



# BALL MOSS

## Therapeutic Possibilities

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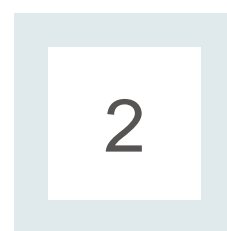
ONE HEALTH DAY CONFERENCE  
NOVEMBER 3, 2018

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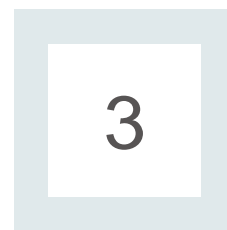
## Ball Moss

The Plant and its Bioactive



## Drug Development

The Innovation Process



## Cancer Research

Ball Moss Extracts and  
Oncology



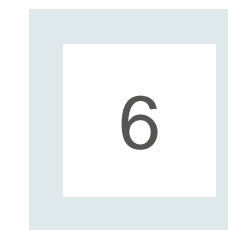
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## About Us

Biotech R&D Institute



# BALL MOSS



# *Tillandsia recurvata* (L., 1762)

Ball Moss or Old Man's Beard

- A flowering plant that grows on larger host plants
- Depends on host plant for structural support, photosynthesizes its own food
- Hold fasts or pseudo-roots, are only for anchorage.
- Water and nutrients absorbed from the air (bromeliad)
- Grows well in areas of low light, airflow, high humidity

**Kingdom:** Plantae  
**Order:** Poales  
**Family:** Bromeliaceae  
**Genus:** *Tillandsia*  
**Species:** *recurvata*

FLOWER  
Seed dispersed by  
wind

LEAVES  
Elongated and thick.  
Absorbs and retains  
nutrients and water



HOLD FAST  
(PSEUDO ROOTS)  
Found on the  
underside of the plat,  
for attachment to  
host.



## Distribution

Believed to be native to southern United States. However well distributed and characterized across the tropics of the western hemisphere.

# Ethnomedicinal Use of Ball Moss

COUNTRY	USES	PART USED
<b>Bolivia</b>	Kidney inflammation	Leaf
<b>Brazil</b>	Rheumatism, ulcers, haemorrhoids, coagulation	Entire plant
<b>Mexico</b>	Menstrual regulation	Not Indicated
<b>Uruguay</b>	Anti-spasmodic, eye infection	Leaf
<b>USA</b>	Leucorrhoea	Entire Plant

No official reports of Ball Moss uses as traditional medicine in Jamaica.

A glass dish filled with various pills and capsules, surrounded by fresh herbs and flowers on a wooden surface. The pills and capsules are in various colors and shapes, including yellow, brown, and white. The herbs and flowers include purple and white blossoms, and green leaves. The background is a dark, textured wooden surface.

