Phytomedical Research

Phytomedical research in Jamaica, a Caribbean SIDS: from ethnomedicine to botanical products

Dr. Sylvia Mitchell
Medicinal Plant Research Group
The Biotechnology Centre
University of the West Indies
Mona Campus, Jamaica

Summary

- Caribbean hotspot
- Ethnomedicine / Traditional Knowledge
- History
- Research findings
- Capabilities
- Successful botanical products
- Way forward

Caribbean Hot Spot

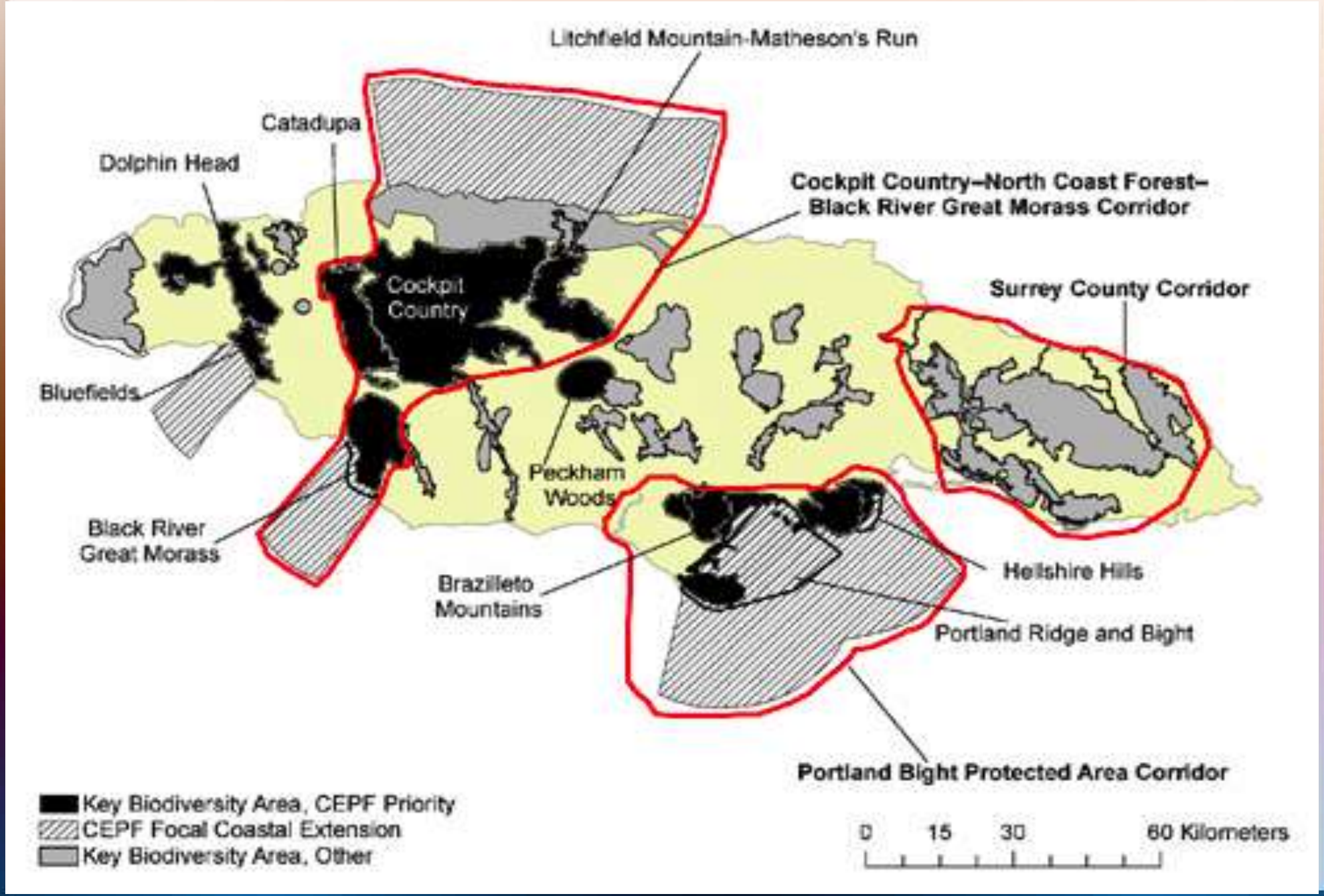
- Caribbean Islands biodiversity hotspot is a complex region composed of 12 independent nations and several British, Dutch, French and U.S. overseas territories. As a result of its geography and climate, it is one of the world's greatest centers of unique biodiversity.

- Exceptional array of ecosystems ranging from montane cloud forests to cactus scrublands, and hosts dozens of highly threatened species.

- High population growth rate, high population densities, tourism, increasing urbanization of the population, monetary inequity and poverty, and increasing cost of imported goods has led to unsustainable demand for land and natural resources to the detriment of the hotspot’s biodiversity and ecosystems.

Caribbean Hot Spot

Jamaica in the Caribbean Hot Spot



How to protect this biodiversity?

- Demarcate area for conservation
- Ex situ conservation
- In vitro conservation (gene bank) - live
- Herbarium, pictures - preserved
- Alternative livelihoods (sustainable, LFMC linked to scientists)

History of Phytomedical Research

Significant years

- 1948 – UWI, started with Chemistry Dept
- 1960 - SRC
- 1989 – Biotechnology Centre, UWI
- 1999 – Medicinal Plant Research Group, UWI
- 1999 – Natural Products Research Lab, UTECH
- 2002 – CHBA, Wellness cluster
- 2004 – beginning of TRAMIL ethnomedicinal surveys; full survey in 2010
- 2006 – WIMJ 1948-2001 review paper

Major findings

REVIEW OF RESEARCH CONDUCTED ON JAMAICA-GROWN MEDICINAL PLANTS

- **1948-2001 REVIEW OF UWI RESEARCH**
- **22 M.Phil. and 31 Ph.D.**

- **Total of 334 locally-grown plants were identified as medicinal**

- **193 of these plants were studied in terms of medicinal properties**
- **23% of endemics exhibited bioactivity vs 11% of non-endemics – crude extracts and natural chemicals**

