



# Natural Synergy

## Essential Oils in Cancer Research

**Nicole Stevens**

Brigham Young University

UNLV Cancer Research Institute

# Introduction: Cancer

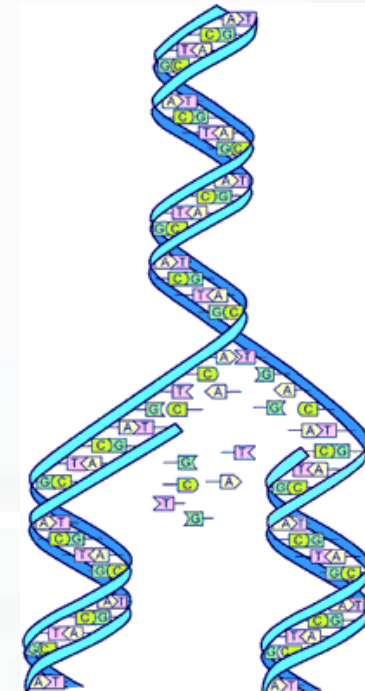


- **Second leading cause of death in the U.S.**
- **Lung cancer most common, followed by breast (women) and prostate (men)**
- **Risk of developing cancer during lifetime**
  - ❖ **Men = 1:2**
  - ❖ **Women = 1:3**
- **Approximately 1,500 cancer deaths each day in U.S.**
- **In the U.S., direct medical treatment, loss of productivity and early mortality from cancer costs us yearly > \$143 BILLION**
- **Genetic risk factors vs. controllable risk factors**

# Introduction: What is cancer?



- **Arguably the most important single factor: DNA repair**
  - ❖ If functioning properly, these systems can compensate for mutations
- **Sources of mutation**
  - ❖ Intracellular
    - DNA copying errors
    - DNA division errors
    - Free radicals
  - ❖ Extracellular
    - Radiation
    - Chemicals
    - Environment
- **Cancer = damaged DNA is propagated to new cells**
  - ❖ Malfunction of cell growth signals and death signals



# Introduction: What is Cancer?



- **Problems in diagnosing cancer**
  - ❖ Time before diagnosis
  - ❖ Multiple mutations = difficult to characterize
  
- **Problems in treating cancer**
  - ❖ Genetic variation between patients
  - ❖ Microenvironments
  - ❖ Cancer cell type
    - **Chemotherapy targets rapidly proliferating cells (GI tract, hair cells, bone marrow)—cancer may not be rapidly proliferating**
    - **Radiation may only kill some cells and further mutate others**
  - ❖ Side effects
  - ❖ Compromised immune system
  
- **Cancer research: new ways of treating cancer**

# Introduction: Plants as drug sources



- **Many plants have a long medicinal history**
  - ❖ Hyssop, spikenard, myrrh and frankincense mentioned in the Bible
  - ❖ Tribal and cultural uses
- **Less than 1% of higher plants have been exhaustively studied for medicinal value**
- **High probability that new drugs remain to be found**
- **Good success so far: many anti-cancer drugs currently on the market were developed from plants**
  - ❖ Taxol
  - ❖ Colchicine
  - ❖ Vincristine

# Introduction: Essential Oils



- **Specific (and variable) combinations of plant chemicals**

- ❖ Protective: coping with environmental stress
- ❖ Destructive: killing or inhibiting growth of invaders
- ❖ Stimulatory: promoting cell growth



