

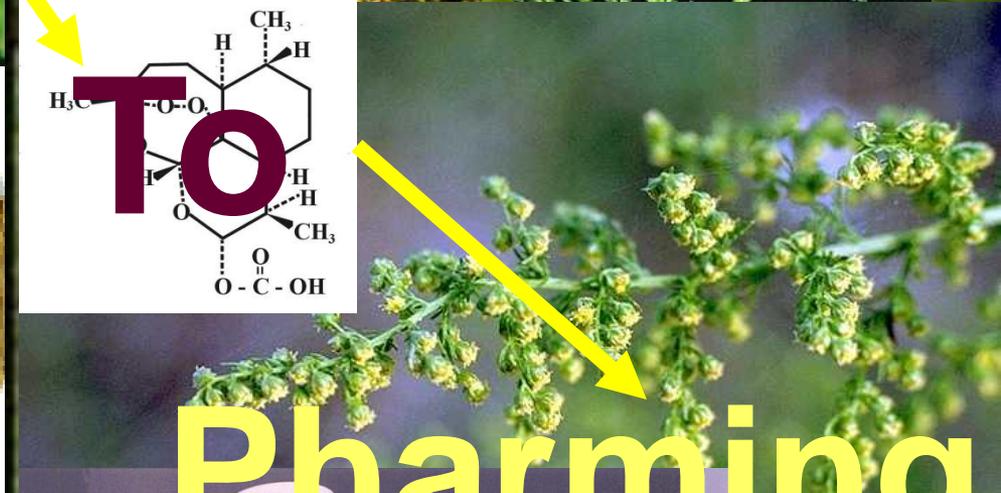
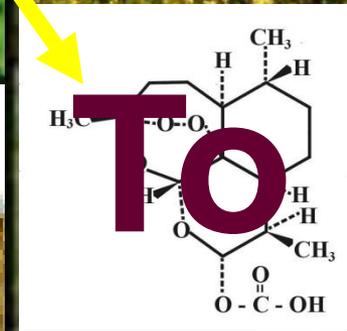
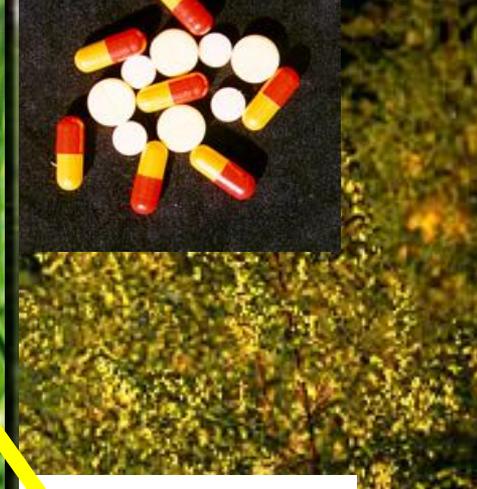
Generating new avenues for biotech enterprises through Farm-Pharma-Nutrition integration



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SKiES Life Technologies Pvt Ltd
Former Director CIMAP/CSIR

AKWL, UPCST, Lucknow, 13 March 2015

Farming



Pharming



???

Not to follow

Innovate

Example !

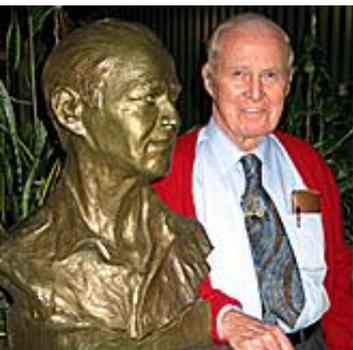
Tall grows to dwarf

Innovate

Wheat Dwarf gene sources Norin 10, Tordo S

Dwarf gene rice
Dee geo woo ger

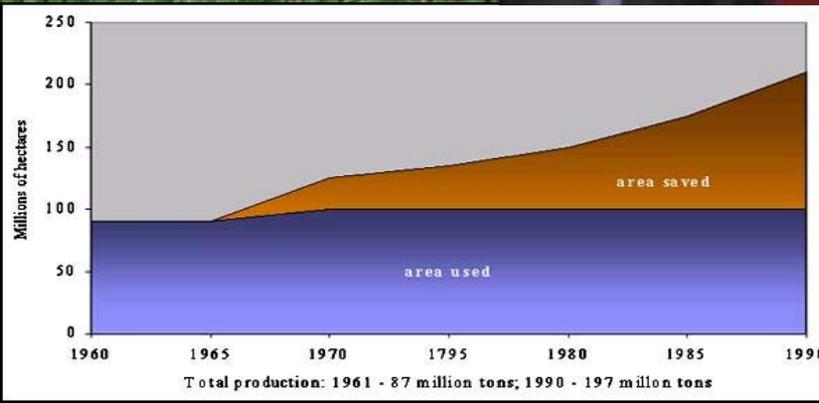
**Green
Revolution**



Hybridization

Emmer

- Purely accidental
 - ◆ Wild wheat X goatgrass
 - 14 + 14 chromosomes
 - ◆ Produced fertile hybrid "**emmer**"
 - Diploid (28 Chromosomes)
 - Dispersed by wind
 - ◆ Emmer X goatgrass
 - 28 + 14 chromosomes
 - Fertile hybrid "**bread wheat**"



Plants

Molecules of Drug Value....

Did you think

Why ?

Respond

Defend

Plants

... photosynthesise but are non-mobile

Attract

Do not Run away

Coexist

Example !



“Plants do not speak, they just whisper! Therefore, you have to be real close to them to understand them!!” – *derived from Norman E Borlaug*

Terpenes

Alkaloids

Plant's whisper

...the phytochemicals

Glycosides

Flavonoids

Saponins

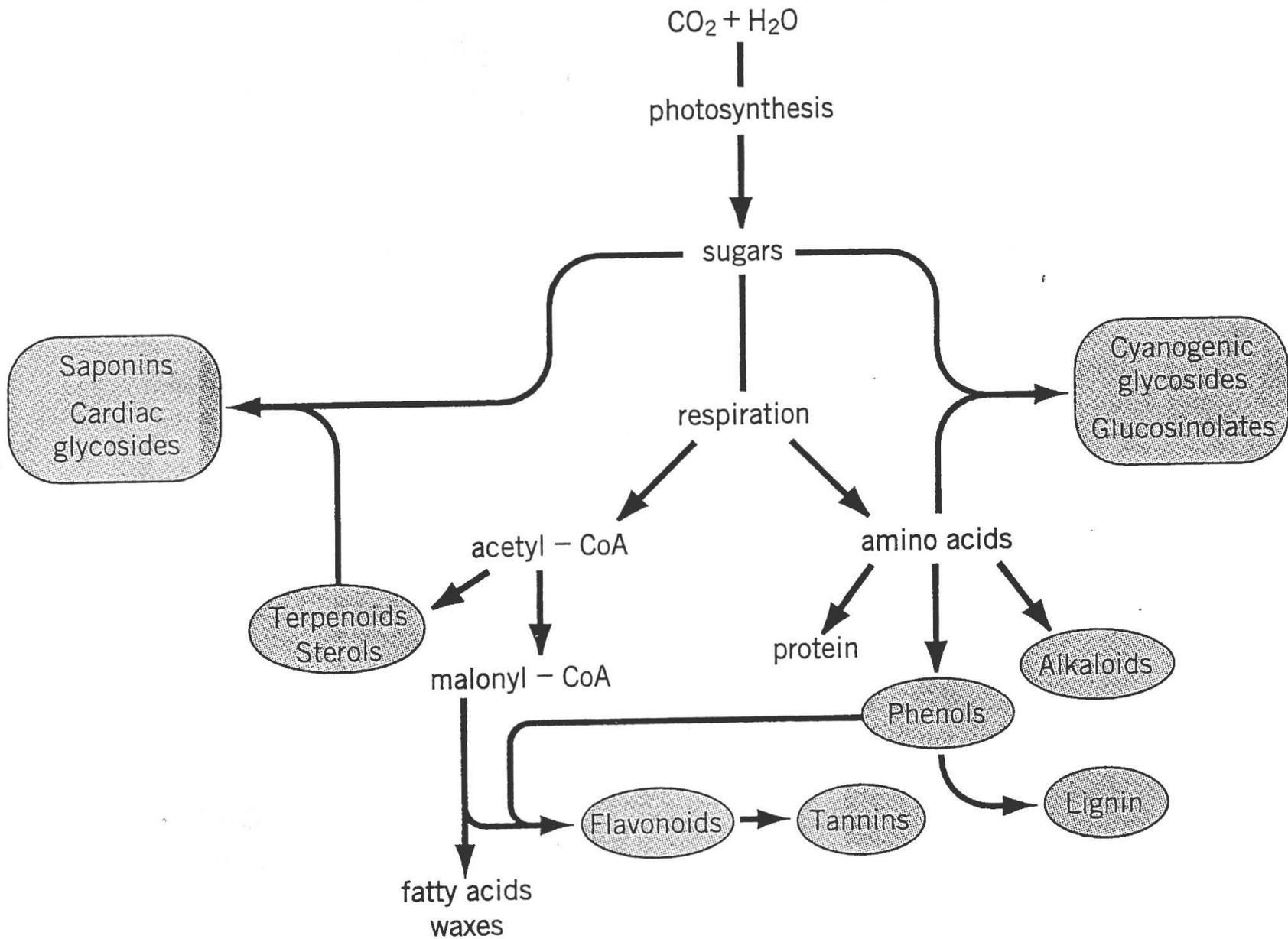
Phytochemicals ...

It is estimated that terpenes contribute the most to the sales of plant-derived drugs. As taxoids gain as treatment for cancer, the terpene category should increase its share still further in the next several years. Steroids are another key group in the terpene category.

Glycosides are the next most significant category. Flavonoids, saponins, anthraglycosides and digitalis compounds are among the most important groups within this category.

Alkaloids are the third most significant category of plant-derived drugs, in terms of sales. Included are the belladonnas, camptothecins, opiates, Rauwolfias, and Vincas, among others.

All other plant-derived drugs include miscellaneous substances and plant drugs for which the active principles have not been well characterized. Among the important groups within this category are plant-derived vitamins, psoralens, ephedrines, salicylates and various others.





22000 described
Mentha species, Cymbopogon Species, Ocimum Species, Pelargonium species, Clarkia breweri, Petunia etc

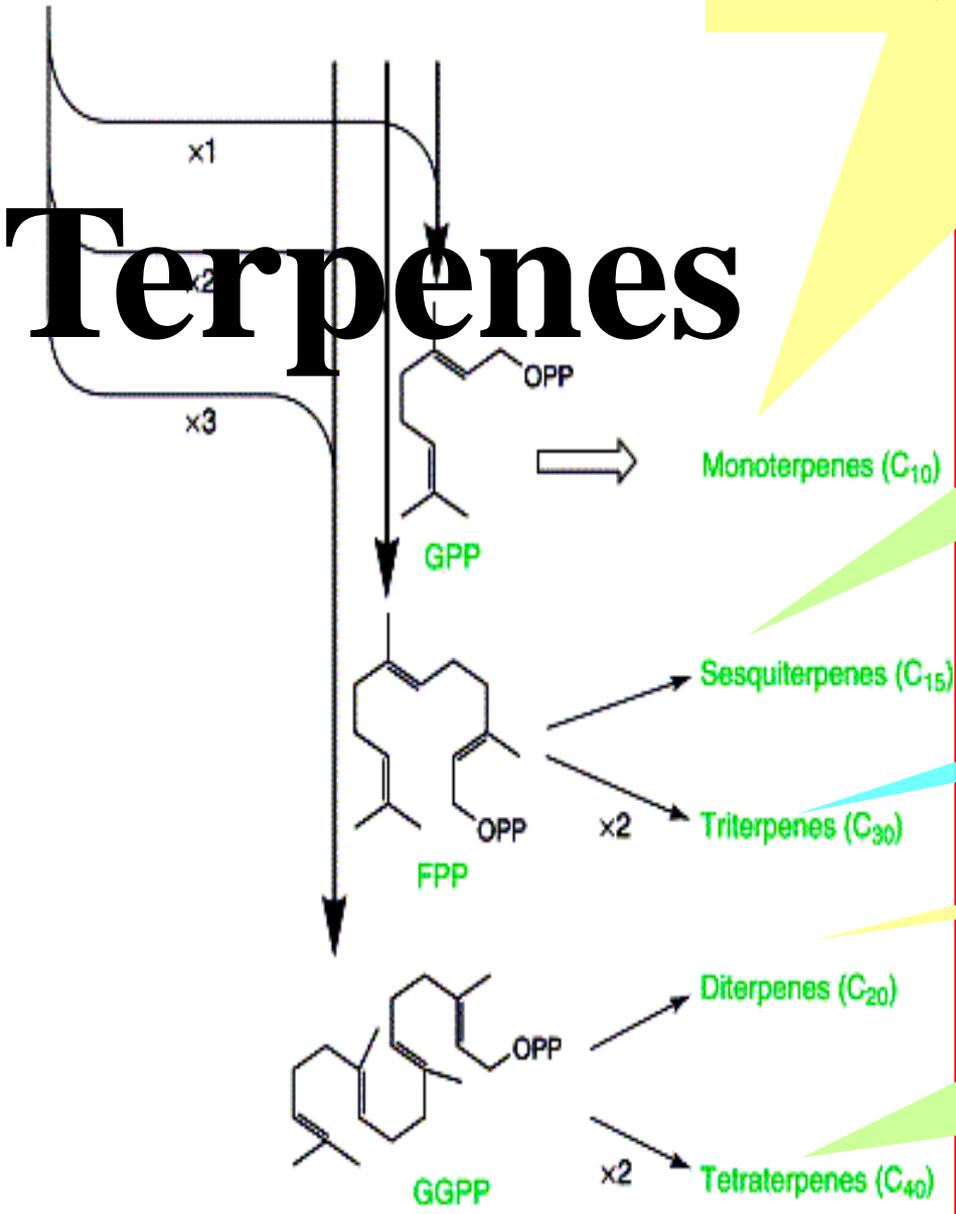
Sesquiterpene lactones (SL's) of which over 3000 have been described, mostly in the Asteraceae (daisy) family
Artemisia annua, Pyrethrum, Chicory, Tulip, Tagetus, Sage, cotton, Tansy, Yarrow, Chamomile, Arnica etc

Bacopa monnieri, Centella asiatica, Coccinia indica, Lagerstroemia speciosa, Annona cherimola, Nigella sativa, Oenothera biennis, Salvia officinalis, Morus alba, Fagopyrum esculentum, Ocimum basilicum, Zea mays, Glycyrrhiza glabra, Commiphora

Stevia rebaudiana, Tinospora cordifolia, Panax notogingsang etc

Morinda citrifolia, Luffa aegyptiaca Mimosa pudica, Spinacia oleracea, Daucus carota, Capsicum annum, Ipomoea batatas, Brassica nigra, Beta vulgaris

Terpenes



India is going the way of developed countries. With the per capita income of Indians on the way up, lifestyle diseases are projected to replace infectious diseases as the major chunk of illnesses in the country.