- **NP (NC) identified in 44 plants, 29 of these NP (NC) were bio-active**

- **Several patents awarded eg monamycin (1959), eryngial (2002), bitterwood extraction method (2007) and products registered (trade secret passed to son) – cannasol & amasol. Other potential patents have been lost.**

JAMAICAN HERBS

- flowers
- fruit
- seeds
- leaves
- stem
- bark
- roots
- rhizomes

- HERBS
- SHRUBS (bush)
- TREES
- VINES

MARKET FOR:
culinary herbs & spices
medicinal plants
Ess oils – aromatherapy, flavours, fragrances

YEAR-ROUND AS THERE ARE MANY PLANTS, MULTI-USEABLE, LESS PLANT WASTAGE, SUITABLE FOR SMALL & LARGE FARMERS

REVIEW OF RESEARCH CONDUCTED ON JAMAICA-GROWN MEDICINAL PLANTS

- Crude extracts from 80 plants were found to be active against human, animal and plant pathogenic pests: bacteria, insects, mites, nematodes, fungi

- Most potent plants tended to exhibit multiple bio-activities: John Charles (*Hyptis verticillata*), Neem (*Azadirachta indica*), Shame-mi-lady (*Mimosa pudica*), Breadfruit (*Artocarpus altilis*), Kidney Bush (*Bontia daphnoides*), Ackee (*Blighia sapida*) and Spirit Weed (*Eryngium foetidum*). There are many other useful medicinal plants.

- Some of our plants are known to be medicinal around the world. These include Ginger (*Zingiber officinale*), Garlic (*Allium sativa*), Aloe (*Aloe vera*), Fever grass (*Cymbopogon citratus*), hot peppers (*Capsicum* spp) and some are endemic eg search-mi-heart.

REVIEW OF RESEARCH CONDUCTED ON JAMAICA-GROWN MEDICINAL PLANTS

MEDICINAL PROPERTIES

- **Fresh cut - isolated coumarin increases wound healing**
- **Soursop - sedative action**
- **Ganja - glaucoma**
- **Papaya - ulcer dressing**
- **Cho-cho - antihypertensive**
- ***Piper* spp. - anticancer**
- **Spirit weed - epilepsy control, anti-inflammatory**
- **Vervine - presor activity**
- **Belly-ache bush - anti leukemic agent**
- **DIABETES - hypo- or hyperglycaemic agents - annatto, pepper, periwinkle, cashew, jew plum, guaco, cerassee, king of the forest, coconut, comfrey, ganja**

REVIEW OF RESEARCH CONDUCTED ON JAMAICA-GROWN MEDICINAL PLANTS

AGRICULTURALLY USEFUL PROPERTIES

- Shame mi Lady, dodder, chicken weed, breadfruit, tamarind, white sorrel , spirit weed - **Nematocidal**
- breadfruit, pepper, kidney bush, dodder, wild yam, tobacco, neem, wild caia, hibiscus, rosemary, Coffee Rose, John Charles, neem, mountain cinnamon, jack in the bush, ackee, goat weed, *Piper* and *Peperomia* spp. - **Insecticidal**
- bitter damson, comfrey, chicken weed, vervine, neem, castor oil, pimento - **Acaricidal**
- Neem, Guinea hen weed, *Piper betle, Peperomia* - **Fungicidal**
- Neem, Guaco, Jamaican broom, *Coccoloba* krugii, black sage, logwood, cerassee, white sage - **Antibacterial**

REVIEW OF RESEARCH CONDUCTED ON JAMAICA-GROWN MEDICINAL PLANTS

Plant ref. no.	Isolated Natural Product	Bioactivity
46. Ganja	Cannabitriol	Glaucoma
48. Wild Caia	Diterpene cleomolide	Insecticidal activity
91. Rosemary	Terpene	Lethal to *Cylas formicus*
98. Belly-ache bush	Jatrophone	Anti-leukemic agent
106. John Charles	Cadina-4,10(15)-dien-3-one	Lethal to *Cylas formicus*
	Flavonol	Antitumor and antimicrobial
123. *A. trisulcatum*	Choline	Improved short-term memory
135. Breadfruit	Pentacyclic triterpene	Lethal to *Cylas formicus*
	Gamma-aminobutyric acid	Hypertensive agent
166. P. amalgo var nigrinodum	**Nigrodine, pipercide, guineesine**	**Antifeedant, anticancer, antifungal**
	3 amides	Lethal to *Aedes argyptii*
	Gamma-butyric acid	Hypertensive agent
225. Vervine	Dopamine	Pressor activity

THIS INFORMATION IS NOW AVAILABLE ON THE INTERNET

A) SPECIES FOUND ONLY IN JAMAICA (ENDEMICS)

These plants are found nowhere else in the world

54 *Acanthosperum camphoratum*
183 *Amyris plumieri* Candlewood
245 *Cassia italica* Jamaica senna
45 *Cinnamodendron corticosum* Mountain cinnamon
174 *Coccoloba krugii*
22 *Cordia brownei* Black sage
274 *Croton wilsoni* Pepper rod
285 *Dryopteris sp.* White stick
187 *Fagara martinicensis* Prickly Yellow
43 *Lobelia accuminata*
262 *Pectis spp.* Stink weed
161 *Peperomia clusifolia*
120 *Phoradendron wattii*
168 *Piper fadyenii*
171 *Piper verrucosum*
99 *Rhytidophyllum tomentosum* Search-mi-heart
144 *Sauvagesia brownie* Iron shrub
201 *Smilax balbisiana* Chainy root
190 *Spathelia glabrescens*
343 *Triumfetta sloanei* Bur weed
72 *Vernonia pluvalis*

197 *Alvaradoa jamaicensis*
314 *Boerhavia scandens* Rat ears
36 *Cassia jamaicensis* Jamaican broom
257 *Conyza karvinskyanus* Rockside daisy
241 *Cordia jamaicensis* Black sage
299 *Dendropemon pauciflorus* Mistletoe
188 *Fagara elephantiasis* Yellow sanders
266 *Ipomea jamaicensis* Wild potato slip
44 *Lobelia viridiflora*
40 *Peltophorum linnaei* Brazilletto
163 *Peperomia proctorii*
312 *Pimenta jamaicensis* Wild pimento
170 *Piper murrayanum*
286 *Polypodium exiguum* Hug-me-tight
264 *Senecio discolor* White-back
104 *Clusia portlandiana*
191 *Spathelia sorbifolia* Mountain Pride
71 *Vernonia acumiata* Bitter bush
74 *Wedelia gracilis* Consumption weed

REGIONAL ETHNOMEDICINE

- The people of the Caribbean have long used herbal medicine as “bush teas”, NOW called “herbal teas”.

