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

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GLOBAL HEALTH & WELLNESS MARKET

GLOBAL WELLNESS ECONOMY

Greater than $3.4 trillion

- Beauty & Anti-Aging $1,026 billion
- Wellness Tourism $494 billion
- Spa Industry $94 billion
- Fitness & Mind-Body $446 billion
- Complementary & Alternative Medicine $187 billion
- Healthy Eating, Nutrition & Weight Loss $574 billion
- Preventive & Personalized Medicine $433 billion
- Workplace Wellness $41 billion
- Wellness Lifestyle Real Estate $100 billion

Note: Numbers may not add up due to overlap

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The Global Functional Foods Market is poised to grow over the next decade to reach approximately $3.4 billion by 2025.
Globally the market is growing at 7 – 22%.
Global market to be more than USD 170 billion by 2013.

- USA, 36%
- Japan, 22%
- France, 6%
- Rest of Asia, 7%
- Rest of EU 6%
- Germany, 5%
- Italy, 3%
- Switzerland, 3%
- UK, 2%
- India, 1%
- Others, 9%
OPPORTUNITIES AND CHALLENGES

Opportunities and drivers

- Natural Resources
- Prevalence of NCDs

Challenges

- 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 H$_2$O$_2$-induced oxidative stress in human liposarcoma SW872 cells
Original article

*Morinda citrifolia* L. fruit extracts modulates H$_2$O$_2$-induced oxidative stress in human liposarcoma SW872 cells

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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

*Tumour Biology, 2016, 37(2), 1803-1815*
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, Aaptos 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
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 chemical level.

**Antioxidant activity**
- 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: \(\text{IC}_{50} : 0.56 \pm 0.05 \text{mg/ml}\)
  - \(\text{Fe}^{3+}\) reducing: \(45.69 \pm 1.15 \mu\text{Mol Fe (II)g/ FDW}\)
  - \(\text{Fe}^{2+}\) chelators: \(\text{IC}_{50}: 0.14 \pm 0.01 \text{mg/ml}\)

**Cytotoxic activity**
- 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 (\(\text{IC}_{50} <10\mu\text{g/ml}\) )

**Antibacterial & Antibiotic potentiating activity**
- 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*

**Genetic identification of *N. exigua***
- Genetic characterisation of the sponge *Neopetrosia exigua* is currently under investigation

**Genetic characterisation**
- The sponge *Neopetrosia exigua* is currently under investigation

**Ethyl acetate fraction**
- Hexane & Ethyl acetate fraction
- Total crude extract
- Ethyl acetate fraction

**Epigenetic activity**
- 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*

**Ethyl acetate fraction**
- The total crude extract recorded the highest tumor reactivation potential with GFP expression level of 82.4 ± 9.32% comparable to the epigenetic drug Trichostatin A (85.87±11.87%)

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

Cytotoxicity on HST 578T (mg/ml):
- **R. mucronata** propagules: <0.5
- **B. gymnorrhiza** propagules: <0.5
- **P. tripinnata**: <0.5
- **H. musciformis**: <1
- **H. discoidea**: <1
- **T. ornata**: <1
- **Diadema sp.**: <1.5
- **T. gratilla**: <2.5
- **Tripineustes sp.**: <1.5
- **U. prolifera**: <6

Cytotoxicity on SW 872 (mg/ml):
- **B. gymnorrhiza**: <0.5
- **R. mucronata**: <0.5
- **P. tripinnata**: <0.5
- **H. musciformis**: <1
- **H. discoidea**: <1
- **T. ornata**: <1
- **T. gratilla**: <1.5
- **Diadema sp.**: <5
- **Tripineustes sp.**: <1.5
- **U. prolifera**: <6
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

CURRENT CHALLENGES

Infrastructure & Product Dev
Regulations
Consumer awareness & acceptance
Product performance flavour and taste
Market competition

FUTURE CHALLENGES

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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