



Potential of traditionally used medicine as functional foods and nutraceuticals: Challenges and Opportunities

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GLOBAL HEALTH & WELLNESS MARKET



GLOBAL WELLNESS
INSTITUTE™
EMPOWERING WELLNESS WORLDWIDE

GLOBAL WELLNESS ECONOMY

Greater than \$3.4 trillion



Note: Numbers may not add up due to overlap

January 2016

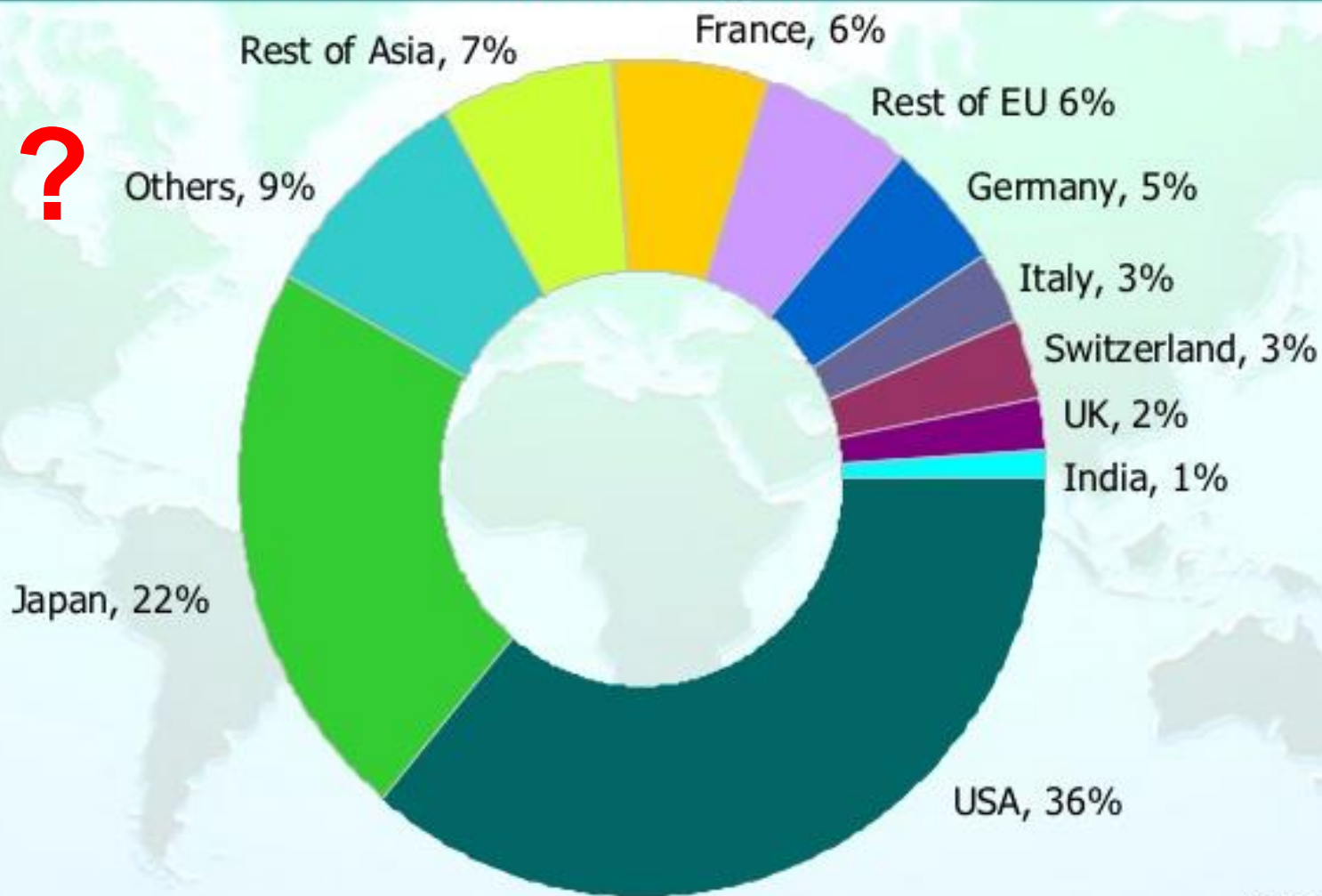
GLOBAL FUNCTIONAL FOODS MARKET ANALYSIS & TRENDS - INDUSTRY FORECAST TO 2025

The Global Functional Foods Market is poised to grow over the next decade to reach approximately **\$3.4 billion** by 2025.

Maths: Global Nutraceuticals Industry

Globally the market is growing at 7 – 22%

Global market to be more than USD 170 billion by 2013



Source: Frost & Sullivan.

OPPORTUNITIES AND CHALLENGES

**Opportunities
and drivers**