- Caribbean Ethnomedicine is not as well developed as Chinese and Indian systems. A reason for this may lay in the fact that many indigenous people were decimated during the period of slavery.

- The current uses of plants in the Caribbean are an amalgamation of African, European and American Indian customs, embellished by experimentation with and adoption of novel local material. Africans managed to bring many of their medicinal plants with them through the middle passage since the 1400s. In French WI there is influence from Southeast Asia, and India influence in Trinidad.

JAMAICAN MEDICINAL PLANTS

In Jamaica plants are being used for health purposes in the three major systems of medicine:

- They are being used traditionally by well-known groups of people such as the Maroons, as well as less defined groups such as country and town folk all across Jamaica;

- Medicinal plants are being used in herbal products, which are being sold locally and internationally eg root tonic;

- Jamaican-grown plants are also being used as a source of natural products from which pharmaceutical products are being developed eg phytophmaceuticals.

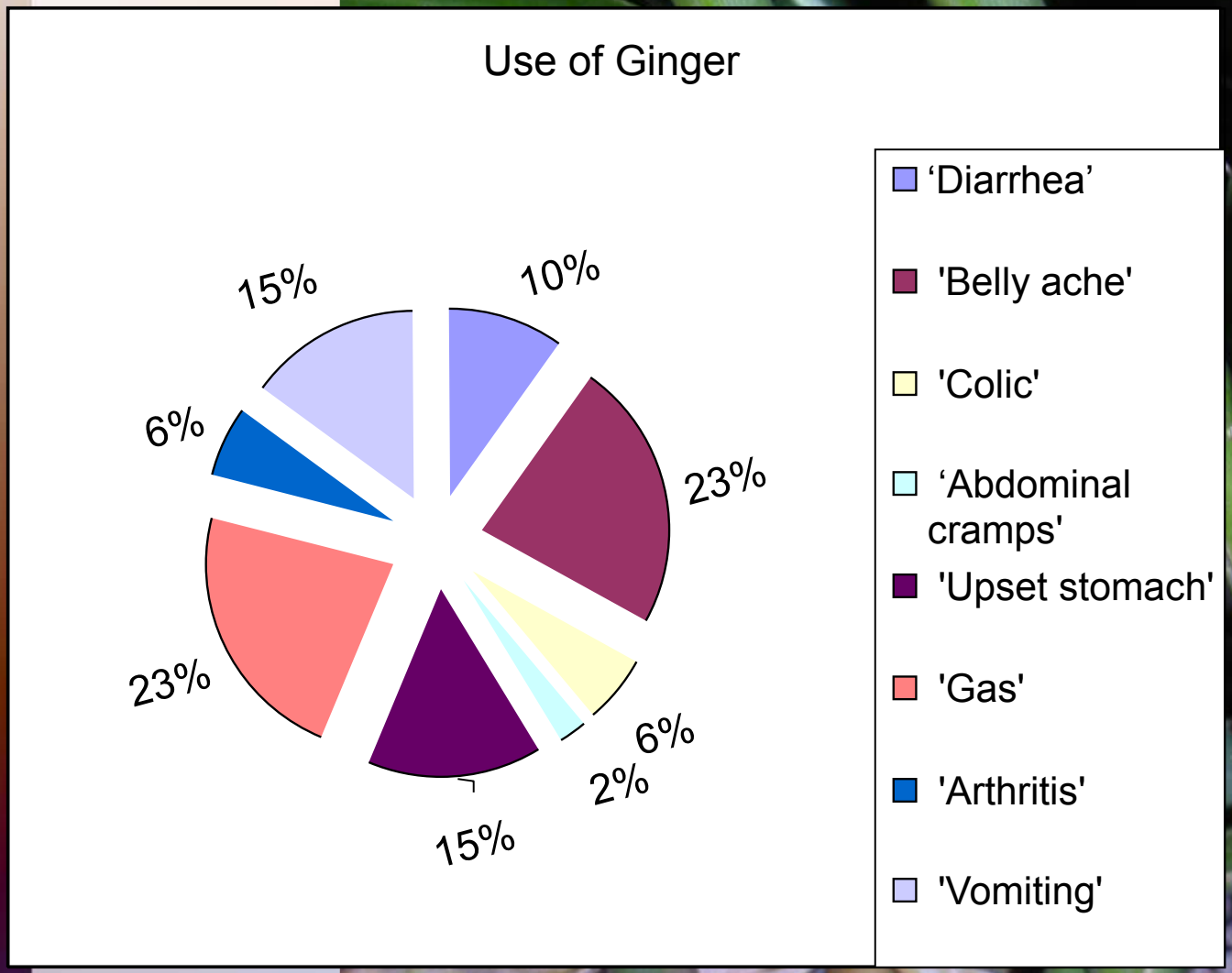
HOW ARE MEDICINAL PLANTS USED IN JAMAICA?