The healthcare study was carried out by the Confederation of Indian Industry in association with McKinsey and Co.

The treatment of obesity has proven that it can reduce the onset of **lifestyle diseases** such as hypertension, high cholesterol levels, diabetes mellitus, and even erectile dysfunction.

Nervine
Obesity
Diabetes
General tonic

Drug Therapeutics: billion \$ Categories

- Inflammatory/Immunological
- Cardiovascular
- Metabolic/endocrine
- Anti-infectives
- Oncology
- Neurological
- Pain

Plant sourcing...

Nervine tonics

Asparagus racemosus, Saponins



Acorus calamus, Phenyl propanoids



Withania somnifera, alkaloids



Bacopa monnieri, Triterpenoid saponins



Centella asiatica, Triterpenoid saponins



Nelumbo nucifera, Alkaloids

Plant sourcing...

Anti-Obesity

Obesity leads to

- High blood pressure
- Diabetes
- Abnormal blood fats
- Coronary artery disease
- Stroke
- Osteoarthritis
- Sleep apnea

- Cancer

Ephedra sinica, alkaloids ephedrine and pseudoephedrine



Garcinia cambogia, hydroxycitric acid (HCA)

Hypericum perforatum, Hypericin, polycyclic quinone



Red apple, Pyruvate.



Commiphora mukul, steroid, guggulesterone



Saccharum officinarum Policosanol



Camellia chinensis, Flavanoid, Caffeine



Allium sativum, Alicin (Diallyl thiosulfinate)

Beta sitosterol

Annona cherimola, *Nigella sativa*, *Oenothera biennis*

Salvia officinalis, *Morus alba*, *Fagopyrum*

Ascorbic acid: *Hippophae rhamnoides*, *Capsicum annuum*,
Anacardium occidentale, *Momordica charantia*, *Moringa oleifera*,
Capsicum frutescens, *Manihot esculenta*, *Raphanus sativus*,
Emblica officinalis

Citric acid: *Hibiscus sabdariffa* , *Ananas comosus*,
Citrus limon, *Citrus paradisi*, *Garcinia mangostana*,
Glycine max , *Punica granatum*, *Citrus sinensis* ,
Zizyphus jujuba, *Fragaria spp*

Beta Carotene: *Morinda citrifolia*, *Luffa aegyptiaca*
Mimosa pudica, *Spinacia oleracea*, *Daucus carota*
Capsicum annuum, *Ipomoea batatas*, *Brassica nigra*,
Beta vulgaris

**Amla - The Richest Natural Source of Vitamin C. 8.7 mg of Vitamin C
from Amla = 100 mg of Vitamin C from synthetic sources**

Plant sourcing...

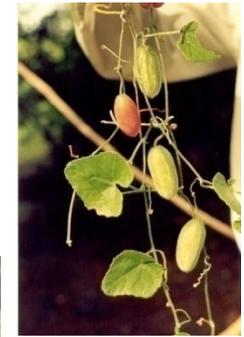
Anti-Diabetes



BitterGourd (*Momordica Charantia* L.). Seed extract
(Protein) p-insulin



Coccinia indica ,
Triterpenoids, Taraxerone



Gymnema sylvestre,
Gymnema saponin



Pterocarpus marsupium, flavonoid



Lagerstroemia speciosa, Triterpenoids, corosolic acid

Trigonella foenum-graecum alkaloids, Trigonelline
and Choline



Stevia rebaudiana bertonii Stevioside, diterpene glycoside



Tinospora cordifolia
Tinosporin, cordifolide, diterpene



Plant sourcing...

Anti-Cancer

Colchicum autumnale, colchicine(alkaloid)



Betula alba, Betulinic acid (Triterpene)



Camptotheca acuminata, camptothecin (alkaloid)



Betula alba

Cannabis sativa, tetrahydrocannabinol (Sesquiterpene)



Foto: Stig Lundmo

Podophyllum hexandrum, podophyllotoxin (lignan)



Nothapodytes foetida, camptothecin (alkaloid)



Catharanthus roseus, Vincristine, vinblastine (alkaloid)



Taxus wallichiana, Taxol(diterpenoid)

A Look at the Developed World Market

The opportunity for India & SEA

- Aromatherapy
- Aroma Sprays and Flower Waters
- Body and Bath
- Bulk Herbs
- Bulk Ingredients
- Bulk Oils
- Butters
- Capsules
- Clays
- Essential Oils
- Facial Care
- Green & Black Teas
- Hair Care
- Herbal Extracts
- Herbal Oils
- Herbal Salves & Balms
- Herbal Teas
- Herbs for Pets
- Incense, Resins and Candles
- Massage Oils
- Medicinal Herb Seeds

Aromatherapy

Ajowan
Allspice
Amyris
Angelica
Anise Seed
Balsam Peru
Basil
Bay
Benzoin
Bergamot
Black Pepper
Cajeput
Calendula
Camphor White
Caraway
Cardamom
Carrot Seed
Catnip
Cedarwood
Celery Seed
Chamomile
Cilantro
Cinnamon Bark
Cinnamon Leaf
Cistus
Citronella
Clary Sage
Clove Bud
Copaiba Balsam
Coriander Seed
Cornmint
Cubeb Berry
Cypress
Davana
Dill Seed
Douglas Fir
Elemi
Eucalyptus
Eucalyptus, Peppermint
Pine, Scotch

Fennel
Fir Needle
Frankincense
Galangal
Galbanum
Geranium
Ginger
Grapefruit
Helichrysum
Ho Wood
Hops
Melissa
Mandarin
Manuka
Marjoram
Myrrh
Myrtle
Neroli
Niaouli
Nutmeg
Olibanum
Opoponax
Orange, Bitter
Orange, Sweet
Oregano
Palmarosa
Parsley seed
Patchouli
Pennyroyal
Peppermint
Petitgrain

Essential Oils Oil Blends & Resins Diffusers, Nebulizers & Burners Kits and Samplers Aroma Sprays

Juniper Berry
Ravensara
Rose
Rosemary
Rosewood
Sage
Sandalwood
Savory
Spearmint
Spikenard
Spruce
St. Johns Wort
Tagetes
Tangerine
Tarragon
Tea Tree
Thuja
Thyme
Tuberose
Turmeric
Valerian
Vanilla
Vetiver
Yarrow
Ylang Ylang

Body and Bath

Saponified Organic Coconut and Olive Oils (with retained glycerine), organic Jojoba oil, organic Aloe Vera, and Rosemary extract, Mountain Rose, Juniper Ridge, Mint/Eucalyptus, Citrus or Lavender, Cinnamon, Organic Calendula oil, organic Rosehip seed oil, Chamomile flowers

Aroma Sprays and Flower Waters

Basil hydrosol
Calendula hydrosol
Chamomile hydrosol
Clary Sage hydrosol
Cucumber hydrosol
Lavender hydrosol
Lemon Balm hydrosol
Lemon Verbena hydrosol
Lime hydrosol
Orange Flower hydrosol
Rose Geranium hydrosol
Rose hydrosol
Rosemary hydrosol
Sandalwood hydrosol

Bulk Herbs

Acacia
 Agrimony
 Alfalfa
 Alkanet
 Allspice
 All Purpose Seasoning
 Aloe
 Angelica
 Anise
 Anise Star Pods
 Annatto
 Arnica Arrowroot powder
 Artichoke Leaf
 Ashwaganda
 Astragalus
 Balm of Gilead Buds
 Basil Basil, Holy
 Barberry
 Barley Grass
 Bay Leaf
 Bayberry
 Bee Pollen
 Beet Powder
 Benzoin Gum
 Bilberry
 Birch
 Blackberry Root & Leaf
 Black Cohosh
 Black Haw
 Black Peppercorns
 Black Walnut
 Bladderwrack
 Blessed Thistle
 Blood Root
 Blue Cohosh
 Blue Flag
 Blue Malva (Mallow)
 Blue Vervain
 Blue Violet
 Boldo
 Boneset
 Borage
 Broccoli Seed
 Buchu Leaf
 Buckthorn Bark
 Bugleweed
 Bupleurum
 Burdock
 Butchers Broom
 Butterbur
 Butternut Bark

CacaoCajun Spice
 Calamus Root
 Calendula
 California Poppy
 Caraway
 Cardamom
 Caribbean Blend
 Carob Powder
 Cascara Sagrada
 Catnip
 Catuaba Bark
 Cat's Claw
 CayenneCedar Berry
 Celandine
 Celery Seed
 ChamomileChaparral
 Chaste Tree
 Chervil
 Chickweed
 Chicory root
 Chili Flakes
 Chili'sChili Powder
 Blend
 Chinese 5 Spice
 Chive Rings
 Chlorella Powder
 Chrysanthemum Flower
 Cilantro LeafCinnamon
 Cleavers
 Clove
 Club Moss Codonopsis
 Coltsfoot
 Comfrey
 Coriander Seed
 Cornflowers
 Cornsilk
 Couchgrass
 Cramp Bark Cranberry
 Powder
 Cranesbill
 Cubeb Berries
 Cumin
 Curry
 Damiana
 Dandelion
 Devil's Claw Devil's
 Club
 Dill Seed
 Dill Weed Dog Grass
 Root
 Dong Quai
 Dulce

Echinacea angustifolia
 Echinacea purpurea
 Elder Berry & Flower
 Elecampane
 Eleuthero Root
 Ephedra
 Epimedium
 "Essiac" Formula
 Eucalyptus
 Eyebright
 Fennel
 Fenugreek
 FeverfewFlax
 Fo Ti Forsythia
 Frankincense
 Fringe Tree Bark
 Fumitory
 Galangal Root
 Garam Masala
 Garcinia Fruit
 Garlic
 Garlic Pepper
 Gentian Ginger Root
 Ginkgo
 GinsengGoji Berry
 Goldenrod Herb
 Goldenseal Gotu Kola
 Gravel Root
 Guarana Seed Guggul
 Gum
 Gum Arabic
 Gymnema
 Habanero
 Hawthorn
 Heal All Heather
 Helichrysum Flowers
 Hemp Seed Herbs de
 Provence
 Hibiscus
 Holy Basil
 Honeysuckle Flower
 Hops
 Horehound
 Horse Chestnut
 Horsetail
 Hydrangea
 Hyssop
 Iceland Moss Irish
 Moss Italian
 Seasoning

Jamaican Dogwood
 Jasmine Flower
 Juniper Berries
 Kava Kava
 Kelp Fronds
 Kelp Powder
 Kola Nut
 Kombu
 Kudzu
 Ladies Mantle
 Lavender Flowers
 Lemon BalmLemon
 Pepper Blend
 Lemongrass
 Lemon Peel
 Thyme
 Lemon Verbena
 Licorice Root
 Linden
 Lobelia
 Lovage
 Lungwort
 Lycii Berry
 Maca Root
 Mace
 Maidenhair Fern
 Maitake Mushroom
 Malva (Mallow)
 Flower
 Mandrake
 Marjoram
 Marshmallow
 Meadowsweet
 Mediterranean
 Seasoning
 Mexican Seasoning
 Milk Thistle
 Mistletoe
 Motherwort
 Mugwort Muira
 Puama
 Mullein
 Mustard Seed
 Myrrh
 Neem
 Nettle Nori
 Nutmeg

Oat straw
 Oat Tops
 Olive Leaf
 Onion
 Orange Peel
 Oregano
 Oregon Grape
 Root Orris Root
 Osha Root
 Papaya Leaf
 Parsley
 Partridgeberry
 Passionflower
 Paprika
 Patchouli
 Pau D'Arco
 Pennyroyal
 Peony, White
 Root Pepper,
 Black
 Pepper, White
 Peppermint
 Periwinkle
 Pine Powder
 Pipsissewa
 Plantain
 Pleurisy Root
 Poke Root Poppy
 Seed
 Prickly Ash Bark
 Privet Fruit
 Propolis
 Psyllium Seed
 and Husk
 Pygeum Quassia
 Bark
 Raspberry
 Red Clover
 Red Clover
 Flowers
 Red Clover Seeds
 Red
 RootRehmannia
 Root
 Reishi
 Mushrooms
 Rhodiola root
 Rosehips
 Rosemary
 Rose PetalsRose
 Buds
 Rue Safflower
 Threads Saffron
 Sage, Ceremonial