Challenges

Natural
Resources

Prevalence
of NCDs

Product
Development

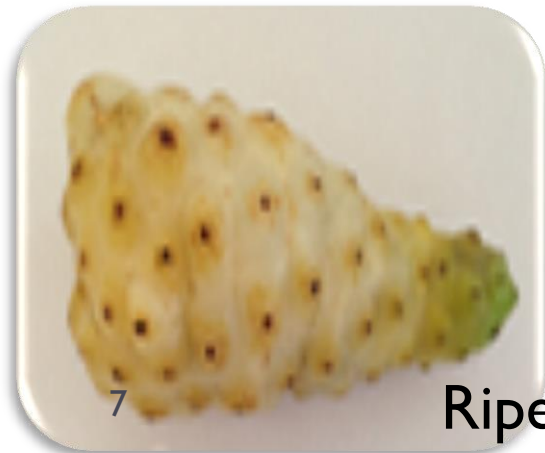
Regulations

Market
Competition

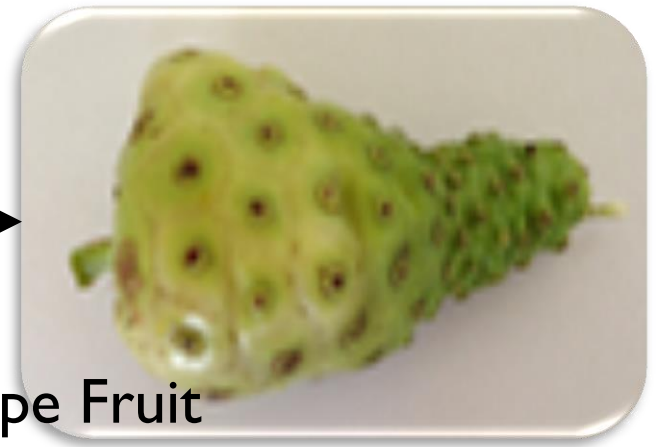
OPPORTUNITIES AND DRIVERS FOR FUNCTIONAL FOOD & NUTRACEUTICAL DEVELOPMENT

- ▶ **Existing natural resources and natural product research in the region**
- ▶ Population demographics and increased incidences of non-communicable diseases

Morinda citrifolia L. fruit extracts modulates H₂O₂- induced oxidative stress in human liposarcoma SW872 cells



Ripe Fruit



Unripe Fruit



Contents lists available at [ScienceDirect](#)

Journal of Traditional and Complementary Medicine

journal homepage: <http://www.elsevier.com/locate/jtcme>



Original article

Morinda citrifolia L. fruit extracts modulates H₂O₂-induced oxidative stress in human liposarcoma SW872 cells