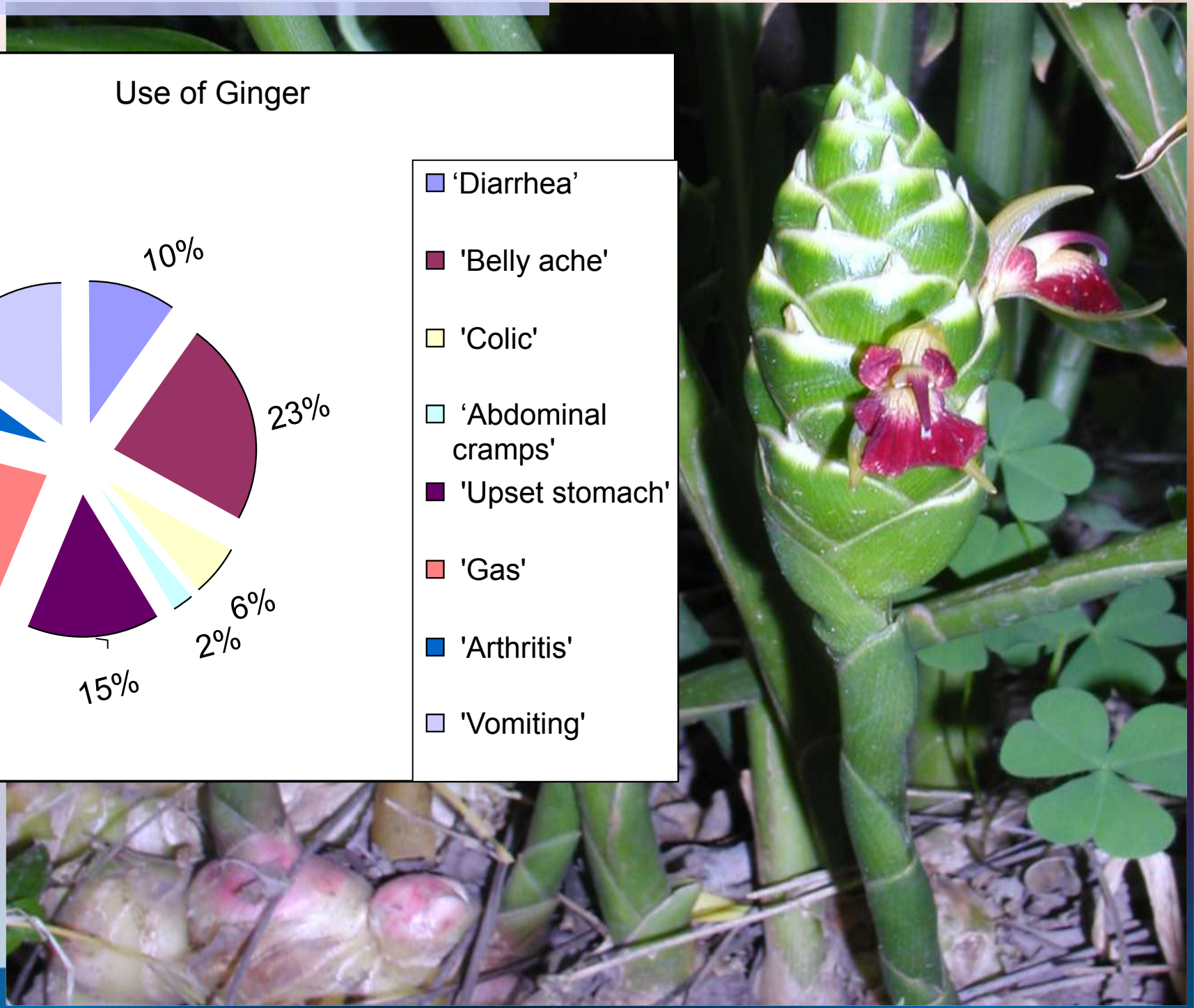
1. 75% of patients at TMRU had used medicinal plants before coming to see the doctor

2. 91% had used herbs for illness (58% given to children <5yrs), 99% for teas or tonics (87% given to children <5yrs)
   - Urban - 58% grown, 20% from market or stores, 18% from rural areas and 4% from friends
   - *Rural – 80% grown, 13% gathered wild, 4% from market, 3% from friends*
   - Total of 72 (urban) and 146 (rural) plants used by adults.
   - *Most popular herbs – cerasee, peppermint, ginger, soursop, cullen mint, sweet orange, sinkle-bible, leaf-of-life, lime, jack-in-the-bush, black-mint (72-20.6% prevalent use) bizzy is 2.2%*