Sage, culinary
 St. John's Wort
 Sandalwood
 Sarsaparilla
 Sassafras
 Savory
 Saw Palmetto
 Schisandra Berries
 Seasoned Salt
 Self Heal
 Senna
 Sesame Seeds Shatavari
 Sheep Sorrel
 Shepherd's Purse
 Shiitake Mushrooms
 Skullcap
 Slippery Elm Bark
 Soapwort
 Solomans Seal Spearmint
 Spikenard
 Spilanthes
 Spinach powder
 Spirulina
 Stevia
 Strawberry Leaf
 Suma Root
 Sumac Berries
 Sweetgrass
 Tansy
 Tarragon
 Tonka Beans Thyme
 Tribulus Tulsi Turkey
 Rhubarb
 Turmeric
 Usnea Uva Ursi
 Valerian Root
 Vanilla
 Vervain Violet
 Vitex
 Wakame
 Watercress Herb
 Wheat Grass
 White Oak
 White Peony Root
 White PepperWhite Pine
 White Sage White Willow
 Wild Cherry
 Wild Lettuce
 Wild Yam
 Witch Hazel Wood Betony
 Wormwood
 Yarrow
 Yellow Dock
 Yerba Mate Yerba Santa
 Yohimbe
 Yucca

Bulk Ingredients

Aloe Vera Gel
 Apricot Kernel Meal
 Arrowroot powder
 Buckwheat Hulls
 Carnauba Wax
 Grapefruit Seed Extract
 Menthol Crystals
 Witch Hazel Extract

Almond Oil
Apricot Kernel Oil
Avocado Oil
Black Cumin Seed Oil
Borage Seed Oil
Castor Oil
Coconut Oil
Evening Primrose Seed Oil
Grapeseed Oil
Hazelnut Oil
Hemp Seed Oil
Jojoba Oil
Kukui Nut Oil
Macadamia Nut Oil
Meadowfoam Seed Oil
Neem Seed Oil
Olive Oil
Palm Oil
Pumpkin Seed Oil
Rosehip Seed Oil
Safflower Oil
Sea Buckthorn Oil
Sesame Seed Oil
Shea Nut Oil
Soybean Oil
Sunflower Oil
Tamanu Oil
Vitamin E Oil
Wheat Germ Oil

Bulk Oils

Ashwaganda
Astragalus
Bee Pollen
Bladderwrack
Burdock
California Poppy
Cat's Claw
Cayenne
Chlorella
Cramp Bark
Cranberry
Damiana
Dandelion
Devil's Claw
Dong Quai
Echinacea
Eleuthero
Epimedium
Fenugreek
Feverfew
Garlic
Ginger
Ginkgo
Ginseng
Gotu Kola
Guarana
Hawthorn
Horsetail
Kava Kava
Kelp
Licorice
Linden
Maca
Marshmallow
Maitake
Milk Thistle
Nettle
Olive
Pau d' Arco
Rosehips
Reishi
Rhodiola
Saw Palmetto
Schisandra
Senna
Shiitake
Skullcap
Slippery Elm
Spirulina
St. Johns Wort
Turmeric
Uva Ursi
Valerian
Vitex
White Willow
Wild Yam
Yellow Dock
Yucca

Single Herbal Capsules

Combination Capsules

Cold care

Organic Echinacea purpurea root ,
Osha root,
organic Elder berry ,
organic Echinacea angustifolia root
organic Goldenseal root ,
organic Ginger root

Liver-Care Capsules

Organic Milk Thistle seed,
organic Burdock root,
organic Artichoke leaf,
organic Dandelion root,
wildharvested Oregon Grape root,
organic Turmeric.

Male-Care capsules

Epimedium (Horny Goat Weed),
organic Eleuthero root,
Maca root,
organic Panax Ginseng root,
organic Ginkgo leaf,
Damiana leaf

Meno-Care Capsules

Organic Vitex berry,
organic Dong Quai root,
organic Burdock root,
organic Eleuthero root,
organic Black Cohosh root,
organic Motherwort,
organic Sage,
organic Licorice root.

Freeze Dried Capsules

Black Walnut-Wormwood (Intestinal Support)
Burdock-Red Clover (Blood Support)
Chaste Tree-Dandelion (PMS Support)
Devil's Club-Huckleberry (Blood Sugar Balance)
Elder Berry-Larix (Immune Support)
Gentian Angelica (Digestive Support)
Ginkgo-Gotu Kola (Memory Support)
Hawthorn-Ginkgo (Circulatory Support)
Horsetail-Nettles (Bone and Joint Support)
KavaKava-Poppy (Relaxation Support)
Milk Thistle-Dandelion (Liver Support)
Nettle-Eyebright (Nasal Support)
Pau d' Arco-Goldenseal (Yeast Balance)
Saw Palmetto-Nettle (Prostate Support)
Sheep Sorrel-Burdock (Cleansing Support)
Soybean-Black Cohosh (Menopause Support)
St John's Wort-Lemon Balm (Mood Balance)
Uva Ursi-Marshmallow (Urinary Tract Support)
Valerian-Passionflower (Relaxation Support)

Herbal Extracts

Single Herbal Extracts

Angelica
Ashwaganda
Astragalus
Bilberry
Black Cohosh
Blue Cohosh
Blessed Thistle
Boneset
Buchu
Burdock
California Poppy
Cactus
Calendula
Cat's Claw
Cayenne
Celandine
Chamomile
Chaste Tree
Chickweed
Cleavers
Coltsfoot
Cornsilk
Cramp Bark
Damiana
Dandelion
Devil's Claw
Dong Quai
Echinacea
Elder Berry
Eleuthero
Eyebright
Fenugreek
Gentian
Ginkgo
Ginseng
Goldenrod
Goldenseal
Gotu Kola
Hawthorn
Hops

Hyssop
Juniper Berry
Kava Kava
Lady's Mantle
Licorice
MilkThistle
Motherwort
Myrrh
Nettle
Oats
Oregon Grape
Osha
Passionflower
Pau d' Arco
Plantain
Pleurisy
Prickly Ash
Red Clover
Red Root
Reishi
Sarsaparilla
Saw Palmetto
St. Johns Wort
Schisandra
Shepherds Purse
Skullcap
Slippery Elm
Usnea
Uva Ursi
Valerian
Wild Cherry
Wild Yam
Wood Betony
Wormwood
Yellow Dock
Yerba Mansa
Yerba Santa
Yucca

Combination Herbal Extracts

Black Cohosh-Kava Kava extract
Black Walnut-Wormwood extract
Devil's Claw-Yucca extract
Dong Quai-Wild Yam extract
Echinacea Premium extract
Echinacea-Goldenseal extract
Ginkgo-Gotu Kola extract
Kava Kava-California Poppy extract
Male Formula extract
Milk Thistle-Dandelion extract
Motherwort-Black Cohosh extract
Nettles-Eyebright extract
Red Clover-Burdock extract
Saw Palmetto-Nettles extract
St John's-Lemon Balm extract
Valerian-Passionflower extract
Vitex-Burdock extract
Vitex-Dong Quai extract

Syrups

Elder Berry Ginger Syrup
Horehound Marshmallow Syrup
Osha-Wild Cherry Syrup

Glycerites (Extracts made with glycerine)

Chamomile-Catnip Glycerite
Dandelion Glycerite
Echinacea Glycerite
Milk Thistle Glycerite
Oats Glycerite

Incense, Resins and Candles

Incense

Incense Cones

Incense Sticks

Douglas Fir

Juniper

Pinon

Port Orford Cedar

Sweetgrass

White Sage

Champa,

Jasmine,

Nag Champa,

Rose,

Saffron

Sandal,

Royal Champa,

Candles

Aromatic Candles

Tea Lights

Soy Candles,

Cedarwood,

Lavender,

Patchouli

Rosemary.

Rosewood

Patchouli

Spruce

Fir Needle

Cinnamon,

Clove

Nutmeg

Orange,

Grapefrui

Resins/Herbs

Copal

Dragon's Blood

Frankincense

Guggul Gum

Makko

Myrrh

Opopanax

Sweetgrass

White Sage

Hymenaea courbaril

Sanguis draconis

Boswellia carteri

Commiphora mukul

Commiphora molmol

Commiphora holtziana

Salvia apiana

Hierochloe odorata

Botanical Hair Care

Rosemary,
organic Chamomile,
organic Nettle,
organic Thyme,
organic Birch leaf,
organic Menthol,
organic Clary Sage,
organic Lavender,
organic Eucalyptus,
organic Yarrow,
organic Marshmallow,
organic Horsetail,
organic Soybean
protein,
Grapefruit Seed
extract.

Lawsonia
Calendula
Aloe Vera
Hibiscus,
Lemongrass organic
Jojoba oil,
certified organic
Hemp seed oil

Facial care

Organic Wild Rosehip Seed oil,
Kukui nut oil,
organic Calendula oil,
Sandalwood,
Neroli,
Helichrysum,
Frankincense,
Carrot Seed
organic Lavender.
Almond Meal,
organic Corn Meal,
powdered Rose petals,
Organic Comfrey leaf,
organic Chamomile flowers,
Rose petals,
organic Calendula flowers,
organic Sweet Orange essential oil.
certified organic Alfalfa extract,
certified organic Aloe Vera gel,
Eucalyptus/Mint,
Citrus or Lavender
Olive,
Jojoba,
organic Aloe Vera, and Rosemary
extract
organic Lavender flower water,
Grapefruit seed extract,
Burdock and Red Clover extract,
essential oils including Lemon.
Vanilla.
organic Wild Rosehip Seed oil,



Biovillage Strategy Translational Research

CIMAP: Societal enabling through R&D

Ensuring sustainability through IP

- **Employment**
- **Income enhancement**
- **Higher living standard**
- **Nutritional & health security**
- **Education & skill gains**

Mentha, the teacher



Challenges to rural entrepreneurship

- 1: Low menthol and low biomass producing varieties
- 2: Late maturing varieties
- 3: Seasonal variation affecting the oil quality
- 4: Insect attack (*Spilarctia obliqua*)
- 5: Non availability of varieties for late transplanting and intercropping



Himalaya in Farmer's Field



Harvesting of 'Kosi' by farmers



Distillation by farmers

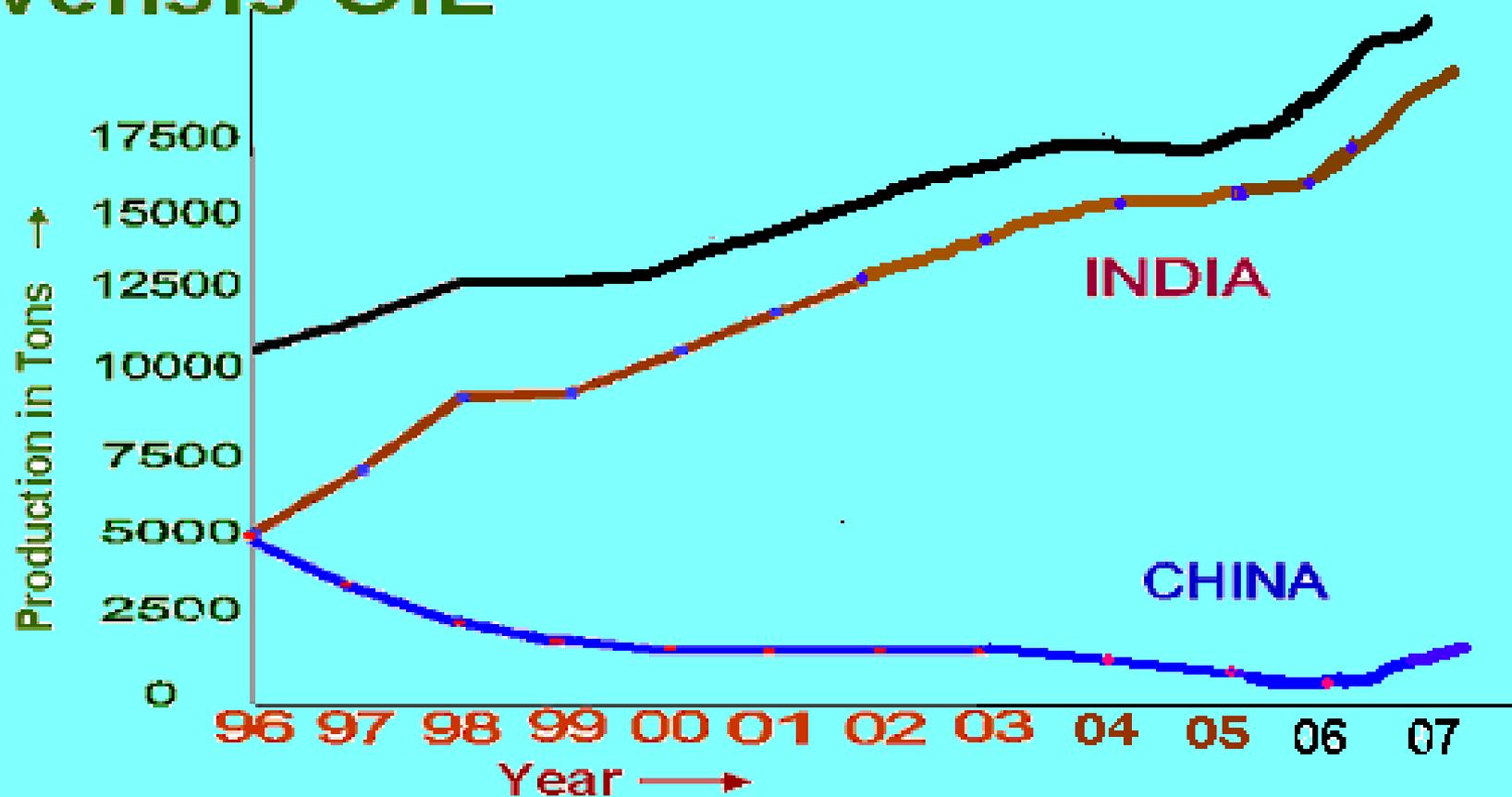


Marketing of essential oil



From kachha to pucca house

M.arvensis OIL



Source: Shri SC Varshney, Mint Meet 2007, Lucknow

Impact of futures trading on Mentha market

| Particular | | | |
|--|--|--|--|
| <i>Acreage</i> | | | |
| <i>Production</i> | | | |
| <i>Price</i> | | | |
| <i>Sales Value</i> | | | |
| <i>Export</i> | | | |
| <i>India's Share in world production</i> | | | |
| <i>India's Share in world trade</i> | | | |
| <i>Average Export realization</i> | | | |
| <i>Total export</i> | | | |