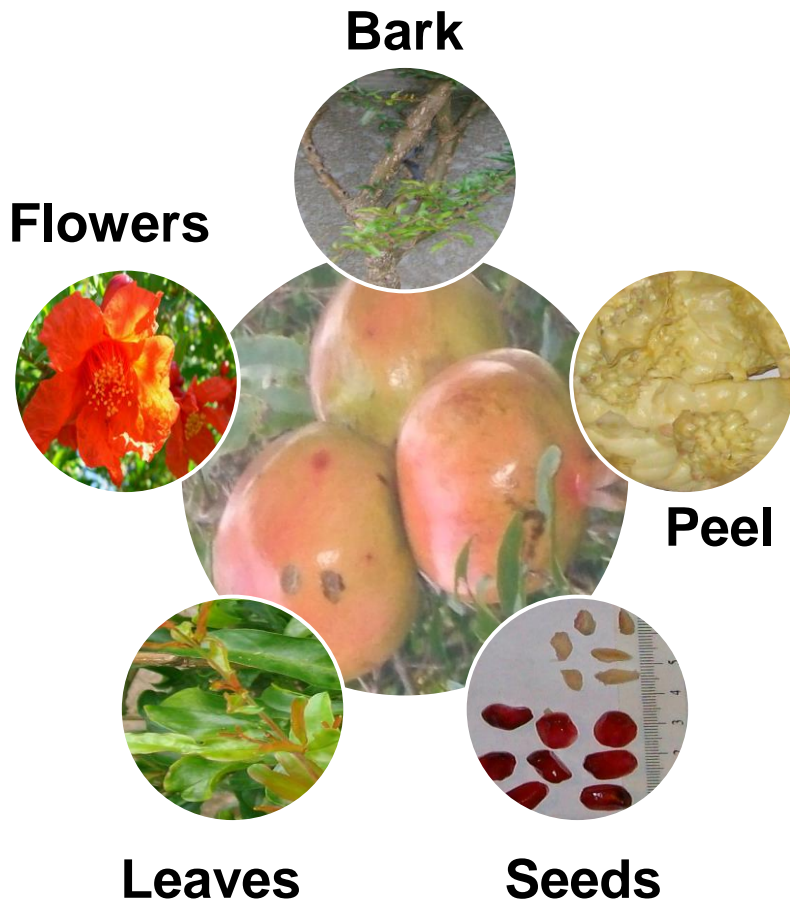
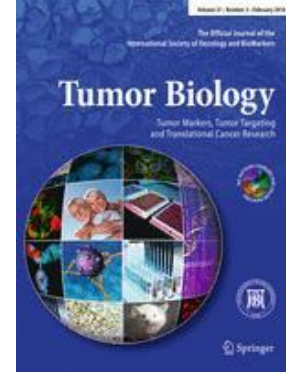
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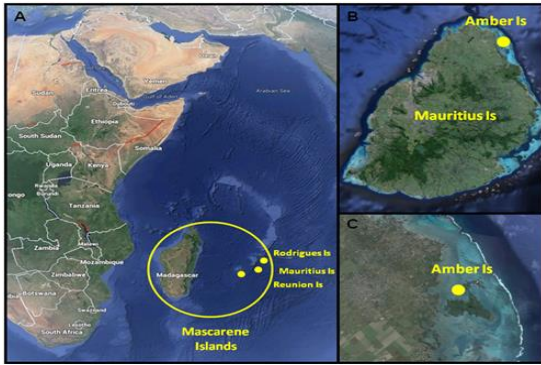
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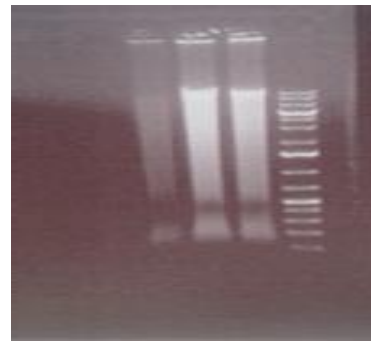
Apoptotic effects of non-edible parts of *Punica granatum* on human multiple myeloma cells