**DRUG  
DEVELOPME  
NT**



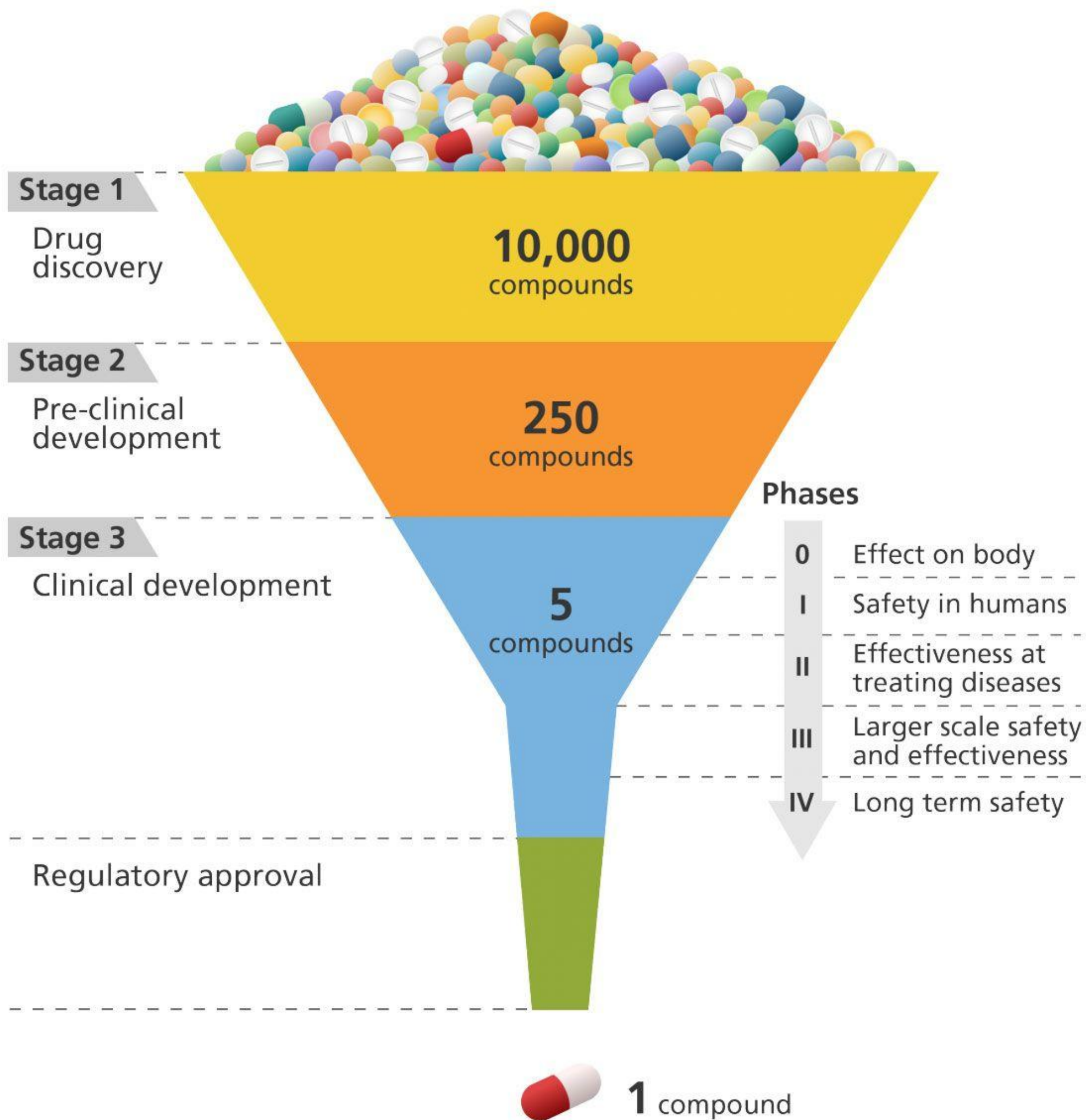
# Cancer Drug Development

- CANCER IS THE LEADING CAUSE OF DEATH IN THE WORLD (9.8 million lives/year) – World Health Organization
- The Jamaican morbidity/mortality caused by breast and prostate cancer is among the highest in the world.
- For many years, not only have most medical breakthroughs been based on compounds of natural origin but such compounds also represent a large share of the pharmaceutical market.
- **A successful anticancer drug should kill or incapacitate cancer cells without causing significant damage to normal cells.** This ideal situation is achievable by inducing selective **apoptosis in cancer cells.**
- **The R&D and use of plant extracts to treat cancer has been among the most successful strategies.**