Export of Major Spices from India

(QTY IN M.T; VALUE RS CRORE)

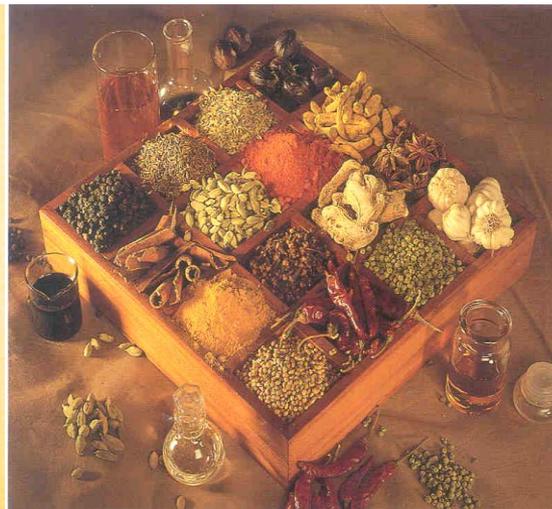
| ITEM | 2006 - 07(E) | |
|---------------------------------|----------------|----------------|
| | QTY | VALUE |
| PEPPER | 28,750 | 306.02 |
| CARDAMOM(S) | 650 | 22.36 |
| CARDAMOM(L) | 1,500 | 16.95 |
| CHILLI | 148,500 | 807.75 |
| GINGER | 7,500 | 39.75 |
| TURMERIC | 51,500 | 164.80 |
| SEED SPICES | 70,125 | 362.52 |
| VANILLA | 125 | 19.96 |
| CURRY POWDER | 9,500 | 86.93 |
| MINT PRODUCTS | 16,250 | 1100.95 |
| OILS & OLEORESINS | 6,250 | 510.79 |
| TOTAL (Including Others) | 373,750 | 3575.75 |



India's Share In Value Added Spices

Qty in Tons

| SPICES | INDIA'S EXPORT | WORLD TRADE | % SHARE |
|------------------------------------|-----------------------|--------------------|----------------|
| SPICE OILS & OLEORESINS | 6250 | 7500 | 83 |
| MINT PRODUCTS | 16250 | 30000 | 54 |



Taking New Challenges

- **End-to-end Mission**
- **Establishing Value Chain**
- **Cultivation to product to market**

Entrepreneurship

Mission mode approach for establishing value chain

Biovillages











It works



It works



It works



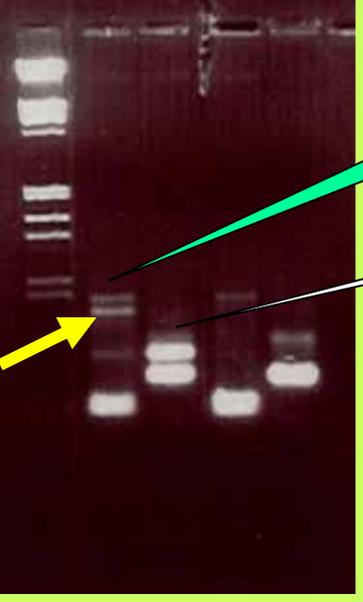
It works

It works



Artemisia

- Target 1: Process for large scale isolation of artemisinin from plant *Artemisia annua***
- Target 2: Conversion of artemisinin to stable compounds**
- Target 3: High yielding genotypes**
- Target 4: Enhancing genetic variability in the plant**
- Target 5: Stabilization of artemisinin production, Agrotechnology**



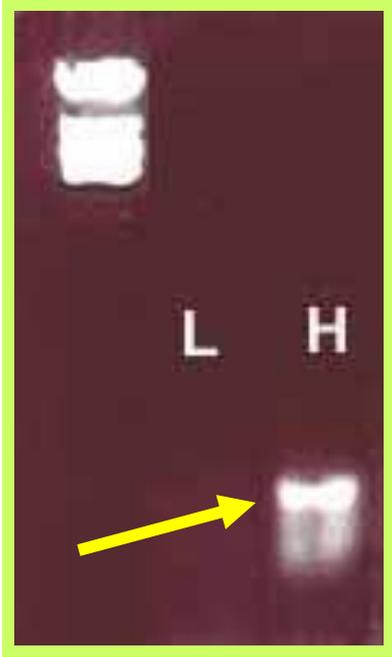
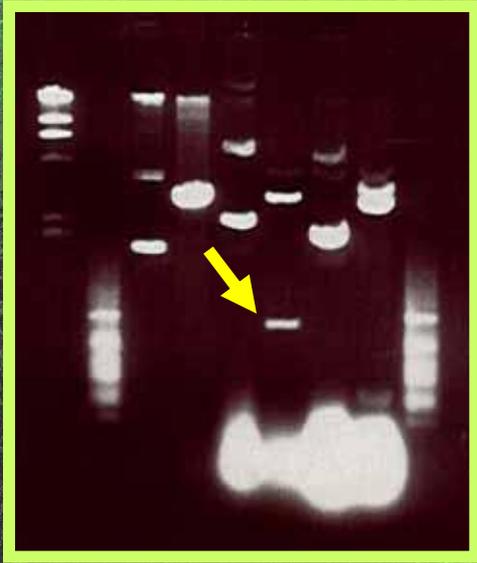
High type

Low type

Synthesis of primers

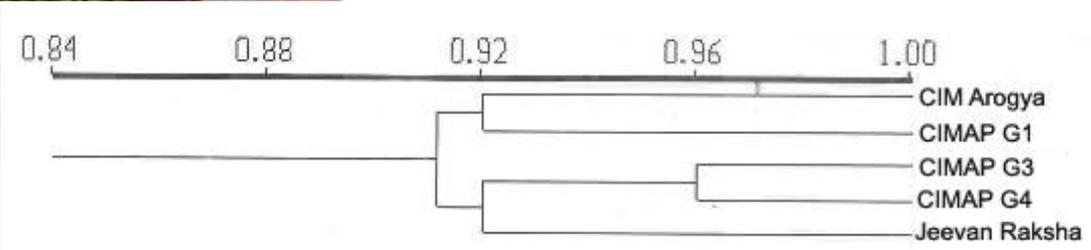
Sequence

PCR



Biotechnology Research

CIM-Arogya For drug intermediate Industry



High artemisinin containing variety 'CIM-Arogya' of *Artemisia annua* and its production technology package licensed to M/s Themis Med care on 18 May, 2004 on the occasion of 31st RC Meeting



Signing of agreement with Sanat Products , New Delhi on 11.1.06 for technology licensing of *Artemisia annua* cultivation and processing



M/s Biotech International Limited, New Delhi signed agreement with CIMAP on 5th September, 2005 for acquiring technology for cultivation and processing of *Artemisia annua*



Licensing Agreement for CIM-Arogya signed with Vital Healthcare, Mumbai on 19.1.2005



Signing of technology licensing agreement with M/s Scimitar Biotech Pvt. Ltd., New Delhi on 17th November, 2005 for CIM-Arogya technology demonstration in Chandigarh

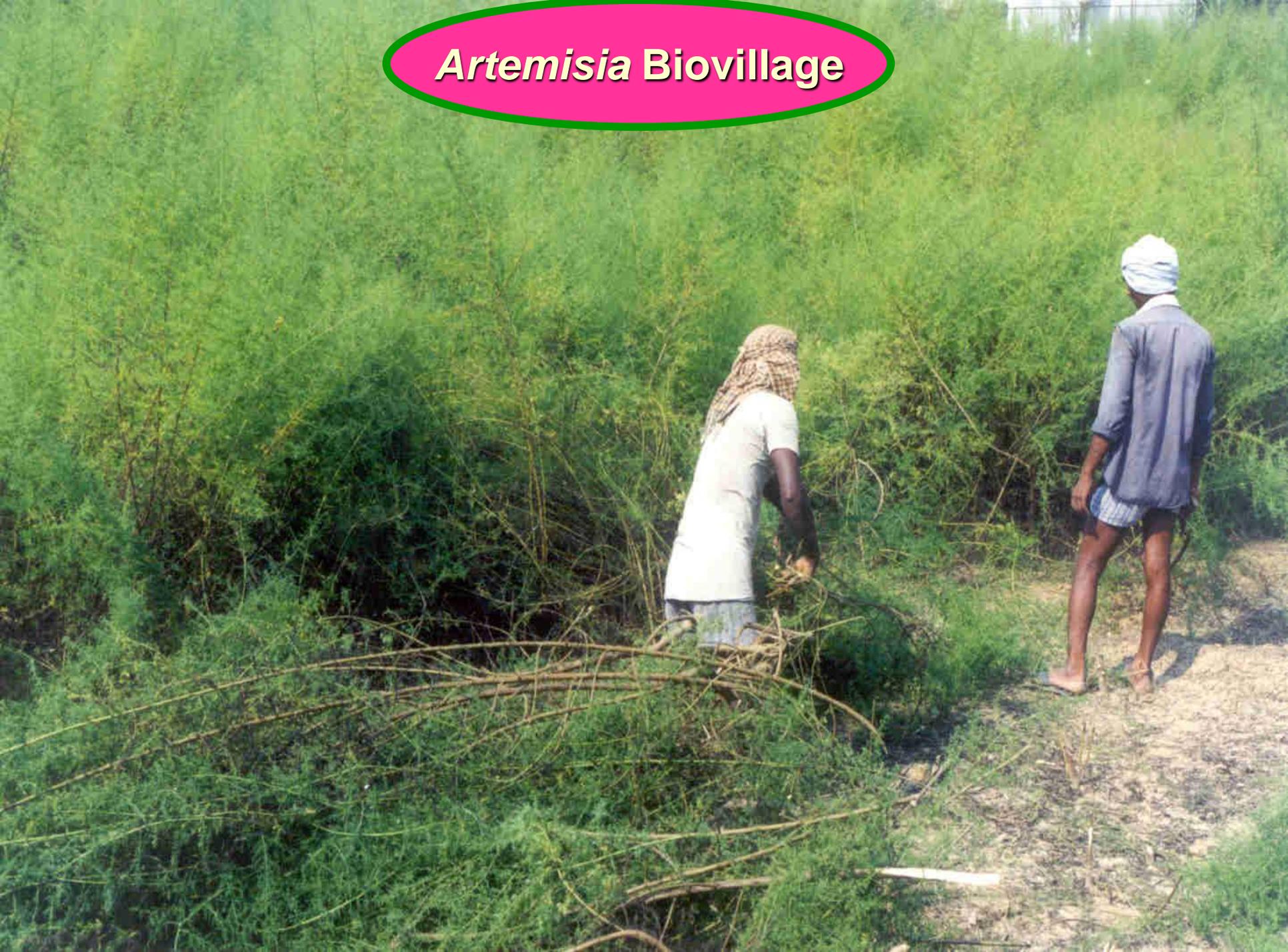


Signing of agreement with Bharthi Society (TN) on 3rd August, 2005 for cultivation of antimarial drug plant *Artemisia annua* var. Jeevanraksha involving women farmers



Signing of agreement with G-SFC, Vadodara on CIMAP Annual Day on 26th March, 2006 for licensing industrial technologies of *Artemisia*, *Silybum* and *Geranium*

Artemisia Biovillage









Campaign to fight malaria hit by surge in demand for medicine

David Cyranoski, Tokyo

An alarming shortfall of a key drug is undermining an international drive to reduce the malaria death toll. A rise in demand has led to a shortage of artemisinin, the main treatment for malaria that is resistant to conventional therapies, the World Health Organization (WHO) announced on 8 November.

Artemisinin is extracted from the wormwood plant, *Artemisia annua*, which grows wild in southern China and Vietnam. Combined with other drugs, its derivatives, such as artesunate and artemether, can clear symptoms of malaria in three days. Malaria currently kills about a million people every year, mainly in Africa.

In 2001, the WHO recommended that artemisinin-based combination therapies, or ACTs, should be used in countries where there is resistance to drugs such as chloroquine. Artemisinin-based drugs are more expensive than conventional treatments, in part because large doses are required.

The WHO reached a high-profile agreement with drug firm Novartis in 2001 for the company to supply one such ACT — artemether–lumefantrine (Coartem) — at cost price. In May this year, the Geneva-based Global Fund to Fight AIDS, Tuberculosis and Malaria took the further step of requiring all of its



Natural high: demand for products of the wormwood plant, which is used to make artemisinin, has soared.

prepare. “Before June 2004, we never got a guarantee of a large order from Novartis,” she says. The company is now ramping up production. A factory that can produce 20 tonnes of artemether a year — the full amount requested by Novartis — is due to open next autumn.

But manufacturing capacity only matters if the raw material is available. Increasing demand has pushed up the price and forced producers to use low-quality, low-yield leaves. Kunming Pharmaceutical will open its own plantation in February.

With production looking bleak for months to come, Bosman says that one of the greatest concerns is the further spread of ineffective fake ACTs. “This will feed a huge black market,” she says.

Work is also under way to find varieties that grow well in local climates in Africa. Tanzania already has a promising variety and should be able to provide 20 tonnes by 2006, says Bosman.

Chemical fix

Long-term, hopes are resting on the development of synthetic artemisinin-based drugs, which avoid the unreliability of cultivation. Scientists at the University of California, Berkeley, have created transgenic bacteria that can make a precursor to artemisinin. (V. J. J. M. *et al.*, *Science*, 2004, 304, 1592–1594.)

Estimated Demand
180 million doses of ACTs required

Total requirement = 27 tonne artemether = 54 tonne artemisinin
From 2400 ha cultivation for one ACT

For at least 10 ACTs
Potential 24000ha

Nature, Vol 432, 18 November 2004, P259

Main producer China stopped exporting artemisinin and India is viewed as potential exporter

World market demand



आर्टीमिसिया जैव ग्राम मिशन का शुभारम्भ

LAUNCHING OF ARTEMISIA BIOVILLAGE MISSION

18 फरवरी, 2005



Source of New Hope Against Malaria is in Short Supply

New drugs based on an old Chinese cure could save countless lives in Africa, if health agencies and companies can find ways to make enough

It seemed like a classic case of bait and switch. In 2004, the World Health Organization (WHO) and the Global Fund for AIDS, Tuberculosis, and Malaria threw their weight behind a radical change in the fight against malaria in Africa. Old, ineffective drugs were to be abandoned in favor of new formulations based on a compound called artemisinin that could finally reduce the staggering death toll. More than 20 African countries have signed on. But the catch is there aren't nearly enough of the new drugs to go around.