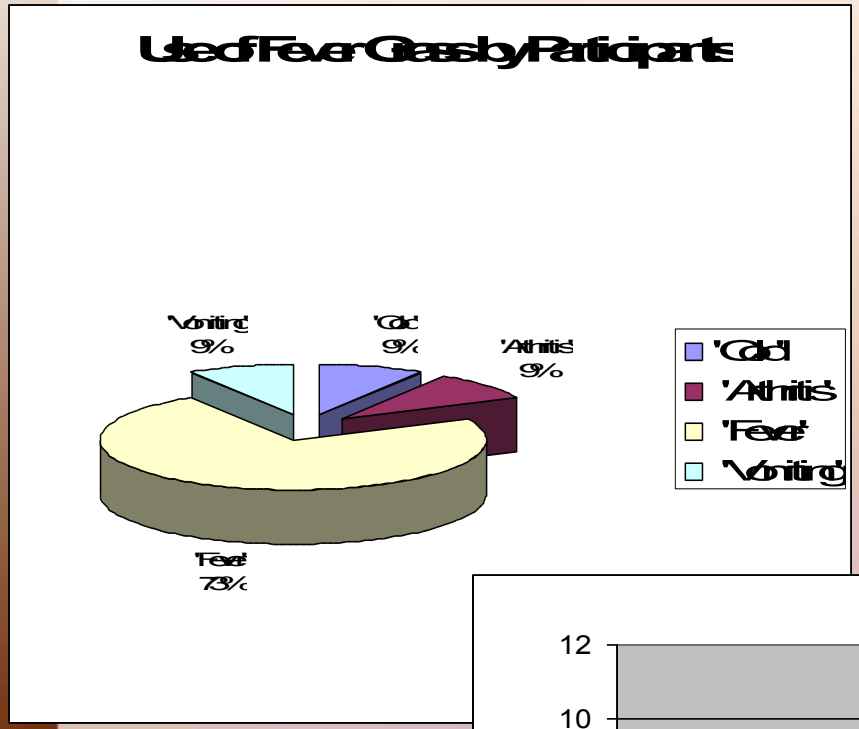
3. Our surveys: 80-100% usage

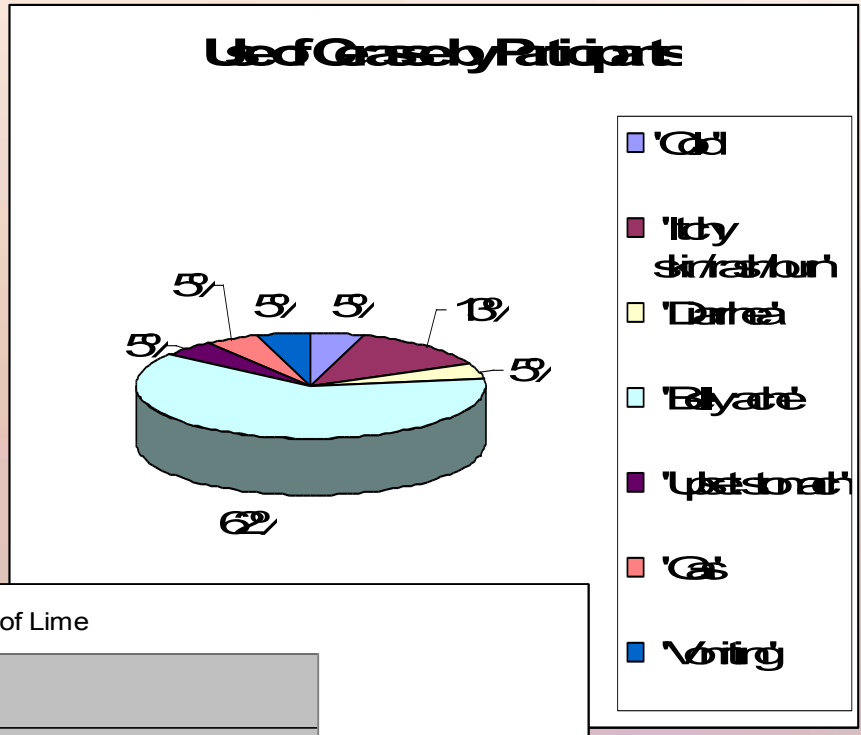
GINGER – Folk use

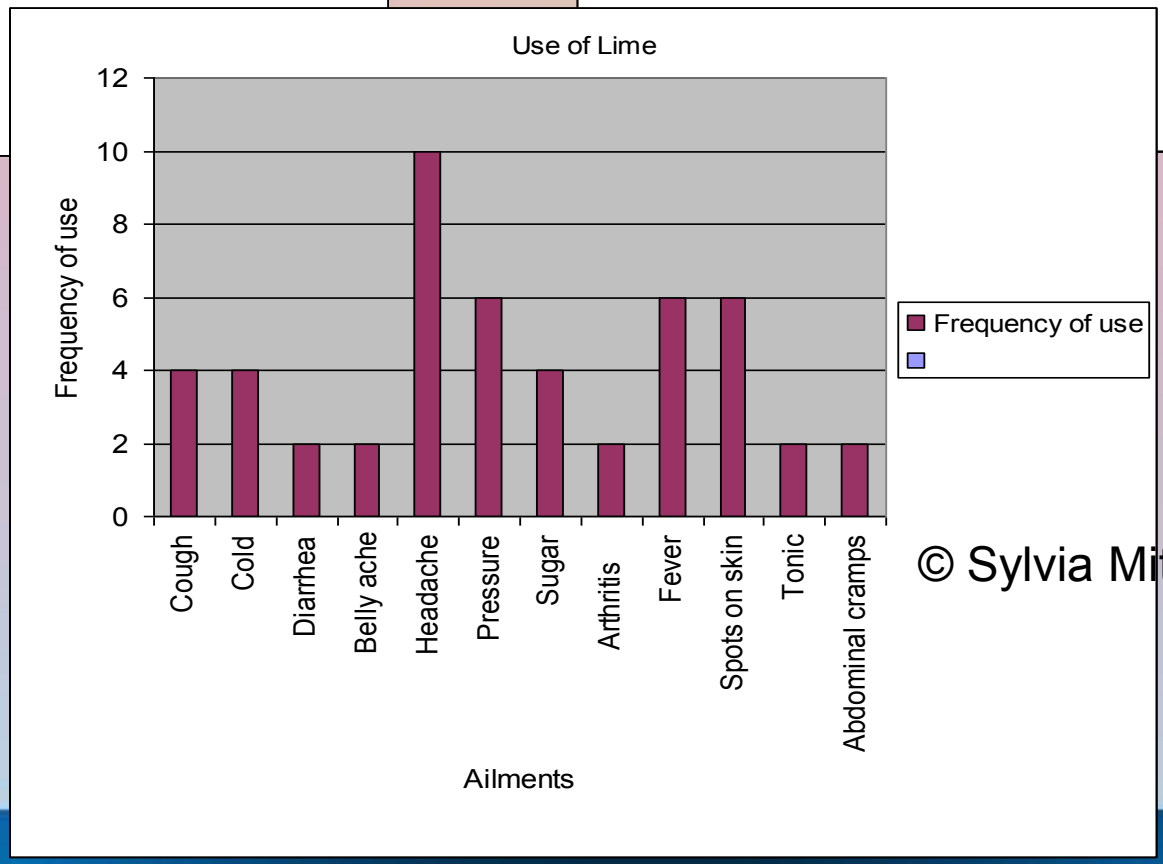


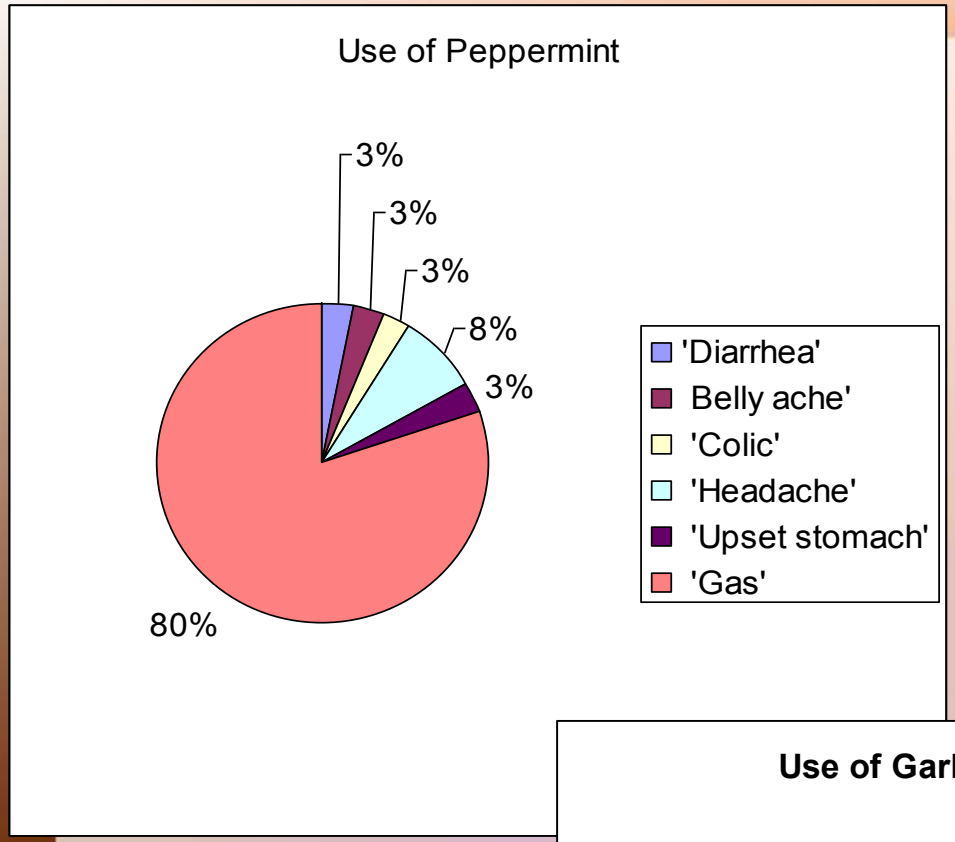


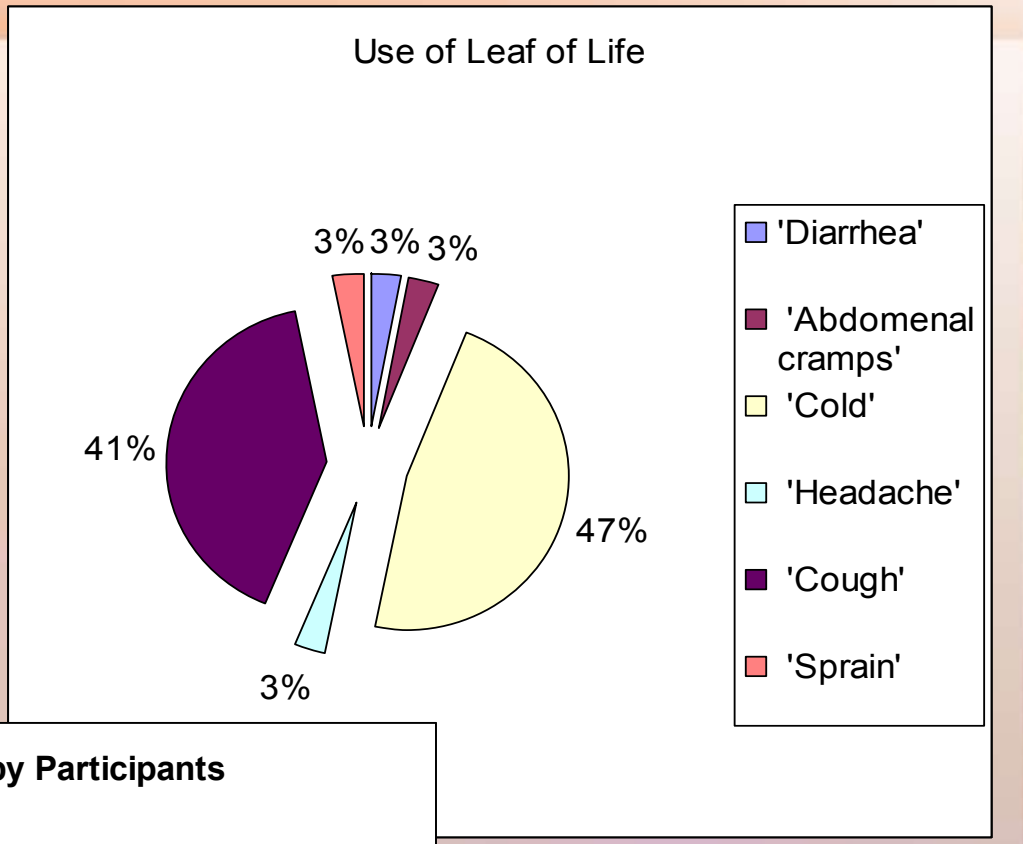
Bermaddy, St. Catherine

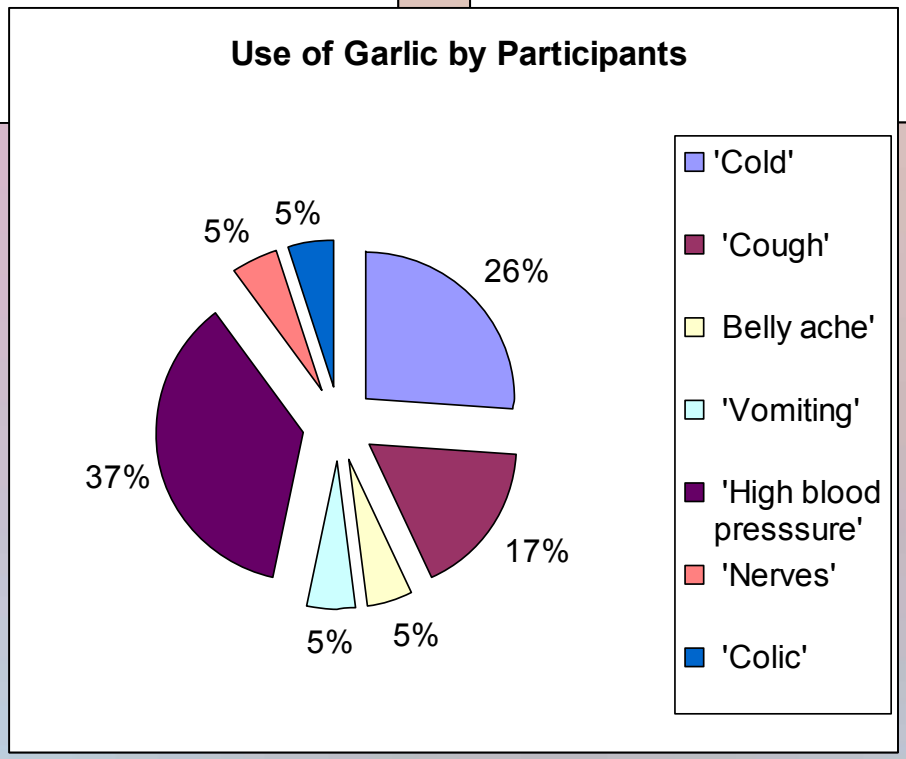












JAMAICAN ETHNOMEDICINE HERITAGE

JAMAICAN ETHNOMEDICINE HERITAGE

JAMAICAN ETHNOMEDICINE HERITAGE

JAMAICAN ETHNOMEDICINE HERITAGE

JAMAICAN ETHNOMEDICINE HERITAGE

JAMAICAN ETHNOMEDICINE HERITAGE

Research and Development

- Identification of phytochemicals: HPLC, GC-MS etc
- Bioactivity: anti-microbial, anti-cancer, effect on P450 enzymes,
- Product development: lotions, creams, essential oil, soaps, shampoo etc.
- Clinical trials – MCT – just starting
- Alternative livelihoods
  - Biotechnology: provision of clean planting material, conservation, genetics
  - Agriculture
  - Post-harvest and agro-processing
  - Marketing and standards

MEDICINAL PLANTS SECTORS IN JAMAICA

1. Dried and Fresh Herbs
2. Herbal Teas
3. Liquid Extracts and Tinctures
4. Exotic Herbal Drinks and Root Tonics
5. Essential Oils
6. Nutraceuticals
7. Cosmeceuticals
8. Plant Derived Pure Pharmaceuticals

THE PRODUCTS

- Whole plants
  - Green herbs (freshly picked) eg john charles, mints, fever grass