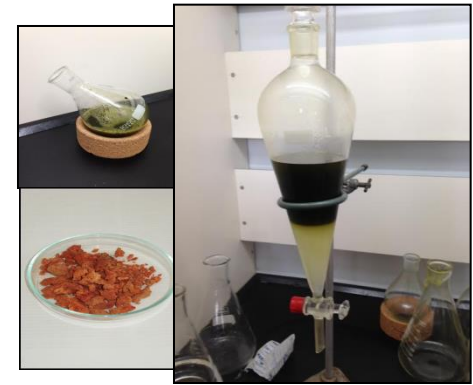
- Antiproliferative and apoptotic effects on U266 multiple myeloma cells
- Loss of mitochondrial membrane potential when exposed to the leaves and stem extracts
- Increasing cell cycle arrest



Collection of marine samples from Amber Island, Mauritius



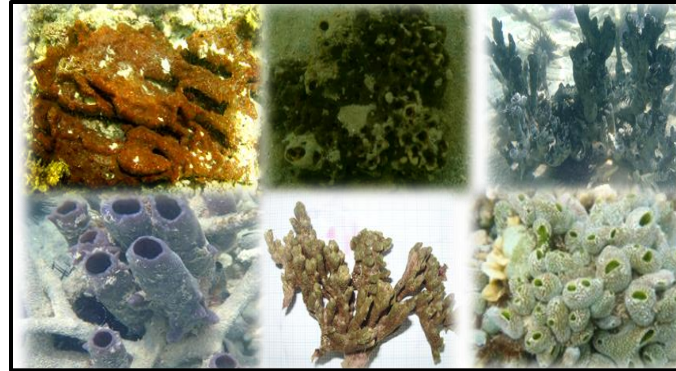
Genetic characterisation of marine species



Extraction & fractionation of crude extracts



A battery of antioxidant screening



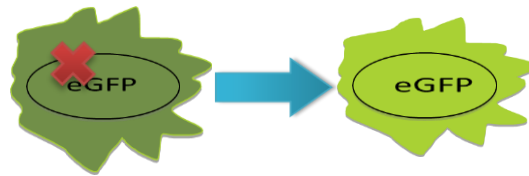
Marine sponges (*Neopetrosia exigua*, *Aptos chromis*, *Iotrochota birotulata*, *Haliclona tuberosa*, *Halichondria sp.*), Tunicate (*Didemnum molle*)



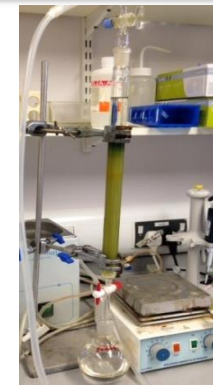
Antibacterial activity & Antibiotic Potentiating activity against a 9 of ATCC bacterial strains



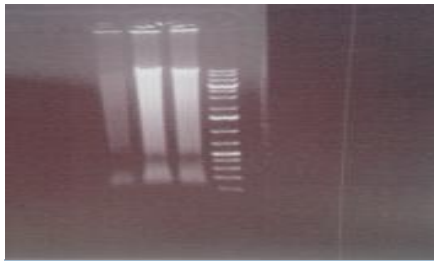
Cytotoxic screening against a panel of human cancer cell lines



Ability of extracts to activate tumor suppressor genes assessed using Highthroughput methods in a Hela GFP cancer cell model



Bioassay guided fractionation and characterization of active chemical constituents



Genetic characterisation of the sponge *Neopetrosia exigua* is currently under investigation

Genetic identification of *N. exigua*

The sponge *Neopetrosia exigua* ethyl acetate fraction was recorded as the most potent bioactive extract and was thus for further investigations at the molecular and



Ethyl acetate fraction

Highest antioxidant activity
ABTS radicals ($91.46 \pm 1.08 \mu\text{Mol TE/g FDW}$)
NO radicals ($\text{IC}_{50}: 0.44 \pm 0.06 \text{ mg/ml}$)
OH radicals ($\text{IC}_{50}: 0.56 \pm 0.05 \text{ mg/ml}$)
Fe³⁺ reducing ($45.69 \pm 1.15 \mu\text{Mol Fe (II)/FDW}$)
Fe²⁺ chelators ($\text{IC}_{50}: 0.14 \pm 0.01 \text{ mg/ml}$)