Just before Christmas, WHO—which buys the tablets from Novartis for use in African countries—announced that it would deliver only half of the 60 million doses anticipated in 2005, leaving many countries in the cold. “It’s a very cruel irony,” concedes Allan Schapira of WHO’s Roll Back Malaria effort.

Other companies producing the drugs have the same problem as Novartis. Artemisinin is derived from plants grown primarily on Chinese and Vietnamese farms, and they have not kept up with demand. Several plans are afoot to create a new, more stable, and cheaper source. Last month, for instance, the Bill and Melinda Gates Foundation announced a \$40 million investment in a strategy to make bacteria churn out a precursor to artemisinin. But such alternatives will take at least 5 years to develop, so the shortages are likely to persist, warns Jean-Marie Kindermans of Médecins sans Frontières in Brussels.

New malaria drugs are badly needed. The parasite *Plasmodium falciparum* has developed resistance to the mainstays, such as chloroquine and sulfadoxine-pyrimethamine. The death toll—more than a million annually—is not declining, despite Roll Back Malaria, an ambitious international campaign launched in 1998 to halve mortality by 2010.

Enter *Artemisia annua* (also known as sweet wormwood or Qinghao), a shrub used for centuries in traditional Chinese medicine. In the 1970’s, Chinese researchers discovered that its active ingredient, artemisinin, kills malaria parasites; since then, several chemical derivatives with slightly better properties have been developed. Known by names such as artemether or artesunate, they cure more than 90% of patients within several days, with few side effects observed so far. Best of all, no resistance has been seen yet. To keep it that way, WHO and others recommend that

artemisinin compounds always be used with a second drug in a so-called Artemisinin-based Combination Therapy, or ACT.

Widely used in Asia, the introduction of ACTs in Africa has lagged. Countries have been reluctant to make the switch because, at



Fields of gold. Extracts of *Artemisia annua* (bottom) provide powerful new malaria drugs, but farms have not met demand for the shrub.

about \$2.40 per treatment course, ACTs are 10-20 times more expensive than existing drugs. The Global Fund has also dragged its feet, some allege, by funding the purchase of older, cheaper drugs for too long. Things began to change when an expert group published a scathing letter in *The Lancet* in January 2004, accusing the Global Fund and WHO of “medical malpractice.” Both organizations denied the claims, explaining that they supported ACTs but that change took time. Both also concede that the ensuing debate spurred them to redouble their efforts.

But companies are reluctant to produce the drugs, as are farmers to grow *Artemisia*, without guarantees that they’ll sell—and that’s the problem. The Global Fund does not have

nearly enough money to fund the drugs’ introduction across Africa. Donor countries like the U.S. and the U.K. appear reluctant to spend aid money on market guarantees for big pharma, says Schapira, because it could be seen as lining shareholders’ pockets; at an emergency session at WHO just before Christmas, no donors made any commitments.

WHO’s hope is that growing demand will eventually create a stable artemisinin supply at low prices. *Artemisia* farms are now springing up in India, and WHO is supporting experiments to grow the plants in east Africa.

The Gates Foundation is banking on a less fickle supply route. Over the past 10 years, chemical engineer Jay Keasling and colleagues at the University of California, Berkeley, have spliced nine genes into *Escherichia coli* bacteria to make them produce terpenoids, a class of molecules that includes artemisinin. With a few genes borrowed from *Artemisia*, they should be able to produce an artemisinin precursor, Keasling says.

On 13 December, the foundation announced a \$42.6 million grant to the Institute for OneWorld Health in San Francisco—which bills itself as the world’s first non-profit pharmaceutical company—to help Keasling finish the engineering. Then a biotech startup will optimize the process for producing artemisinin—“tons and tons of it,” says OneWorld Health president Victoria Hale—about 5 years from now. Her assumption is that pharmaceutical companies will package OneWorld’s artemisinin derivatives into ACT tablets and sell them at well under a dollar per treatment.

There’s another alternative. Jonathan Vennerstrom and colleagues at the University of Nebraska, Omaha have synthesized a compound called OZ277 (or simply OZ) that, like artemisinin, has a peroxide bridge shielded by large chemical rings. The compound has been tested as an antimalarial in vitro and in animals, and it looks even better than the real thing, Vennerstrom and colleagues reported in *Nature* in August. Ranbaxy, an Indian pharmaceutical company, is developing it further; a phase 1 safety trial has just been completed.

Ideally, 4 or 5 years from now, OZ will result in new drug combinations that have the power of current ACTs but cost less than a dollar per treatment, says Chris Hentschel, chief executive of the Medicines for Malaria Venture (MMV), a non-profit based in Geneva that supports its development. Still, Hentschel is trying to temper his optimism. Drugs can always fail during testing, and even ACTs may eventually lose their efficacy, like almost every malaria drug before. That’s why, despite the new hope, MMV has its pipeline well-stocked with unrelated candidates.

—MARTIN ENSERINK

Science, Vol 307
7 January 2005 p33

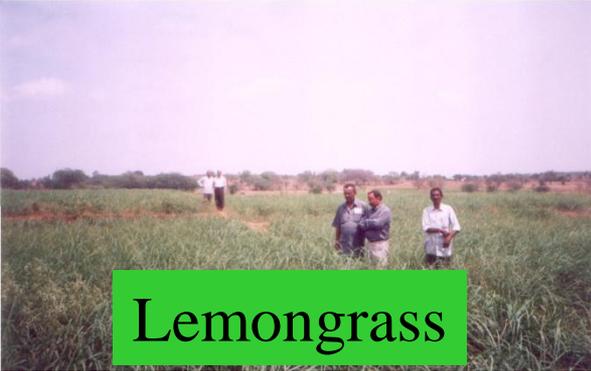


Geranium

UP Plains



Artemisia



Lemongrass

**CIMAP
Biovillage
Mission**



Khus

Patchouli



Mentha

Seed Biovillage 2008



Herb to Product: Value Enhancement

| MAP | Herb | Oil | Aroma Chemical |
|------------|------|------|--|
| Mint | 2 | 350 | 600: Menthol Crystal 1000: Menthyl Acetate 1700: Menthone 6000: <i>Cis</i> -Hexanol |
| Lemongrass | 2 | 300 | 600: Citral 1000: Alpha Beta Ionone 1400: Vitamin A |
| Geranium | 2 | 3000 | 6000: Rhodinol |
| Basil | 2 | 300 | 500: Methyl Chavicol 1000: Anethole |

Rates in Rs. Per Kg

Value Addition Menthol /Essential Oils

- Menthol flakes / bold crystals
- Isolation of aroma chemicals / natural isolates from the mint oils by fractionation distillation
- Derivatization / chemical modifications of isolates for value addition
- Deterpenation / reconstitution of mint oils



Mentha arvensis → Menthol, Menthone / isomenthone, Menthyl acetate

Mentha spicata → Terpenes, l Carvone

Mentha citrata → Linalool & linalool acetate

Mentha piperita → Menthol, pipretone, menthafuron

Laboratory to Industry

The Paradigm Shift

Industry from laboratory



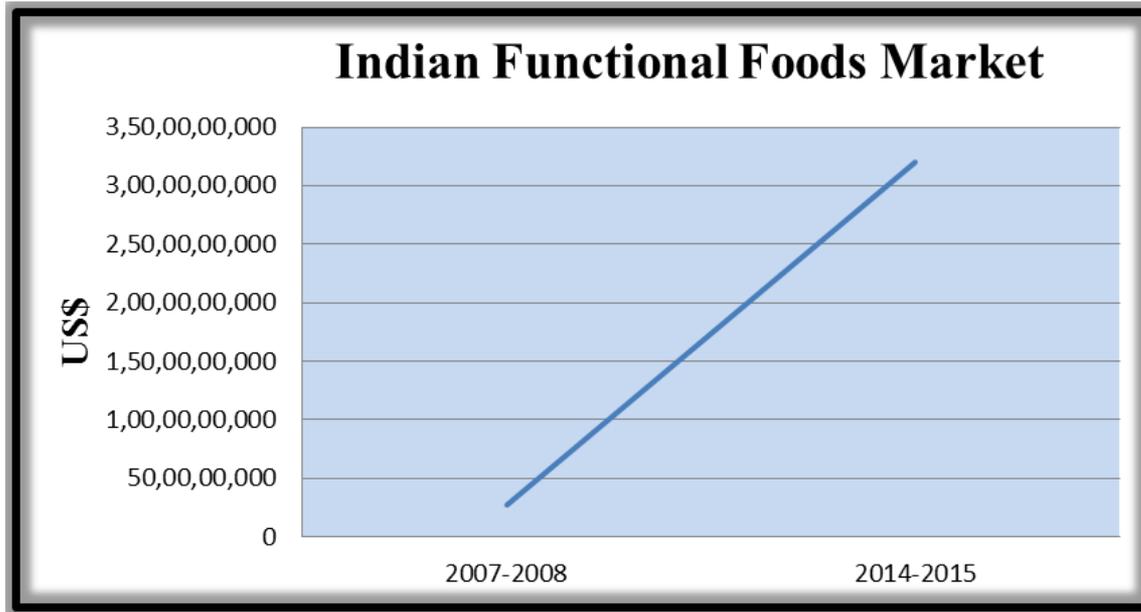
**Nutraceuticals and functional food products
for nutrition based healthcare**

The SKiES Targets

SKiES Life Technologies Pvt. Ltd.

Bringing nature to life





Source: Technopak

In India, the functional food industry has earned revenues of more than US \$ 265 million (Approx Rs 1,325 Crores) in 2007-08 and with an estimated growth rate of 43 %, it will reach US \$ 3.2 billion (Approx Rs 16,000 Crores) in 2014-15. (Source: Technopak)

In India, functional foods are therefore expected to see increased consumption over the next five years resulting in functional foods and beverages garnering greater product share in the market as opposed to dietary supplements (Source: Frost & Sullivan)

“Functional Food”

Typically a functional food encompasses all edible items having a health-promoting and / or disease-preventing property beyond the primary function of providing nutrients.

“Nutraceutical”

A nutraceutical is a product isolated / purified from foods and is normally available in medicinal forms that are not usually associated with food and possesses demonstrable physiological benefit / provides protection against chronic diseases.

Thus, functional foods are fast becoming a part of the meals with health benefits and better delivery.

Frontier Bio-horticulture

Interestingly vegetables and fruits or horticultural crops in general represent the best examples of edible plant harvest having functional food properties with a potential to develop nutritional ingredients or supplements. The perception of horticultural crops and products only as food, pulps and juices in various forms is now changing with developments in nutrition research. The chemistry of horticultural crops including edible and non-edible plant biomass is gaining importance for their metabolome capabilities to compete with conventional medicinal plants constituents for preventive health care

Khanuja SPS, Shukla AK (2011) Human health and nutrition: Functional foods. In: *Horticulture to Horti-Business* (Editors: KL Chadha, AK Singh, VB Patel), Proceedings Book of the Fourth Indian Horticulture Congress held at New Delhi during 18-21 November, 2010, Westville Publishing House, New Delhi, pp 433-445

Probiotics

- Definition: Live microorganisms which when ingested in adequate amounts confer a health benefit on the host.
- Majority of probiotics are Gram +, lactic acid producers
 - Bifidobacterial species and *Lactobacillus* species
 - Survive transit through stomach and duodenum
- Others include: non-pathogenic streptococci, enterococci, *E coli* Nissle 1917, *Saccharomyces boulardii* (yeast)

Fooks, et al. Int Dairy J, 1999

Sheil, et al. In Gastrointestinal Microbiology, 2006

Prebiotics

- Ingested substances that selectively stimulate the proliferation and/or activity of desirable bacterial populations present in the host intestinal tract.
- Usually target bifidobacteria and lactobacilli
 - Bifidogenic or bifidus factors explored in the 50s
- Usually are non-digestible oligosaccharides (NDOs)
 - Lactulose, galacto-oligosaccharides, lactosucrose...

Crittenden and Playne. In Gastrointestinal Microbiology, 2006, pg 285-314.

YoFi Protein & Fibre full Prebiotic Chocolate

Yogurt, the Yo, is an excellent source of protein better than milk not only in quantity but also more importantly the quality. Since yogurt is made with live and active lacto-cultures, it is now a healthy lifestyle favourite. Quality! Because the microbial culturing of the milk proteins during fermentation in yogurt preparation makes these proteins easier to digest. Such proteins are also referred as "pre-digested." like honey is for the carbohydrates!!

Caseins, are the major group of milk proteins that coagulate in yogurt, having the most appropriate amino acid composition for growth and development of the young. Caseins are highly digestible in the intestine and this wonderful quality of these proteins in cattle milk makes it such an important human food. Coagulated casein in yogurt is rich source of amino acids and two important inorganic elements, calcium and phosphorus. Yo, the first value part of YoFi bar is yogurt contributing these nutritious and so easily digestible proteins.

Fibre, the Fi, is the second value part of YoFi bars. Nutritionists recommend 25 to 38 grams of fibre every day and obviously it is not possible to get it from one meal or one source. Best way is to supplement a portion of fibre from a dessert product like chocolate! Although not an energy source for humans, fibre is an important dietary aid that makes the gut healthy, metabolism strong and prevents many diseases or disorders like it can decrease cholesterol levels, help to reduce the risk of heart disease and even help control blood sugar levels.