  - Dried or powdered – all (>366 plants) – capsules, packaged, exported
  - Spices – fresh eg hot pepper, ginger or dried eg nutmeg, pimento, curry
  - Teas – wide range: eg ginger, sorrel, cerrassee, cinnamon, fever grass

- Simple products
  - tinctures (spirit), syrups, herbal wines, root tonics
  - nutraceuticals & functional foods incl snacks eg candied ginger
  - agricultural products eg neem oil
  - natural dyes eg annatto
  - essential oils & oleoresins eg pimento oil, orange oil (aromatherapy, flavors)
  - bio-preservatives eg vinegar
  - soaps, lotions, creams - cosmeceuticals

- Complex products
  - Phytopharmaceuticals
  - Natural products eg curcumin, capsaicin
  - Plant derived prescription drugs eg cannasol
- Associated businesses – wellness centres, medical tourism etc

GUINEA HEN WEED

- *Petiveria alliacea* (guinea hen weed) is a member of the Phytolaccaceae family. It can be found growing in tropical areas of Central and South America, the Caribbean and Africa.
- It is a perennial weed with strong garlic-like scent when crushed.

- Also used as an insect repellant, nematicide, acaricide and bactericide.
- Extensively used in folklore medicine for treating colds , headaches, fevers and diarrhea.

Several secondary plant metabolites (SPM) have been isolated from various parts of the plant including:

- Dibenzyl disulphide (root)
- Dibenzyl trisulphide (root)
- Bezaldehyde (root)
- Tannins,senfol (leaf)

• Dibenzyl trisulphide (DTS) found to be an anti-proliferative/cytotoxic agent with Mitogen- activated protein kinase (MAPK) signal transduction mode of action (Williams,*et al*, 2003).

•This type of activity is of particular interest as a chemotherapeutic agent for the control of a broad-spectrum of pathological cells (e.g. cancer) with a greater degree of selectivity.

ROOT TONIC PLANTS OF JAMAICA

Root tonics

- Made using roots and barks of the forest
- Multi-herb decoction
- Produced for nutraceutical purposes – to build ‘strength’
- Roots and barks harvested unsustainable from forest
- Large and growing market
- In need of certification

110.5%	Chainy root	*Smilax balbisiana*
94.7%	Sarsaparilla	*Smilax regelii*
94.6%	Strong back	*3 diff plants: Cuphea parsonsia, Desmodium canum, Desmodium adscendens*
57.9%	Raw moon	*Trophis racemosa*
57.9%	Nerve wist	*Iresine diffusa?*
55.3%	Medina	*Alysicarpus vaginalis*
50%	Ginger	*Zingiber officinale*

Root tonics of Jamaica

- 94 plants in all

- 24 plants were most common (found in more than 20% of tonics)
- 3 to 26 plants used per tonic
- Avg 13.3 plants per tonic
- All (100%) had in chainy root (*Smilax balbisiana*) which is endemic to Jamaica