*Catharanthus roseus*

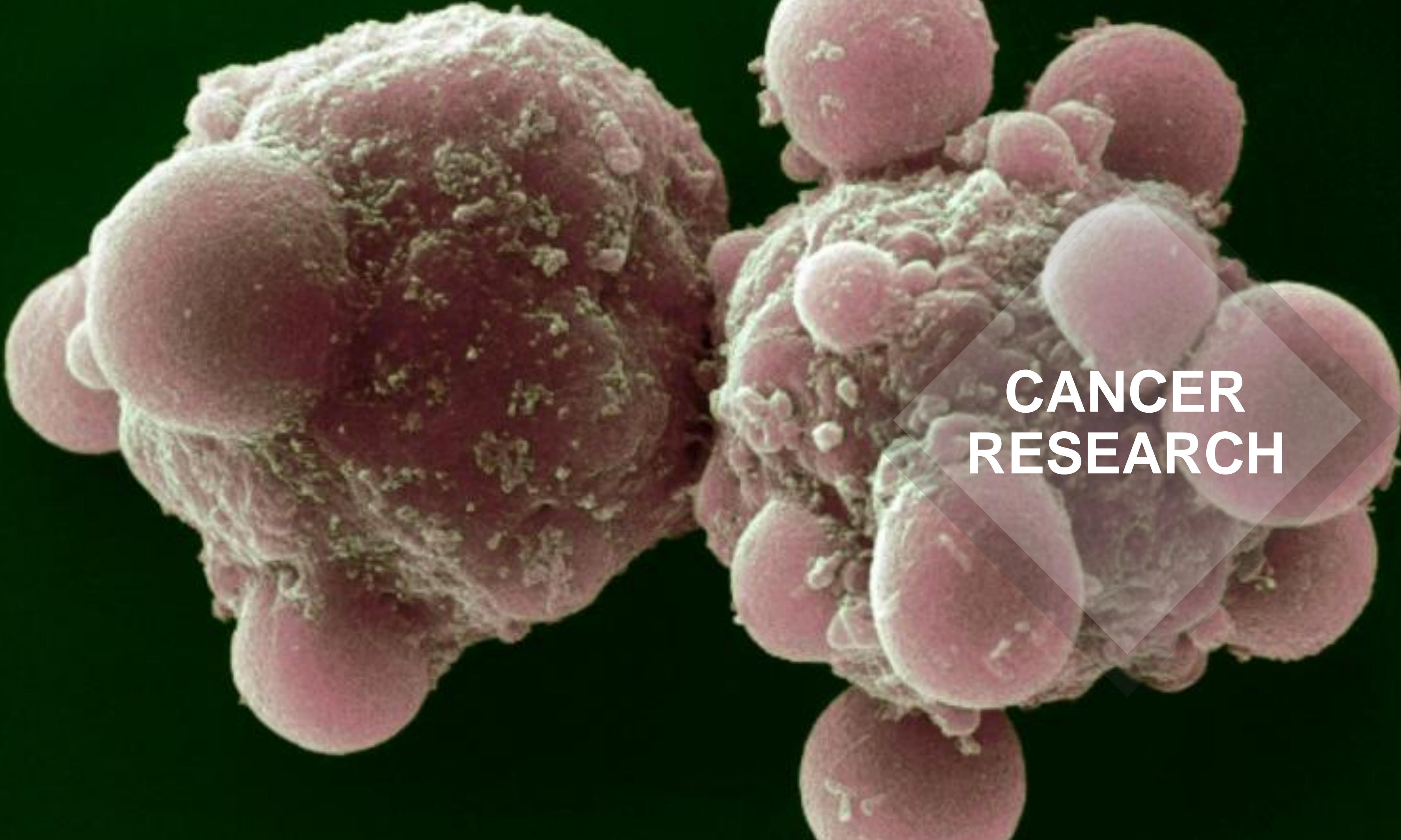
Canadian scientists, having learnt the folk tradition of cancer patients drinking the tea, isolated the active alkaloid that would be vinblastine and vincristine. Effective against leukemia, Hodgkin's lymphoma, lungs and breast cancer.



# The Process of Drug Development

Natural product drug development includes several distinct steps (which could normally take 10-30 years & \$2.6 billion):

- evaluation of the biological activity of plant extracts
- isolation and chemical characterization of the bioactive compounds
- analysis of the structure-activity relationships and design of new semi-synthetic drugs
- elucidation of the mechanism of action
- clinical trials
- commercialization



**CANCER  
RESEARCH**



Why Ball  
Moss?