YoFi gets this from Fenugreek (*Trigonella foenum-gracium*) or traditionally called "Methi" in India which is a leguminous herb possessing wonderful medicinal and spice value. Fenugreek seeds offer the richest source of both soluble and insoluble fibre. The whole seed powder has a bitter taste and odour due to certain constituents, present in its germ portion but not due to its polysaccharide. Purified fenugreek oligosaccharide gum used in this YoFi bar is a completely odourless and tasteless ingredient making the chocolate taste as it should!



Most desirably the fenugreek gum thickens the ingested food to form a gel in stomach trapping fat, sugars and starch hydrolysing 'amylase' enzyme to slow down sugar absorption.

Wow! YoFi bar has Yo (Yogurt) joining the Fi (Fiber) for the gut bringing a smiling life with guts !!



YoFi is wonder of deep scientific functional food research combining taste with nutrition having most digestive proteins with soluble fibre, a necessity of metabolism and healthy life. And that too is in a "GenY" taste format of a chocolate bar that has added value of the prebiotic potential too for making all probiotic supplements effective which we take for gut health by helpful microbes that sustain life!!

What next? YoFi is appearing in deep (Dark chocolate), light (Milk chocolate) and white (Milky bar) choices for adults, teens and children while seniors have all for them too with less sugar and fat. It is for everyone whether you like classic chocolates or you like mild or light.

SKiES Life Technologies Pvt. Ltd.

Bringing nature to life

Research & Development : SKiES Lab, Biotech Park, Kursi Road, Lucknow 226021, UP, INDIA
Head Office : SKiES, E-6, Office-1, 1st Floor, Bali Nagar, New Delhi 110015, INDIA

Contact: Biotech Park : +91 8765346971, Head Office : +91 11 25937717

info@skiesindia.com

www.skiesindia.com



YoFi BAR
Deep Dark Chocolate

Yogurt Protein & Fiber

2 2 7 1 3 9 6 6 0 0 0 5 8 2

FSSAI Registration

2nd July 2013

**YOGURT
PROTEIN
FIBER**



**Launch for Market
13 August 2013**

YO.FI



LiKiES



Yogurt, the Yo, is an excellent source of protein better than milk not only in quantity but also more importantly the quality. Since yogurt is made with live and active lacto-cultures, it is now a healthy lifestyle favourite. Quality! Because the microbial culturing of the milk proteins during fermentation in yogurt preparation makes these proteins easier to digest. Such proteins are also referred as "pre-digested." like honey is for the carbohydrates!!

Fibre, the Fi, is the base value part of **LiKiES**. Nutritionists recommend 25 to 38 grams of fibre every day and obviously it is not possible to get it from one meal or one source. Best way is to supplement a portion of fibre from a dessert product like chocolate! Although not an energy source for humans, fibre is an important dietary aid that makes the gut healthy, metabolism strong and prevents many diseases or disorders like it can decrease cholesterol levels, help to reduce the risk of heart disease and even help control blood sugar levels.

Most desirably the fenugreek gum thickens the ingested food to form a gel in stomach trapping fat, sugars and starch hydrolysing 'amylase' enzyme to slow down sugar absorption.

LiKiES, are real love for the those who want to combine taste with nutrition and have healthy flavours of nature in candies format. The fruits in **LiKiES** give them power of antioxidants, β -carotene, flavonoids, vitamins, amino acids and micronutrients. The matrix of "Makhana" provides healthy starch better than dry fruits along with protein, vitamin C, iron and calcium. Almonds provide healthy lipids with high quality protein. Yogurt protein being of fermented nature are much more digestive. Cardamon (Elaichi) is not only the aroma but also a rich source of antioxidant spice.

Wow! YoFi bar has Yo (Yogurt) joining the Fi (Fiber) for the gut bringing a smiling life with guts !!

LiKiES have a rainbow of fruits, almonds, yogurt, makhana & aroma joining the dietary fibre for the healthy gut.

Ingredients: Sugar, Hydrogenated Vegetable Oil, Yogurt Protein, Fenugreek Fiber (Soluble), Cocoa Solids & Antioxidants (E 322) with specified fruit pulps, almonds, makhana and/or spices as defined by candy flavours. Added artificial (ethyl vaniline) natural and nature identical permitted flavours.

Nutritional Information (Per 100g)

| | Chocolate | Milky Bites |
|----------------------------------|-----------|-------------|
| Energy K Cal | 521 | 548 |
| Carbohydrate g | 59.4 | 54.35 |
| Sugar g | 43.7 | 45.12 |
| Protein g | 8.3 | 7.99 |
| (Supplemented Yogurt Protein) g | 3.0 | 3.0 |
| Fat g | 27.8 | 33.13 |
| Dietary Fiber g | 9.8 | 9.86 |
| Supplemented Soluble Fiber) g | 2.0 | 2.0 |

FSSAI Reg. No.: 22713966000582



SKiES Life Technologies Pvt. Ltd.

Research & Development : SKiES Lab, Biotech Park, Kursi Road, Lucknow 226021, UP, INDIA
Head Office : SKiES, E-6, Office-1, 1st Floor, Bali Nagar, New Delhi 110015, INDIA

info@skiesindia.com,

www.skiesindia.com

Contact: Biotech Park : +918005044134,

Head Office : +91 11 25937717

New Products Launch 10 December 2013



| NUTRITION INFORMATION* | |
|---------------------------------|----------|
| | Per 100g |
| Energy Kcal | 521 |
| Carbohydrate g | 59.4 |
| Added Sugar g | 43.7 |
| Protein g | 8.3 |
| (Supplemented Yogurt Protein) g | 3.0 |
| Fat g | 27.8 |
| Fiber g | 9.8 |
| (Supplemented Soluble Fiber) g | 2.0 |
| Intact Sesame Seeds g | 20.0 |

* Approximate Value

STORAGE CONDITIONS: Store in Cool, Hygienic & Dry Place, 20°C & 55% Relative Humidity. Ensure product is stored in air tight container or pouch once opened, Avoid moisture contact, Change in physical appearance is inevitable due to tropical climate, However, it does not affect the eating quality of product.

www.skiesindia.com

nutraSKY™
Nutrition that tastes WOW!

YoFi™ BAR
Classic Milk Chocolate
Yogurt Protein & Fiber with Til Grains

Wow!! Til version of LiKIEs and YoFi brings so many nutrients like Calcium, Manganese, Copper, Iron, Phosphorus, Selenium and Zinc with Vitamin B1, fiber and protein embedded in antioxidants and omega fatty acids in YoFi matrix of taste & health together.

CONTAINS ADDED ARTIFICIAL (ETHYL VANILLIN), NATURAL & NATURE IDENTICAL FLAVOUR (S)

Net weight : 15 gms
Best before 9 month from Packaging

Ingredients: Sugar, Hydrogenated Vegetable Oil, Yogurt Protein, Fenagreek Fiber (Soluble), Cocoa Solids & Antioxidants (E 322) with specified amount of intact Sesame (Til) seeds. Added artificial (ethyl vaniline) natural and nature identical permitted flavours.

Manufactured by:
SKIES Life Technologies Pvt. Ltd.
Biotech Park, Kursi Road, Lucknow 226021, UP, INDIA
Customer Care No. : +91 8005044134
care@skiesindia.com

FSSAI Reg. No. : 22713966000582

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Batch : CHM(TL)13272

Mfg. : Dec.13

MRP Rs.: 15/-
(incl of all taxes)

**Designer foods with functionality are possible
If you have worked well on matrix that delivers**

Power of JV : ProIN



ProIN Megabite & MegaGrain
 Delivering complete protein in nature's way !
 Health on Cocoa and Fenugreek Matrix with great taste !!



Loaded with Antioxidants & Dietary Fibre for an ever toned up body

Vegetarian bar rich in all eight essential amino acids meeting body's need

ProIN MEGABITE CLASSIC
 PROTEIN 20%
 COCA

- ❖ Combining smoothness of a bar with richness of natural vegetarian protein.
- ❖ Just dissolves in mouth exciting the taste buds making protein absorption cool way
- ❖ Real prebiotic bar enriched with soluble fiber for a healthy gut and supporting digestion
- ❖ Enriched with 20% protein combo from Yogurt and Soybeans in cocoa matrix full of antioxidants.

ProIN MEGABITE GRAINIE
 PROTEIN 23%
 COCA

- ❖ First of its kind health bar with flavor and goodness of cocoa and studded crunchy protein
- ❖ Protein grains loaded with antioxidant and fiber embedded in a taste full choco matrix
- ❖ The grain and cream texture gives a unmatched feel in the mouth and protein goes in rocking.
- ❖ Superhigh protein bar with 23% protein inviting you to indulge in taste for body health

ProIN MEGAGRAIN
 PROTEIN 24%
 COCA

- ❖ The only product of its kind with crunchy prebiotic grains to munch protein
- ❖ The protein full grains that taste wonderful with cocoa top note and antioxidant touch
- ❖ The protein granules that rock in mouth, eat them straight or drink through shake as smoothie
- ❖ Unmatchable towering 24% protein that you cannot resist such a tasteful format



Technology & Manufacturing
 SKIES Life Technologies Pvt. Ltd.
 SKIES Lab, Biotech Park, Kursi Road,
 Lucknow-226021, UP, INDIA

Bringing nature to life

Marketing and Distribution
 Do You Even Gym (DYEG)
 E-6, Bali Nagar, Raja Garden
 Lucknow-226002, UP, INDIA



Vegetarian protein bars and grains for body builders



**Protein delivery is important
....and not just the content**

**29-30 March 2014
Body Power 2014, Mumbai**



HEALTHKART
snapdeal.com
ShopClues.com



ProIN

Available Online at

amazon.in

snapdeal.com

ShopClues.com



Think Resources !!

..... and market ??

Glocal – not local nor only global

Kalanamak rice, 'Buddha's gift', awarded GI tag

Deriving its name from the black husk (kala) and a mild salty (namak) taste, it is considered as one of the finest rice varieties in the international market.

CHENNAI: If you think Basmati rice, a subject of many patent battles, is the best, here is Kalanamak rice. Known for its aroma and distinct taste, Kalanamak has now been awarded the Geographical Indication (GI) tag.

It surpasses Basmati rice - the variety with the highest trade volume in the international market - in every aspect except grain length, says Uttar Pradesh State Biodiversity Board in a document on agricultural diversity. It is soft, easily digestible and has a long shelf life. It also has "greater head rice recovery after polishing and better elongation after cooking," says the board.

According to the GI registry journal, grains similar to Kalanamak were found from excavation sites at Aligarhwa (Siddharthnagar, UP) - identified as the territory of Buddha's father, king Shuddodhan. The name 'Shuddodhan' means pure rice.

Source: Manish Raj, TNN Oct 4, 2013, Times of India

Strategic Placement...

UP as the Nutra Capital of India

Global Nutraceutical Market, 2011

Source: Frost & Sullivan

The Global Nutraceutical market in 2011 was estimated to be \$149.5 Billion, with US, Europe and Japan being the largest regional markets accounting for nearly 93% of the global Nutraceutical demand. These markets are nearing maturing, with exceedingly high per capita spends on nutraceuticals products (Japan has a per capita spend of \$51/person/year, while US and Europe have \$40 and \$35 each. The global average is only around \$21*/person/year) Thus forcing Nutraceutical manufacturers to look at developing countries such as India and China, which have considerably lower per capita spends on Nutraceutical products, as key growth regions for their Nutraceuticals portfolio

While global nutraceuticals market was valued at US \$ 149.5 billion in 2011 (Source: Frost & Sullivan), it is forecast to rise to almost US \$ 207 billion by 2016 (Source: BCC Research)

Indian Nutraceutical Market Growth

Source: Frost & Sullivan

Indian nutraceuticals market was valued at US \$ 1480 Million (Approx Rs 7,400 Crores) in 2011 (i.e. 0.9899 % share of Global nutraceuticals market) and is expected to be roughly US \$ 2731 Million (Approx Rs 13,655 Crores) by 2016 (i.e. 1.3193 % share of Global nutraceuticals market). (Source: Frost & Sullivan and BCC Research). The Indian Nutraceutical market is estimated to grow to US \$ 2731 Million in 2016 at a CAGR of 13 %. Functional foods will be the quickest growing category till 2015 followed by Dietary Supplements. However, dietary supplements, specifically herbal and dietetic supplements will form the greatest opportunity areas for Nutraceutical manufacturers , driven by growing demand from an evolving consumer base.

Universities & Institutions in Uttar Pradesh

UNIVERSITIES

Uttar Pradesh has a total of 53 universities, the second-highest in all Indian states and territories.

Central Universities: 4

State Universities: 23

Private Universities: 16

Deemed Universities: 10

Total: 53

Uttar Pradesh has four Central Universities, the highest for any Indian state along with Delhi

| University | Location | Established | University Status | Comments | References |
|--|-----------|--|-------------------|--|---------------------------|
| <u>Aligarh Muslim University</u> | Aligarh | 1875 as Mohammedan Angelo-Oriental College | 1920 | It was established by <u>Sir Syed Ahmed Khan</u> . | [2] |
| <u>Allahabad University</u> | Allahabad | 1876 as Muir Central College | 1887 | This university was at one point called the "Oxford of the East". | [3][4] |
| <u>Babasaheb Bhimrao Ambedkar University</u> | Lucknow | 1996 | 1996 | It is one of the newest central universities in India. It is named after <u>Babasaheb Bhimrao Ambedkar</u> , the chief architect of the <u>Indian Constitution</u> . | [5] |
| <u>Banaras Hindu University</u> | Varanasi | 1916 | 1916 | It was founded by Pandit <u>Madan Mohan Malviya</u> on 1350 acres (5.5 km ²) of land donated by the <u>Kashi Naresh</u> , the hereditary ruler of Banaras. | [6][7][8] |

Example Uttar Pradesh as the Niche

**UP Network Mission on Nutrition
(UPNM - Nutrition)**

Development of Technology Resource Hub of Food Biotech in UP

*Invigorating Uttar Pradesh as the Nutra-Capital of India through
Secondary Agriculture and Biotech Translational Interventions*

Linkage with Complementing Mission Program in Uttar Pradesh

Hausla Campaign of UP Government on Child & Mother Health will be the main beneficiary and direct user of the outcome since it aims at the healthcare of woman and child on holistic mode from preventive to curative by reducing morbidity and mortality at all levels as a catalyst mission of societal health at grass root level. Nutrition component to meet this objective will be complemented by this proposed mission network program

Uttar Pradesh has all the advantages ...

