting the notification form to the Department of Environmental Affairs

Researchers are required by the Biodiversity Act to notify the Minister of Environmental Affairs about the research

Commercialisation phase:

- Filing of intellectual property (IP) / patent application
- Obtaining or transfer of IP and other rights
- Commencement of clinical trials and product development, including market research, multiplication of genetic resources through cultivation, propagation, or cloning to develop and produce medicines, industrial enzymes, food and cosmetic ingredients

Researchers are required to apply for bioprospecting permit

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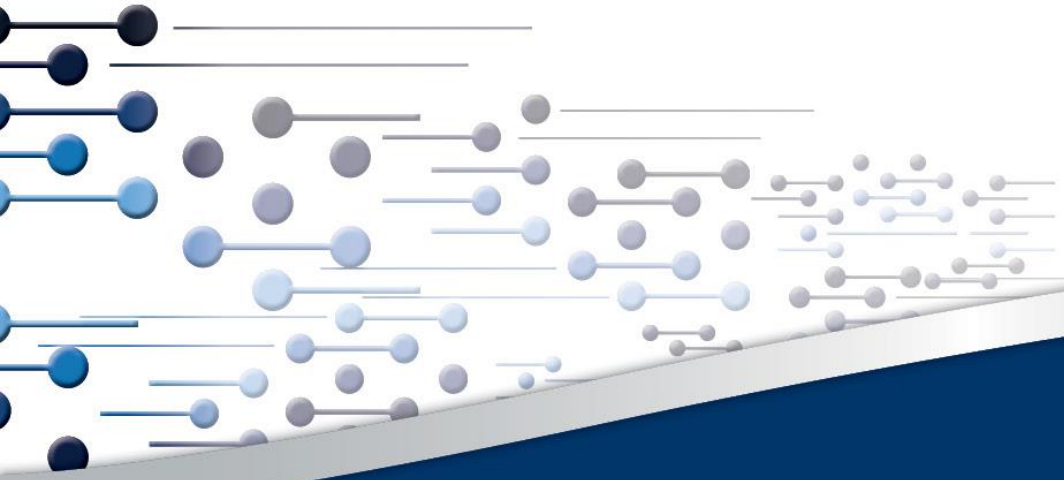
What we have achieved

- Historic research on food plants of SA and interaction with industry and communities
- Food product development from indigenous biodiversity
  - Mopani worm products
  - Sugar replacer (Monatin)
  - Meal replacers
  - Instant grain products (quick cooking products)
  - Health Drink to alleviate malnutrition
  - Chip Dips
  - Beverages (malt, non alcoholic)
- Equipment development and technology improvements for industry
  - microwave technologies for improved food safety –egg pasturiser
  - protein based edible coating for extending shelf life of fruits
- Contributed to SABS regulation standards for food products

Thank you



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