# Methodology

## Extraction

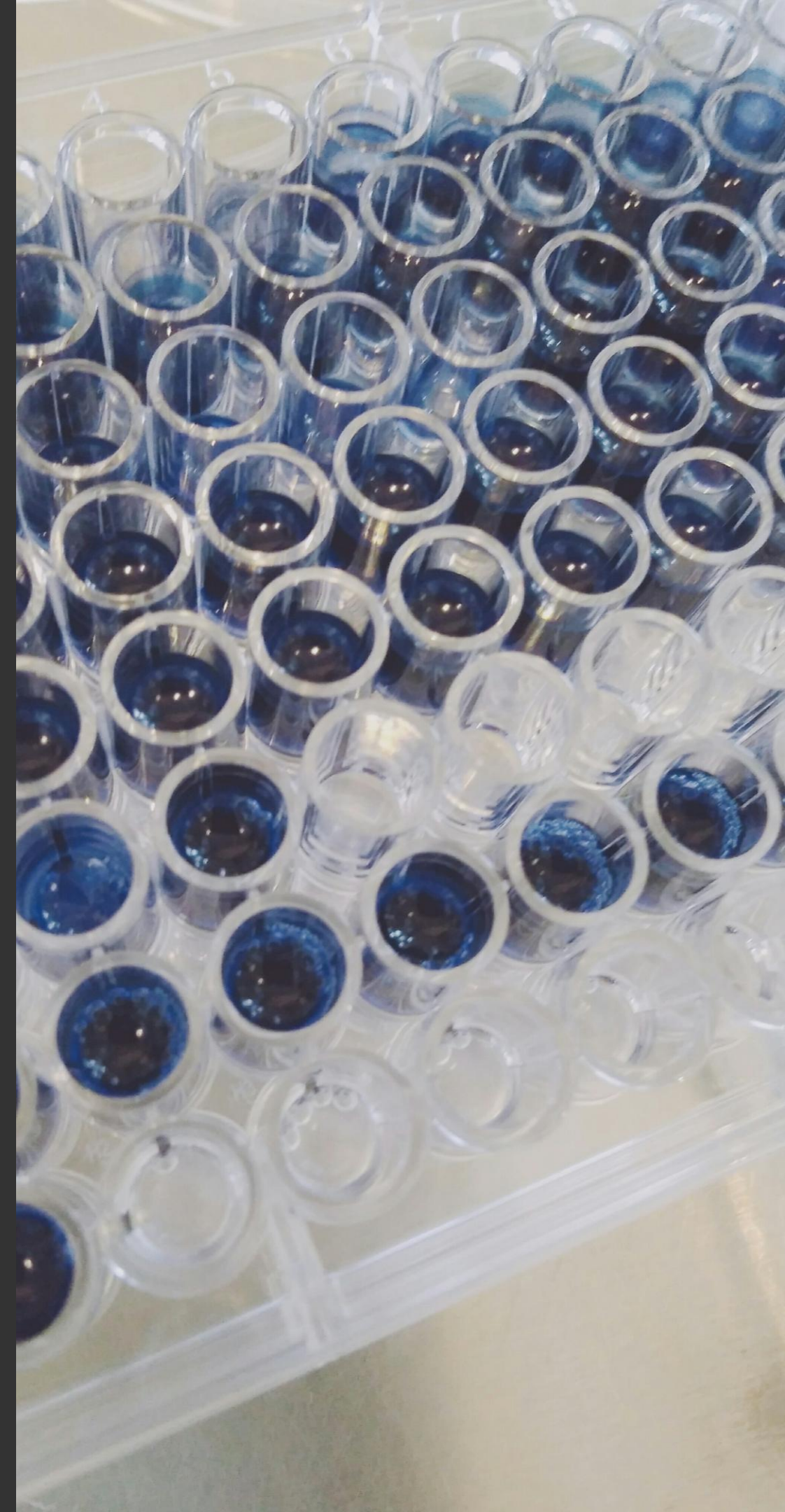
Chloroform extracts of *T. recurvata* prepared and analyzed using chromatography techniques for characterization.