... of becoming a nutraceutical hub of India as the most affected and populated state with agroclimatic/soil diversity suiting variety of plantations and crops that can provide high value harvest for secondary agriculture leading to nutrition products.

Indian long lasting tradition of maintaining health by the intake of appropriate food and nutrition is also truly represented by the state of UP. India is home to almost all kinds of plants ranging from tropical, sub-tropical and temperate zone plants. India is blessed with abundant herbs; the extracts of many of these herbs have been standardised and tested clinically for its quality and efficacy.

These extracts form an integral part of nutraceuticals and functional foods that are available in developed countries.

With R&D organisations and state agricultural universities in UP, drivers of the mission are evident and this network programme makes best cementing force to deliver in a coordinated way of complementarities

Example Networks that delivered

- **NMITLI, CSIR**
- **CSIR Biomolecule Prospection Programme**
- **DBT Network Programmes**
- **DBT: SBIRI, BIRAC, BIG and so on..**
- **ICAR: NARP, NATP, NAIP**
- **CSIR Network Mission Projects**

Vision Uttar Pradesh

- While Indian share is projected at USD 3,2 billion for 2015-16 amounting to just a little above 1% of the world market, it appears too soft and conservative. In this scenario, the state of UP through strategic targets and focus on nutra sector can itself aim to cross this figure in next 5 years and show the leadership and path to the country which should then target minimum 10% of the world share while UP becomes the driving force with 50% of the national share emanating from the state.
- This is tough target but in a methodical way and strategic approach involving University-Institutes-Industry Combo, this can benefit UP not only for fighting its own menace of under- and mal-nutrition at societal level but also raising the economy through its placement at global level representing India as its Nutra-Capital. The plan through this network mission will be logic and soil-climate based selection of crops, plants and R&D based post-harvest technologies touching state-of-art status through steering by industry (SKiES India) and Biotech Park in Lucknow with universities and institutions on PiP mode which are professionally competent to take up the task to the end.

Networking Organizations Example UP Nutrition Mission

- **Central Institutes & Universities**

BBAU – BHU– AU -AMU

CISH – NBRI - CIMAP

UPTECH University – HBTI (BEFT) Kanpur

- **State Agriculture Universities**

- **Narendra Dev University of Agriculture and Technology Faizabad, UP (SAU/ICAR)**

- **Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, UP (SAU/ICAR)**

- **State Food Processing & Technology Training Centres, Lucknow**

(Ministry of Horticulture & Food Processing)

- **R-FRAC (Regional Food Analysis Centre), Lucknow**

Translating Agencies (PiP Mode)

- **Volunteering Industry Network (Nodal SKiES India) and others in Lucknow region (UPSIDC members)**

- **Biotech Park Lucknow (UP State & DBT) as the Hub involving universities and institutes of the region**

Implementing Ministry & Department

Department of Science & Technology,

Ministry of Science & Technology, Uttar Pradesh

Department of Biotechnology, Government of India

Targets....

Phase I: Year 1-2

Products and Technologies based on existing technology leads with institutions (network partners) for SSI/Cottage Industry

Phase II: Year 2-4

Products & Technologies based on focussed R&D on leads that need validation and optimisation for Medium Scale and Small Industries

Phase III: Year 3-5

Products & Technologies that are further improved for cost and need based optimisation and their marketing/industrial adoption at large scale for Industry at all scales

Frontier Bio-horticulture

Interestingly vegetables and fruits or horticultural crops in general represent the best examples of edible plant harvest having functional food properties with a potential to develop nutritional ingredients or supplements. The perception of horticultural crops and products only as food, pulps and juices in various forms is now changing with developments in nutrition research. The chemistry of horticultural crops including edible and non-edible plant biomass is gaining importance for their metabolome capabilities to compete with conventional medicinal plants constituents for preventive health care

Khanuja SPS, Shukla AK (2011) Human health and nutrition: Functional foods. In: *Horticulture to Horti-Business* (Editors: KL Chadha, AK Singh, VB Patel), Proceedings Book of the Fourth Indian Horticulture Congress held at New Delhi during 18-21 November, 2010, Westville Publishing House, New Delhi, pp 433-445

Underutilized fruits for nutritional security – Hidden Opportunity

- The people of the rural regions are severely malnourished along with multiple nutrient-deficiency disorders due to ignorance about importance of fruits and vegetables in their diets.
- The forest areas are full of biodiversity having natural vegetation which is not harnessed fully.
- Due to which a wide gap is formed between health and optimal use of natural sources of nutrients, i.e., underutilized crops.
- The crops, which are neither grown commercially on large scale nor traded widely, may be termed as **underutilized horticultural crops**.
- These crops are cultivated, traded, and consumed locally.
- Their consumption can provide nutrition to the poor and needy tribals by meeting the nutrient requirements of vulnerable groups.
- **As underutilized fruits, nuts, and vegetables are a rich source of carbohydrates, fats, proteins, energy, vitamins-A, B1, B2, B3, B6, B9, B12, C, folic acid, and minerals-Ca, P, Fe, and dietary fiber, they have the nutritional capacity to prevent and cure various diseases like kwashiorkor, marasmus, night blindness, anemia, diabetes, cancer, hypertension, and hidden hunger.**

The top twelve key trends in food, nutrition and health

1. **Nutritionally functional: the biggest trend.**
2. **Dairy: Dairy's rebirth as a natural whole food.**
3. **Protein: Beyond the tipping point.**
4. **Energy: An unstoppable global trend.**
5. **Weight wellness: Consumer thinking redefines a market.**
6. **Snacking: The snackification of everything.**
7. **Slow energy: A new frontier.**
8. **Sugar: The demonisation of sugar.**
9. **Permission to indulge: A very smart strategy.**
10. **Free-from: The consumer-led trend.**
11. **Seniors: Opportunity for science and smaller companies.**
12. **Kids' nutrition: Communication, indulgence and naturalness key to Kids' success.**

Top five industry drivers (EU) in 2014

- FoodNavigator predicts

By Caroline Scott-Thomas+, 06-Jan-2014

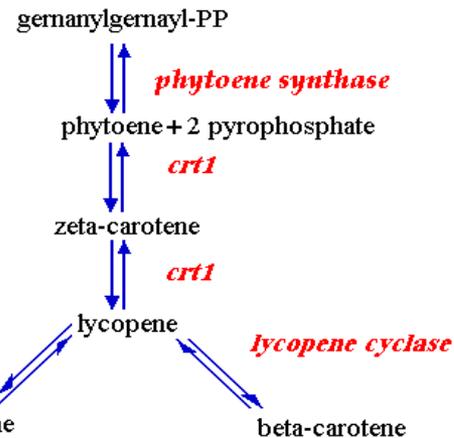
As the New Year dawns, FoodNavigator predicts the top five drivers of the European food industry in the year ahead.

- **Focus shift from ‘sustainability’ to food waste use**
- **Move from ‘local’ to ‘authentic’**
- **Food Information for Consumers (FIC) regulation**
- **Protein in everything (sources include insects)**
- **Healthy indulgence**

Ingro Potrykus and Peter Beyer

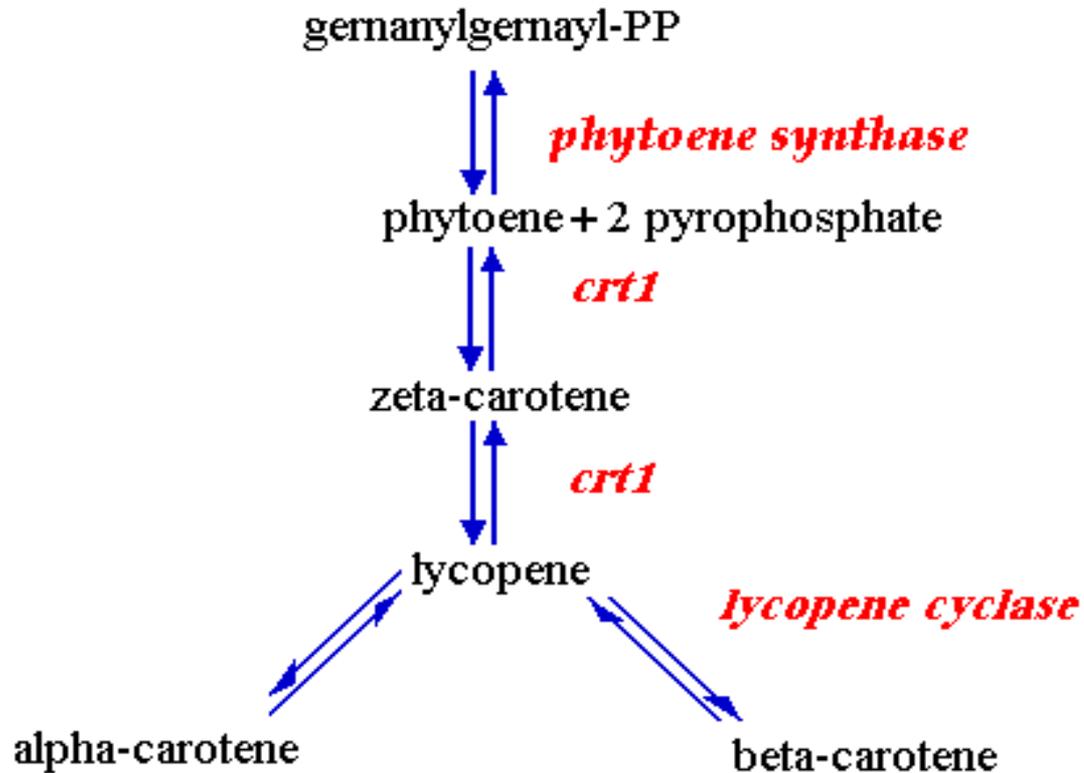


Golden Rice



***psy* (phytoene synthase) & *lyc* (Lycopene cyclase)**
both from Daffodil (*Narcissus pseudonarcissus*)
crt1* from the soil bacterium *Erwinia
***Science* 2000. 287 (5451): 303-305**

Golden Example of Terpenoid Pathway use in Food Crop: Rice for Vitamin Fortification plus...



Think beyond: Horti Rice !!
Tomato.... Moringa....

Mediterranean Diet Helps Control Cholesterol Levels



ScienceDaily (Nov. 1, 2010) — The addition of monounsaturated fat (MUFA) to a cholesterol-lowering dietary portfolio in patients with mild to moderate elevated cholesterol levels increased HDL by 12.5% and lowered LDL levels by 35%, found a study published in *CMAJ (Canadian Medical Association Journal)*.

Plate with baked stuffed eggplants

Sulforaphane

Plant Source: Broccoli

Nutritional Potential / Use:
Stimulant for enzymes that detoxify
chemical carcinogens



R & D Challenge / Scope:

The trait has been selectively bred out of commercial broccoli because of its bitter taste

Dietary Fiber

Plant Source:

Avocado, Oat, Flax, Chia,
Whole grains, Cranberry



Salvia
hispanica
2mm long



Nutritional Potential / Use:

Essential dietary ingredient
but average consumption is
only 14-15g daily against the
RDI of 38 grams

R & D Challenge / Scope:

Fiber content needs to be enhanced in food items for
optimum fiber diet that can be RDI equivalent

Omega-3 fatty acids

Plant Source:
Chia, Flax, Soy



Nutritional Potential / Use:

Docosahexaenoic acid (DHA) and Eicosapentaenoic acid (EPA) are made by seawater microalgae, which in turn is consumed by fish that accumulate these fatty acids. Therefore source is mainly fish or rarely microalgae but not plants.

R & D Challenge / Scope:

Plant sources normally contain only alpha linolenic acid (ALA) and lack the more healthful DHA and EPA. Strategic breeding and biotech interventions are required so that DHA and EPA, can be produced directly from microalgae or designer plants

Calcium fortified food

Plant Source:

Soybean, Peanuts, Pea etc



Nutritional Potential / Use:

Soy milk fortified with calcium is the option for people suffering from milk allergy due to lactose intolerance



R & D Challenge / Scope:

Taste acceptability demands improvement. Similarly bioavailability of calcium (vis-à-vis cow milk) and need of alternate sources can be visualized

Vitamins and Minerals

Plant Source:
Most fruits and vegetables



Nutritional Potential / Use:
Nutritional deficiencies arising out of geographical and regional variation in horticulture crop production patterns can be managed through functional foods



R & D Challenge / Scope:

Identification of synergistic interactions that enhance accessibility, bioavailability and biological potency is desirable

β -carotene

Plant Source:

Carrot, Moringa, GM rice



Nutritional Potential / Use:

Golden Rice developed by transforming rice with three genes: phytoene synthase (psy) and lycopene cyclase (lyc) from daffodil (*Narcissus pseudonarcissus*) and crt1 from the soil bacterium *Erwinia uredovora*. In Golden Rice 2, psy gene from maize was used with crt1 from the original golden rice to get a higher carotenoid content

R & D Challenge / Scope:

Technology could not be commercialized effectively beyond proof-of-concept stage due to large dietary requirements of the fortified rice.

Sources like Moringa offer non-GM sources that are edible and cultivable both and have no safety risks or toxicity

Annona squamosa (Annonaceae)

Atis / Custard apple

Major volatile constituents of *A. squamosa* L. bark

1H-cycloprop(e)azulene (3.46%)
germacrene D (11.44%)
bisabolene (4.48%)
caryophyllene oxide (29.38%)
bisabolene epoxide (3.64%)
kaur-16-ene (19.13%)

Annonaceous acetogenins have also been isolated from *A. squamosa* seeds. **Squamotacin** showed cytotoxic selectively for the human prostate tumor cell line (PC-3).