- **Extracted by steam distillation from various plant parts**

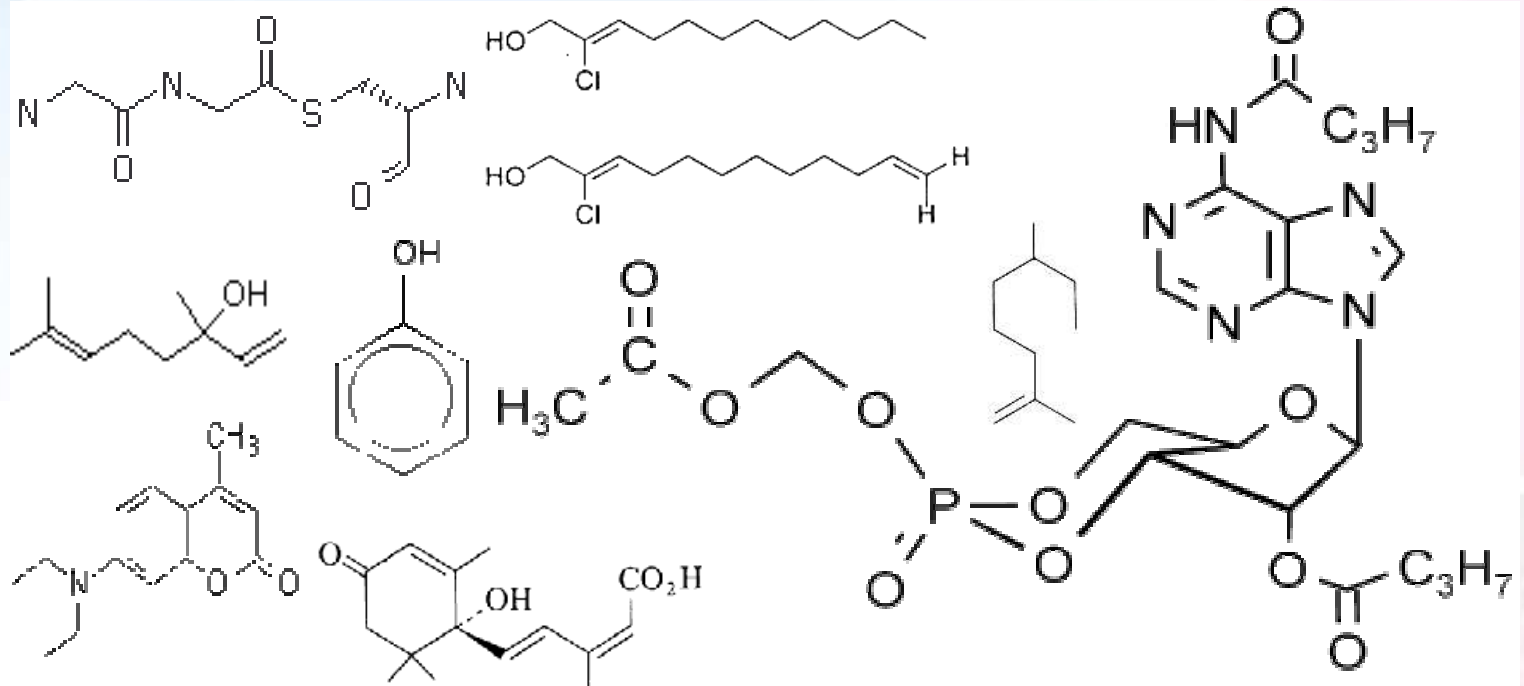
- **Contain many physiologically active chemical constituents**

- ❖ Terpenoids
- ❖ Phenols
- ❖ Coumarins

# Introduction: Essential Oils



The secret is:



# Synergy

# Objective



- **Screen 74 essential oils: 69 single, 5 mixtures**
  - ❖ Cervical, breast, skin, and prostate cancer cell lines
  - ❖ Non-cancerous 3T3 (mouse) fibroblast cells
- **Oils showing 50% or more cancer cell inhibition and 25% or less inhibition of non-cancerous cell growth will be recommended for further study as potential anticancer drugs**
- **Note any correlations between which oils are active against which cancer cell lines**

# Materials and Methods



## •Culturing cancer cells

- ❖ Monolayer growth
- ❖ Flat-bottomed 96-well microtiter plates
- ❖ Incubate in MEM (Minimum Essential Medium) at 37 °C , 5% CO<sub>2</sub> for 24 hours to allow cell adhesion

## •Adding essential oils

- ❖ Concentrations of 200, 100, 50 and 0µg/ml oil added in strip-plot design, 3 replications
- ❖ 0µg/ml oil (pure MEM) used as control
- ❖ Perimeter wells not used in analysis: edge effects
- ❖ Plates incubated at 37 °C, 5% CO<sub>2</sub> 36 hours



# Results



- **58% of the 74 oils showed general cancer inhibition of 50% or greater**
- **34% of the 74 oils showed cancer-specific inhibition**
  - ❖ Seven of these were active against two or more cancer cell lines
- **Of particular interest**
  - ❖ Oils showing synergistic effects
  - ❖ Oils with significant activity at the lowest concentration tested
  - ❖ Oils with multiple anti-cancer activity