Micro-propagation

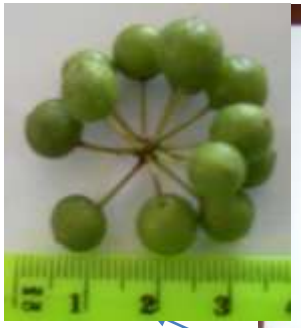
- Produce large numbers of ‘Elite’ cultivars
- Disease-Free Planting Material
- Throughout The Year
- Get New Cultivars To Market
- Direct Cost Advantage for high-cos plants
- Conserve Valuable Germplasm
- Conduct better research into improved farming methods

MICROPROPAGATED PINEAPPLE – 17 MONTHS AFTER TRANSFER

3 months after transfer


UWI
EFJ
BIOTECHNOLOGY CENTRE
MEDICINAL PLANT
GENE BANK

Chainy Root



Chainy Root

sprouted rhizomes

xplants cut from vine (wist)

Initiation

Multiplication

Rooting

Pineapple
Mints
French thyme
Fever grass
Basil
Sarsaparilla
Aloe
Tuna
Medina
Strongback
John Charles
Leaf-of-life

<u>Parameters</u>
Leaf number
Shoot number
Plant width
Plant height
Yield


ESSENTIAL
OIL

Medicinal plant research

Mitchell S.A. (2011) *The Jamaican root tonics: a botanical reference.* Original paper. Focus on Alternative and Complementary Therapies. Volume 16(4):271-280.

Mitchell S.A. And M.H. Ahmad (2006) *Protecting our medicinal plant heritage: the making of a new national treasure.* Jamaica Journal, Institute of Jamaica, Kingston. 29 (3): 28-33.

Mitchell S.A. and M.H. Ahmad (2003) *Establishment of ex vitro and in vitro germplasm collections of important trees and medicinal plants of Jamaica.* Jamaica Journal of Science and Technology 14: 9-16.

Mitchell S.A., Millar M. and M.H. Ahmad (2003) *Neem (*Azadirachta indica*) research at the Biotechnology Center: Testing of neem formulations, Azadirachtin levels in neem oil and Micropropagation of neem plantlets.* Jamaica Journal of Science and Technology 14: 79-89.

Medicinal plant research

Picking D., N. Younger, **S.A. Mitchell** and R. Delgoda (2011) *The prevalence of herbal medicine home use and concomitant use with pharmaceutical medicines in Jamaica.* Journal of Ethnopharmacology. 137(1):305-311.

Delahaye C., L. Rainford, A. Nicholson, **S.A. Mitchell,** J. Lindo and M.H. Ahmad (2009) *Antibacterial and antifungal analysis of crude extracts from the leaves of* Callistemon viminalis. J. Medical and Biological Sciences. Vol 3, Issue 1, 2009: 1-7.

Green C.E., Hibbert S.L., Bailey-Shaw Y.A., Williams L.A.D., **Mitchell S.A.** and E. Garraway (2008) *Extraction, Processing, and Storage Effects on Curcuminoids and Oleoresin Yields from* Curcuma longa *L. grown in Jamaica.* J. Agric. Food Chem., 56: 3664-3670.

Webster S.A., **Mitchell S.A.**, Gallimore W., Williams L.A.D. and Ahmad M.H.

Medicinal plant research

Mitchell S.A. and M.H. Ahmad (2006) *A Review of Medicinal Plant Research at the University of the West Indies, Jamaica, 1948-2001.* West Indies Medical Journal 55(4): 243-269.

Bailey-Shaw Y.A., C.N.A. Salmon, CE Green, SL Hibbert, AM Smith nd LAD Williams (2012) Evaluation of the nutraceutical potential of *Rytidophyllum tomentosum* (L.) Mart.: HPTLC fingrprinting, elemental composition, phenolic content and in vitro antioxidant activity. Pharmaceutical Crops 3: 47-63.

Nwokocha C.R., D. U. Owu, M. McLaren, J. Murray, R. Delgoda, K. Thaxter, G. McCalla, L. Young (2012) *Possible mechanisms of action of the aqueous extract of* Artocarpus altilis *(breadfruit) leaves in producing hypotension in normotensive Sprague–Dawley rats.* Pharmaceutical Biology 50 (9): 1096-1102.

Lowe HLC, CT Watson, S Badal, EN Atch, NJ Toyang and J Bryant (2012) *Anti-angiogenic properties of the Jamaican ball moss (*Tillandsia recurvata). Inter. Research J Biol Sci 1(4):73-76.

Chukwuemeka R. Nwokocha1*, Daniel U. Owu1, Kelece Kinlocke1, JeAnn Murray2, Rupika Delgoda2, Karen Thaxter1, Garsha McCalla1 and Maxine

WAY FORWARD FOR PHYTOMEDICAL RESEARCH IN JAMAICA

What we do not need:

Way forward – Jamaica, Caribbean & beyond

Jamaica

- UWI – Chemistry Dept, FMS, NPI, BTC(MPRG)
- Other Universities: UTECH , NCU
- SRC, JBDC
- CASE
- Supporting institutions: BSJ, PIOJ, NEPA, JIPO, JAMPRO, MOH

Caribbean

- TRAMIL
- CHBA

BEYOND

- TWAS – MPN
- OWSD
- ??

Methods used to market research

1) Fund received to do research and patent taken by funder

2) Plant samples sent abroad where research and patent obtained.

3) Work done locally, trade-secret, on death knowledge passed to son, product registered locally.

4) Product formulation done locally, packaged simply, as teas, or in fancy bottles. May or may not be covered by research and patents.

5) Discover locally, go abroad to do research, foreign lab patents, do more work, and patent new

What is needed to ensure sustainable access to the Caribbean biodiversity and to ensure the ensuing benefit is shared?

1) Better linkages to markets

2) Better agreements for R&D and knowledge etc

3) Support for local R&D and links to overseas specialised labs

4) Repatriation of overseas information to the Caribbean

5) Development of searchable databases eg support for TRAMIL

6) Support for the entire value-chain

Production of clean planting material

Thank you

To ABS

To my family

To God, my Strength and Redeemer