Antioxidant activity

Ethyl acetate fraction

Lowest MIC and MBC values of 0.039 mg/ml and 0.078 mg/ml against *Staphylococcus aureus* and *Bacillus cereus*

Synergistic effect with the antibiotic ampicillin against *S. aureus*

Antibacterial & Antibiotic potentiating activity

Total crude extract

The total crude extract recorded the highest tumor reactivation potential with GFP expression level of $82.4 \pm 9.32\%$ comparable to the epigenetic drug Trichostatin A ($85.87 \pm 11.87\%$)

Epigenetic activity

Hexane & Ethyl acetate fraction

Oesophageal cancer
FLO-1 ($\text{IC}_{50} < 10 \mu\text{g/ml}$)
OE 19 ($\text{IC}_{50} < 10 \mu\text{g/ml}$)
KYSE ($\text{IC}_{50} < 10 \mu\text{g/ml}$)

Human Colorectal cancer
HCT 116 ($\text{IC}_{50} < 10 \mu\text{g/ml}$)

Human cervical cancer
Hela ($\text{IC}_{50} < 10 \mu\text{g/ml}$)

Cytotoxic activity

Cytotoxic activity using of antioxidant rich selected marine organisms : seaweeds, sea urchins, marine molluscs, mangrove propagules and seagrass

R. mucronata
propagules



U.Prolifera



B. gymnorhiza
propagules



T.ornata



P.tripinnata



Diadema sp.



H.musciformis



T.Ciliatum



H.discoidea



opistobranch



T.gratilla



Cytotoxicity on HST 578T	mg/ml
<i>R. mucronata</i>	<0.5
<i>B. gymnorhiza</i>	<0.5
<i>T. ciliatum</i>	<0.5
<i>H. musciformis</i>	<0.5
<i>T. ornata</i>	<0.5
<i>Opistobranch sp.</i>	<1.5
<i>H. discoidea</i>	<1.5
<i>T.gratilla</i>	<2.5
<i>Diadema sp.</i>	<5
<i>U. prolifera</i>	<6

Cytotoxicity on SW 872	mg/ml
<i>B. gymnorhiza</i>	<0.5
<i>R. mucronata</i>	<0.5
<i>P. trippinata</i>	<0.5
<i>H. musciformis</i>	<1
<i>H. discoidea</i>	<1
<i>T. ornata</i>	<1
<i>Diadema sp.</i>	<1.5
<i>Tripineustes sp.</i>	<1.5
<i>U. prolifera</i>	<1.5
<i>T. ciliatum</i>	<4

OPPORTUNITIES AND DRIVERS FOR FUNCTIONAL FOOD & NUTRACEUTICAL DEVELOPMENT IN THE INDIAN OCEAN STATES

- ▶ Existing natural resources and natural product research in the region
- ▶ **Population demographics and increased incidences of non-communicable diseases**
 - Consumer awareness of food-health relationships