Medicinal Uses

- ❖ The leaves serve as a purgative.
- ❖ Bark decoction is used to stop diarrhea.
- ❖ Decoction of the leaves and/or root is taken in cases of dysentery.
- ❖ Decoction of the leaves is good to cure diabetes.
- ❖ The leaves are applied to abscesses and open wounds and used to cure skin itches.
- ❖ The crushed leaves are sniffed to overcome fainting spells and hysteria.
- ❖ The mashed, ripe fruit, mixed with salt, is applied on tumors.
- ❖ Decoction of the leaves is used to aid digestive problem, and to treat colds.
- ❖ Decoction of the leaves is employed in baths to alleviate rheumatic pain
- ❖ Decoction of the leaves is used to clarify urine.
- ❖ The seeds immersed in coconut oil is a traditional treatment for head and body lice. The seed is also made into powder and can be applied on head to kill lice in hair.

It is high in calories and is a good source of iron. The fruits contain no sodium, they are high in carbohydrates and rich in calcium, vitamin C and phosphorus, and with a sugar content of about 50-50 (glucose and sucrose). The roots of the sugar apple tree are powerful enough to induce abortions.

Punica granatum



239 Nucleotides

No EST

31 Proteins

In human pilot studies, juice of the pomegranate was effective in reducing heart disease risk factors, including LDL oxidation, macrophage oxidative status, and foam cell formation, all of which are steps in atherosclerosis and cardiovascular disease.

- Pomegranate aril (seed casing) juice provides about 16% of an adult's daily **vitamin C** requirement per 100 ml serving, and is a good source of **vitamin B5** (pantothenic acid), **potassium** and antioxidant **polyphenols**.
- The seeds also supply fibre and unsaturated oils.
- The most abundant polyphenols in pomegranate juice are the hydrolyzable tannins called **ellagitannins** formed when **ellagic acid binds** with a **carbohydrate**.
- **Punicalagins** are unique pomegranate tannins with free-radical scavenging properties.
- During intestinal metabolism by bacteria, ellagitannins and punicalagins are converted to **uroolithins** which have unknown biological activity *in vivo*.
- Other phytochemicals include **polyphenolic catechins**, **gallocatechins**, and **anthocyanins**, such as **prodelphinidins**, **delphinidin**, **cyanidin**, and **pelargonidin**.

Vitis vinifera

Wine Grapes



113676

Nucleotides

362193 ESTs

76179 Proteins

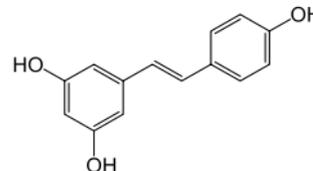
A grape is a **non-climacteric** fruit. It can be eaten raw or used for making jam, juice, jelly, vinegar, wine, grape seed extracts, raisins, and grape seed oil. It is also used in some kinds of confectionery.

• Approximately 71% of world grape production is used for wine, 27% as fresh fruit, and 2% as dried fruit. **India was ranked 10th** among the highest grape producing countries of the world in 2009.

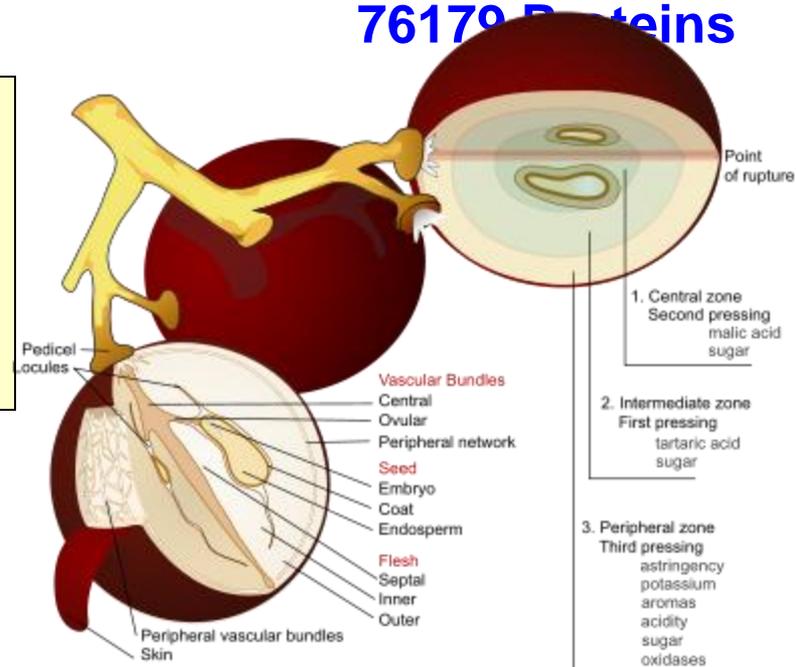
French Paradox

Although the French tend to eat higher levels of animal fat, the incidence of heart disease remains low among them due to protective benefits of regularly consuming **red wine**. Apart from potential benefits of alcohol itself, including reduced platelet aggregation and vasodilation, polyphenols (like **resveratrol**) in the grape skin provide other health benefits.

Trans-Resveratrol



(3,4',5-trihydroxystilbene) - a stilbenoid



Citrullus lanatus

Watermelon

349 Nucleotides
Proteins

8584 ESTs

251



- A watermelon contains about 6% sugar and 92% water by weight.
- As with many other fruits, it is a source of **vitamin C**.
- Contains large amount of amino acid **citrulline**, **lycopene** and **beta-carotene**.
- Seed is **demulcent**, **diuretic**, **pectoral** and **tonic**. It is also used to treat treat bed wetting and is also a good vermifuge.
- A fatty oil in the seed, as well as aqueous or alcoholic extracts, **paralyze tapeworms** and **roundworms**.
- The fruit is used as a febrifuge. It is also diuretic, being effective in the treatment of **dropsy** and **renal stones**. It contains lycopene.

Musa spp.

Banana



4591 Nucleotides 31314 ESTs 2793
Proteins

- Bananas come in a variety of **sizes and colors** when ripe, including yellow, purple, and red.
- Staple **starch** of many tropical populations.
- Reduce the risk of **colorectal cancer**, **breast cancer** and **renal cell carcinoma**.
- Individuals with a **latex allergy** may experience a reaction to bananas.
- Contain considerable amounts of **vitamin B6**, **vitamin C**, and **potassium**. The latter makes them of particular interest to athletes who use them to quickly replenish their **electrolytes**.
- In India, juice is extracted from the corm and used as a home remedy for **jaundice**, sometimes with the addition of honey, and for **kidney stones**.
- India is the top banana producing country of the world.

Solanum lycopersicum

Tomato



127700 Nucleotides 298229 ESTs 5821
Proteins

1 Genome Sequence

- They contain **lycopene**, one of the most powerful natural antioxidants. It is found to prevent **prostate cancer** and enhance the skin's ability to protect against harmful UV rays .
- Tomato varieties are available with double the normal vitamin C (**Doublerich**), 40 times normal vitamin A (**97L97**), high levels of anthocyanin (**P20 Blue**), and two to four times the normal amount of lycopene (numerous available cultivars with the **high crimson gene**).
- Its consumption has been associated with decreased risk of breast cancer, head and neck cancers and might be strongly protective against neurodegenerative diseases.
- Green unripe fruit of the tomato plant contain small amounts of the poisonous alkaloid **tomatine**.
- Tomatoes have been linked to seven **salmonella outbreaks** since 1990.

Capsicum annuum

Capsicum

1628 Nucleotides 118060ESTs 1283
Proteins

- Despite being a single species, *Capsicum annuum* has many cultivars, with a variety of names.
- **Capsaicin** and several related compounds are called **capsaicinoids** and are produced as a secondary metabolite by chili peppers, probably as deterrents against certain herbivores and fungi
- Capsaicin, creates a burning sensation once ingested.
- It is a potential inhibitor of cholera toxin production in *Vibrio cholerae* (Chatterjee et al 2010).
- It is currently used in topical ointments, as well as a high-dose dermal patch (trade name **Qutenza**), to relieve the pain of peripheral neuropathy such as post-herpetic neuralgia caused by shingles.
- Capsaicin creams are used to treat **psoriasis** as an effective way to reduce itching and inflammation



- Capsaicin may help treat ear infections such as **otitis**.
- Also the active ingredient in riot control and personal defense **pepper spray** chemical agents.
- Acts as a **pest deterrent**.

Pseudocereal Proteins

The protein content of pseudocereals is higher than in cereals species. But important is the fact that the quality of the protein is much better. In particular lysine, the limiting amino acid in cereals can be found in high amounts. The high content of arginine and histidine, both essential for infants and children, makes amaranth and quinoa interesting for the nutrition of children. Protein quality not only depends on the amino acid composition, but also on the bioavailability or digestibility. Protein digestibility, available lysine, net protein utilisation (NPU) or protein efficiency ratio (PER) are widely used as indicators for the nutritional quality of proteins. In this respect, the values for pseudocereal proteins are definitively higher when compared to cereals and are close to those of casein. The protein composition of the pseudocereals is typical for dicotyledoneae (2S albumins, 11S and 7S globulins) and therefore similar to proteins of legumes, crucifers and composites (Marcone, 1999). As only a very low amount of prolamins, which differ from those found in wheat, is present pseudocereals are suitable for diets of persons suffering from coeliac disease.

All pseudocereal proteins are highly soluble and thus applicable in functional foods. Protein concentrates from amaranth exhibited much better solubility, foaming and emulsification than two commercial soy proteins (Bejosano and Corke, 1999) and it has been suggested that amaranth protein isolate can act as an effective foaming agent (Fidantsi and Doxastakis, 2001). Good functional properties were especially found for amaranth globulins, while amaranth albumins showed excellent foaming capacity and foaming stability at pH 5, suggesting that they could be used as whipping agents like egg albumins. Depending on protein and thermal conditions, amaranth proteins are able to form self-supporting gels that could be applied in different gel-like foods.

Pseudocereal Lipids

The fat content of pseudocereals is also higher compared to most cereal species. Additionally, the fat is characterised by a high content of unsaturated fatty acids (very high content of linolenic acid). Amaranth contains a high amount of squalene, a highly unsaturated open chain triterpen, which is usually only found in liver of deep sea fish and other maritime species. Squalenes are widely used in pharmaceutical and cosmetic applications.

Pseudocereal Carbohydrates

Mono- and disaccharides can only be found in small amounts in pseudocereals. With a diameter of only 1-3 μm amaranth and quinoa starch granules are among the smallest known. Typical is also their low amylose content of max. 10%. The size of buckwheat starch granules with 2-7 μm is also still below the size of cereal species, but its amylose content is extraordinarily high. Especially in *F. esculentum*, it can reach values of up to 50%. The fibre content of amaranth and quinoa lies in the range of other cereals and shows great variation within different species.

The small size of the starch granule as well as its high amylopectin content explains most of the physical properties of amaranth starch. Compared to other cereal starches, amaranth starch shows excellent freeze-thaw and retrogradation stability. Quinoa starch granules can be found as single polygonal granules, but also in complexes, where up to 14,000 single granules can be bound together to form one complex, either spheroidal or oblong. Therefore full gelatinisation of the quinoa starch is difficult. After drum drying, for example, part of the starch remains in its native form, whereas all other starches are fully gelatinised by drum drying. The high amylose content of buckwheat leads to high expansion indices during extrusion cooking and gives a fine, crispy texture of the extrudates.

| Process | Products | suitable for/specific processing properties |
|-------------------------------|--|--|
| cooking | cooked seeds | amaranth – texture changes of cooked seeds during cooling, quinoa and buckwheat |
| puffing or popping | popped, expanded seeds | amaranth |
| milling | wholemeal flour | amaranth, quinoa, buckwheat |
| milling and classification | flour fractions, protein-rich or starch-rich flour fractions | amaranth and quinoa after adaptation or processing parameters, buckwheat |
| cooking and flaking | Flakes | amaranth, quinoa, buckwheat |
| drum drying | pregelatinised flours | amaranth, buckwheat quinoa – no full starch gelatinisation |
| cooking extrusion | cooked, expanded or non expanded products | amaranth and quinoa only by blending with low-fat raw material due to its high fat content |
| cooking extrusion and milling | pregelatinised flours | buckwheat – very good expansion |
| cooking extrusion and flaking | Flakes | |
| germination (malting) | sprouts, malt | amaranth, quinoa, buckwheat |
| direct starch hydrolysis | protein concentrates, glucose syrup | amaranth, quinoa, buckwheat |
| starch isolation | isolated starch | amaranth, quinoa, buckwheat |

Minor Millets

- Millet is a general term for a wide range of cereals.
- Minor millets are a group of grassy plants with short slender culm and small grains possessing remarkable ability to survive under adverse conditions like limited rainfall, poor soil fertility and land terrain.
- They are also known as coarse cereals and are staple food for the tribal people, where cultivation of major cereals like rice, wheat and maize is either not popular or fail to produce good yields.
- The top producer was India contributing 44% of the global production. Bastar district of Chhattisgarh is an important production hub.
- In addition to be nutritionally rich, the advantage of growing minor millets is that it is a rainfed crop which forms part of a multi-cropping system, in the sense that it is mostly grown along with legumes and oilseeds.
- On the darker side, they are underutilized and neglected crops owing to their lower Preference driven by affluence, longer time and efforts involved in processing of the millets and the lower cooking quality. If these problems could be solved, their high nutritional value can make them doubly valuable as food for farming families and a potential source of income.

Different minor millets, their panicles, standing crop view and whole grains.



Acknowledgement...



Team CIMAP (CSIR)

The green path to better health & life

Translating R&D into Innovation Ventures



Teams are always there – we need to see



NutraHelix Biotech (P) Ltd
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Resourcing Plants for Their Metabolites as Unique Natural Products for Nutrition and Health Care

“Those who think they have no time for healthy eating will sooner or later have to find time for illness.”

Edward Stanley

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