# Results



➤ White Fir

➤ Frankincense

➤ Myrtle

➤ Sandalwood

➤ Thyme

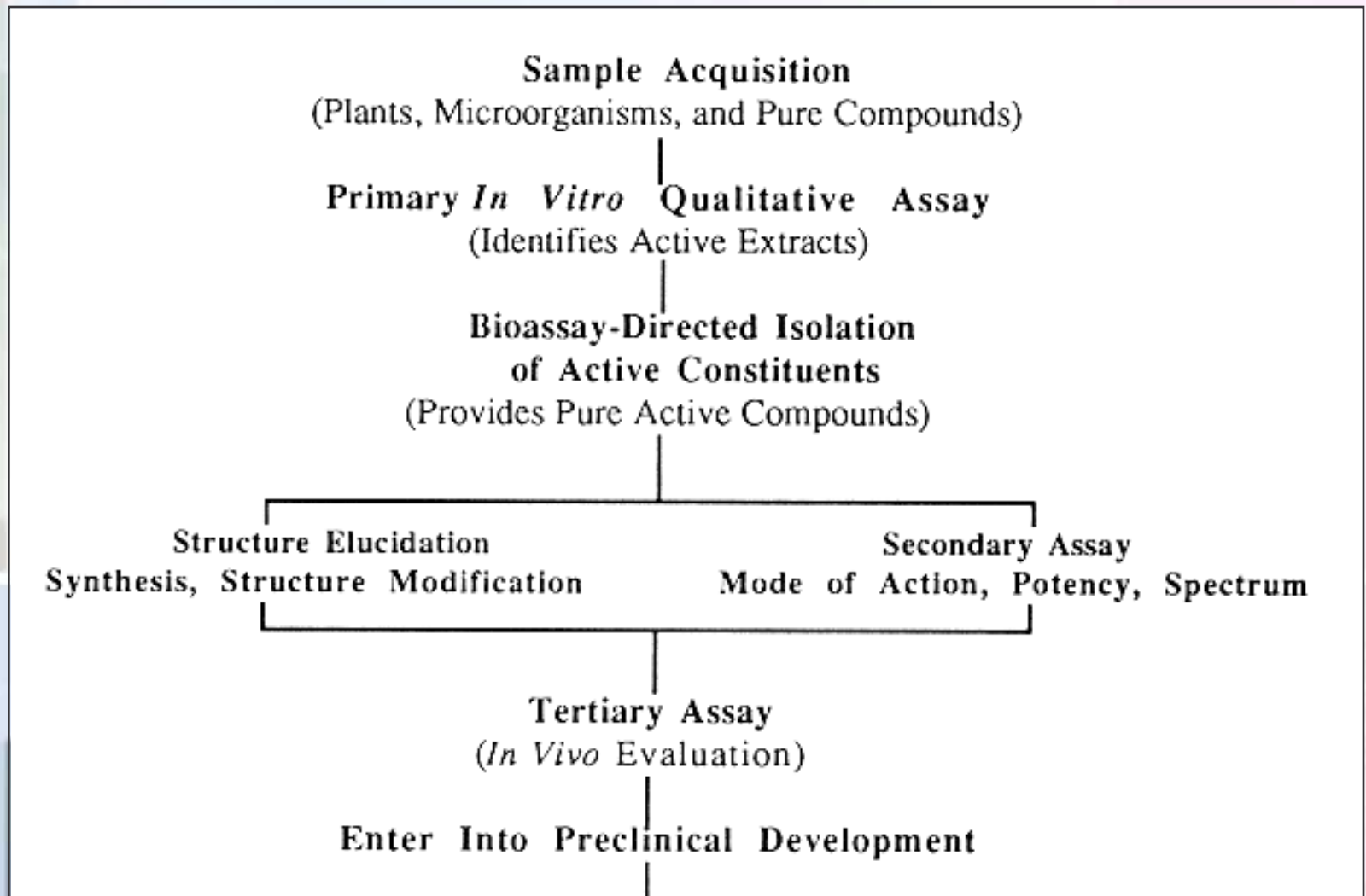
Essential Oils		Cell Line % Inhibition Values				
Oil	Conc.**	HeLa	Prostate	Breast	Skin	3T3
<i>Abies alba</i>	200	72.3*				-18.8*
<i>Anethum graveolens</i>	200	56.5				14.3*
<i>Artemisia dracunculus</i>	200	85.2*			55.1*	3.1*
<i>Boswellia carteri</i>	100	72.1*				-5.3
<i>Canaga odorata</i>	50	61.3*				19.6
<i>Citrus paradisi</i>	200				80.5*	15.7*
<i>Citrus reticulata</i>	200	66.3*				9.3*
<i>Ferula gummosa</i>	100	69.6*				10.7
	200	98.8*				3.3*
<i>Hyssop officinales</i>	200	90.2*			75.9*	2*
<i>Melaleuca alternifolia</i>	100	56.5				4.4*
<i>Myristica fragrans</i>	200	87.4*				5.9*
<i>Myrtus communis</i>	100			81.4*		3.7*
	200		67*	95.2*		6.5*
<i>Pelargonium graveolens</i>	200	77*				0.4*
<i>Pogostemon cablin</i>	50	98.5*				10.7*
<i>Pseudotsuga menziesii</i>	200	96.3*				19.8
<i>Ravensara damascena</i>	200	68.4*				8.7*
<i>Salvia officinalis</i>	200	80.5*				3.3*
<i>Santalum album</i>	50	84.3*		70.2		16.3
	100	97.2*	84.1*	98.1*	58.7	25.6
<i>Thuja plicata</i>	50		82.6*			7.4
<i>Thymus vulgaris</i>	50	62.4	56.7		64.2	19.9
<i>Thymus linalol</i>	200	99*			67*	5.8*
<i>Tsuga canadensis</i>	200	99.1*			93.1*	3.2*
<i>Valeriana officinalis</i>	100	71.6*				7.6*
Peace and Calming	50	63.1				9.6
T. Wood	200	50.4				15.6

# Conclusion



- **Essential oils have potential as anticancer drugs**
- **Screening processes (such as the one used in this study) that are fast, inexpensive and useful provide good leads about which compounds should be further investigated**
- **Further research should be done on promising essential oils—this may lead to new cancer drugs**
  - ❖ **Many technologies available**
- **Areas of interest**
  - ❖ Stimulating apoptosis
  - ❖ DNA repair
  - ❖ Proliferative senescence
  - ❖ Immune protection and stimulation
  - ❖ Preventing metastasis

# Future Research



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