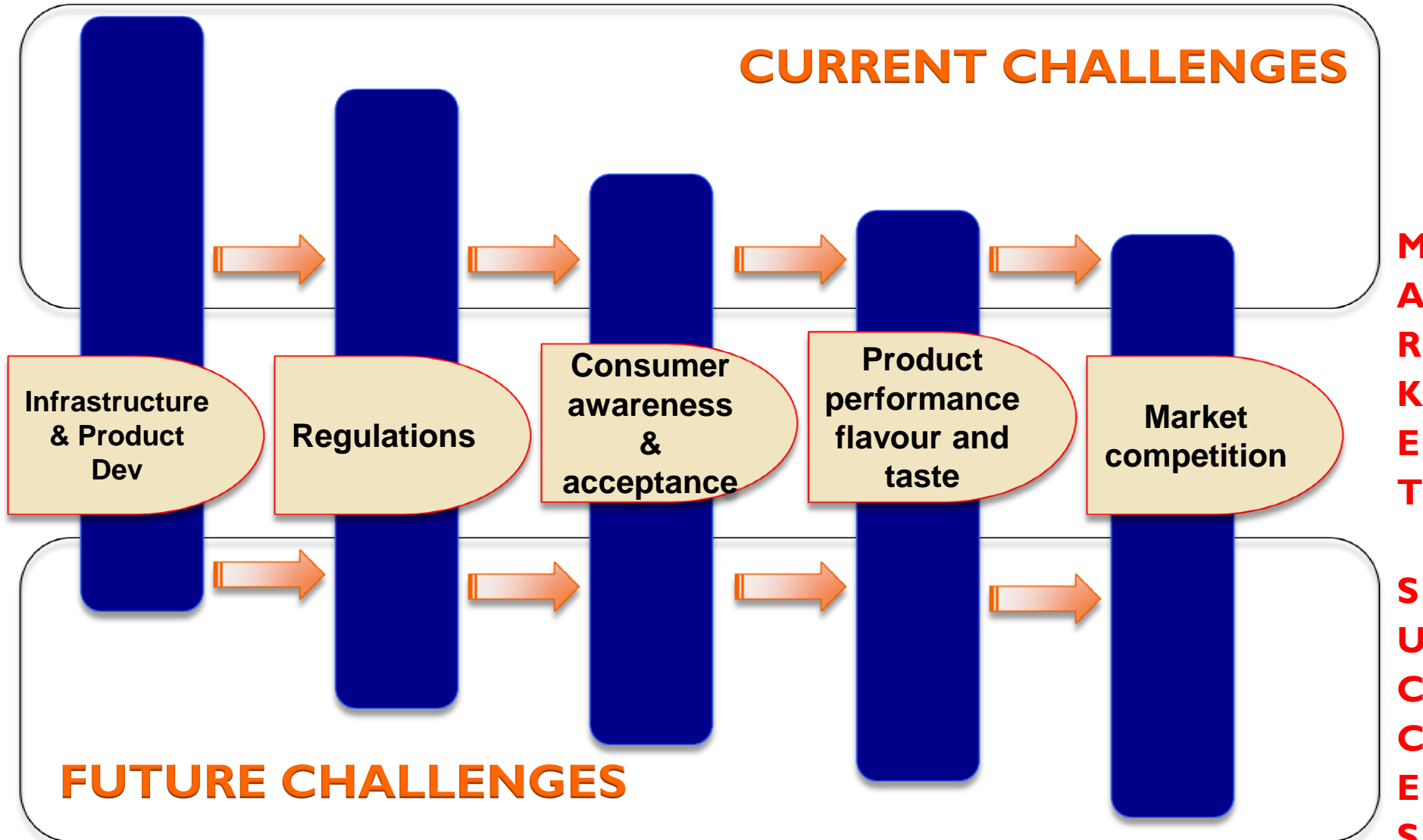
PRODUCT DEVELOPMENT CHALLENGES

- ▶ Infrastructure
- ▶ Research and Development
 - Multidisciplinarity
 - Regional collaboration

CHALLENGES – REGULATIONS

- ▶ Regulatory
- ▶ Labelling

THE WAY FORWARD



Food for thought

- ▶ What are the key factors driving the functional food and nutraceutical food market in the Indian Ocean?
- ▶ Any market size and the growth rate in 2025?
- ▶ What are the key market trends impacting the growth of the global functional food and nutraceutical food market amongst Indian Ocean States?
- ▶ What are the challenges to market growth for functional food and nutraceutical food in this region?
- ▶ Who are the key stakeholders in functional food and nutraceutical market in the region?
- ▶ What are the market opportunities and threats for island states?

THANK YOU

for your attention