## Cancer Lines

Extracts were tested against 5 histogenic tumors: Malignant melanoma (B-16 Melanoma), Prostate Cancer, Breast Cancer, Kaposi's Sarcoma, Non-Hodgkin Lymphoma (HIV Transgenic Mouse Model)

# *In-vitro* Studies

- Growing the tumour cells in culture and testing the plant extract for cell kill in 96 wells plates,
- Incubation period of 48-72 hours,
- Placing 1% trypan blue, which is for staining dead cells in culture
- The dead cells are counted and compared to the live cells and a percentage is taken to determine what percent of the cells the product killed versus those alive.



# *In vivo* Studies

The study **in-vivo**, which are the animal studies, includes growing all of the different cancer cells up in culture followed by collection and counting, using  $1 \times 10^6$  are injected subcutaneously into nude mice.

This process is known as xenograft which is defined as the transplantation of a tumour or cell from one specie to another.

The nude mice are immuno-deficient (little or no immune response) and this allows the tumour to grow.



# Taxol

Taxol (Paclitaxel) a natural product drug, from the pinus plant species, has been recognized as the major anti-tumor agent, which works well against various malignant tumours.

However much of its effectiveness is restricted due to its strong side-effects when used at the required therapeutic doses.

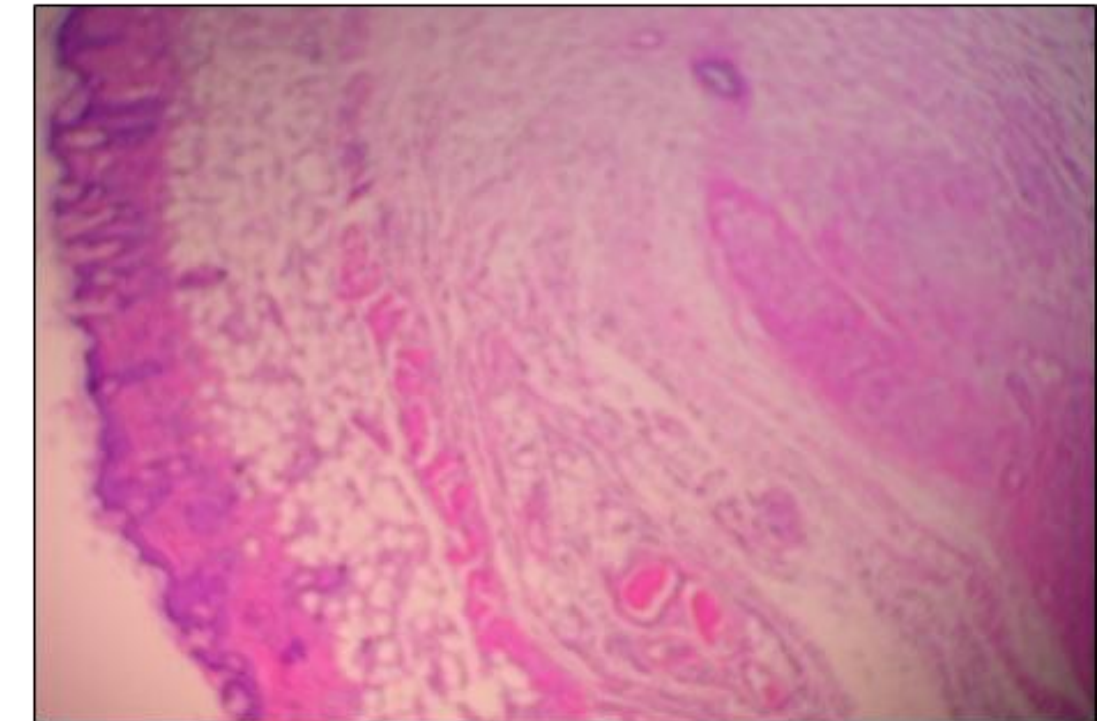
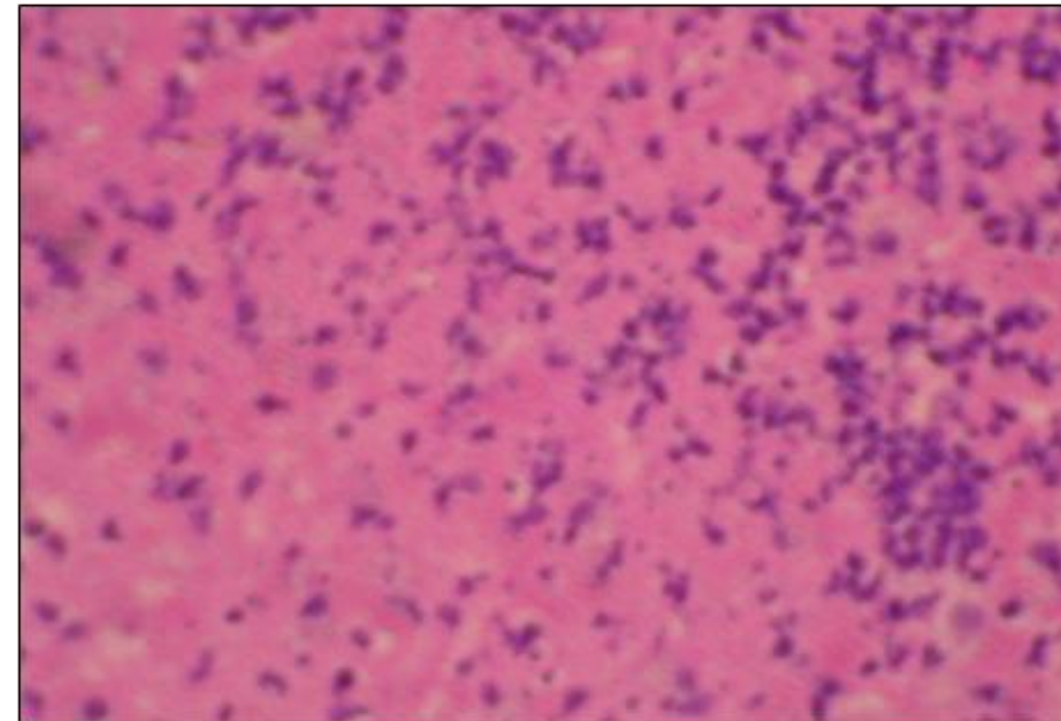
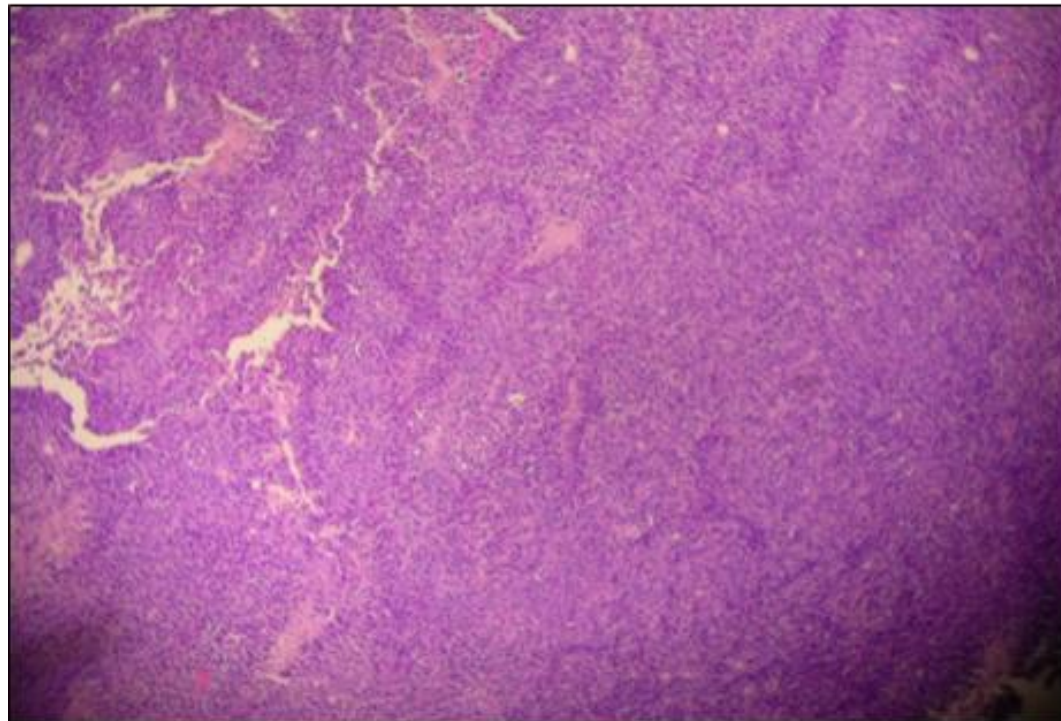
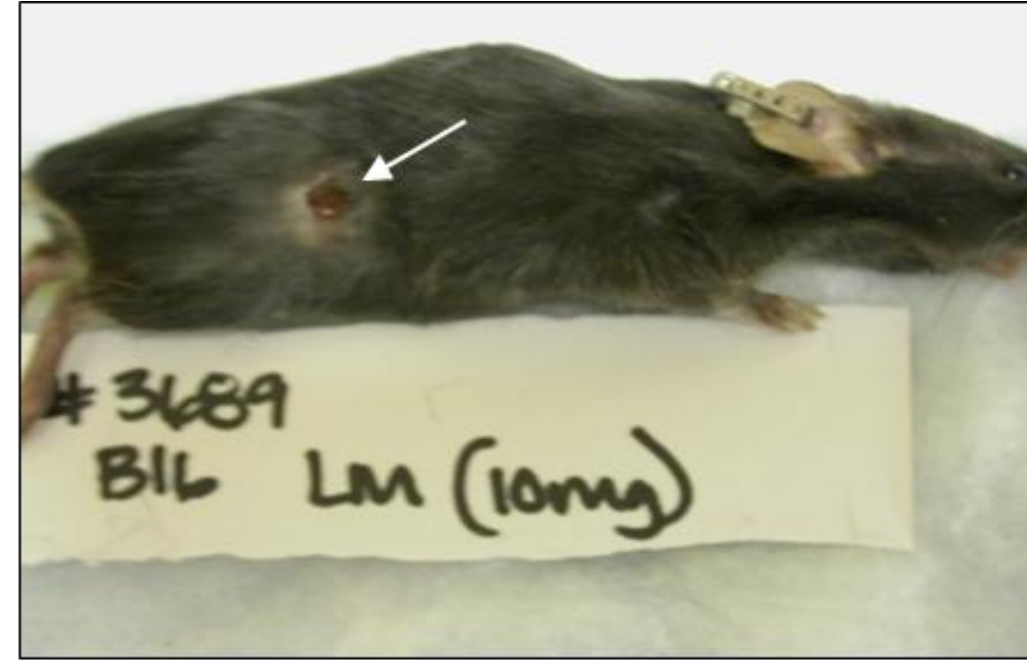
In an effort to maximize the benefit of the anti-tumor effect and at the same time reduce the side-effects, combinations with other anti-tumor drugs, have been tried, and have yielded limited success.

*In our study, we have shown that Taxol in a sub-therapeutic dose, when conco-mitantly used with our plant isolates, produced a greater growth-inhibitory effect and apoptosis, with no observed toxicity than with Taxol alone or the plant isolate.*

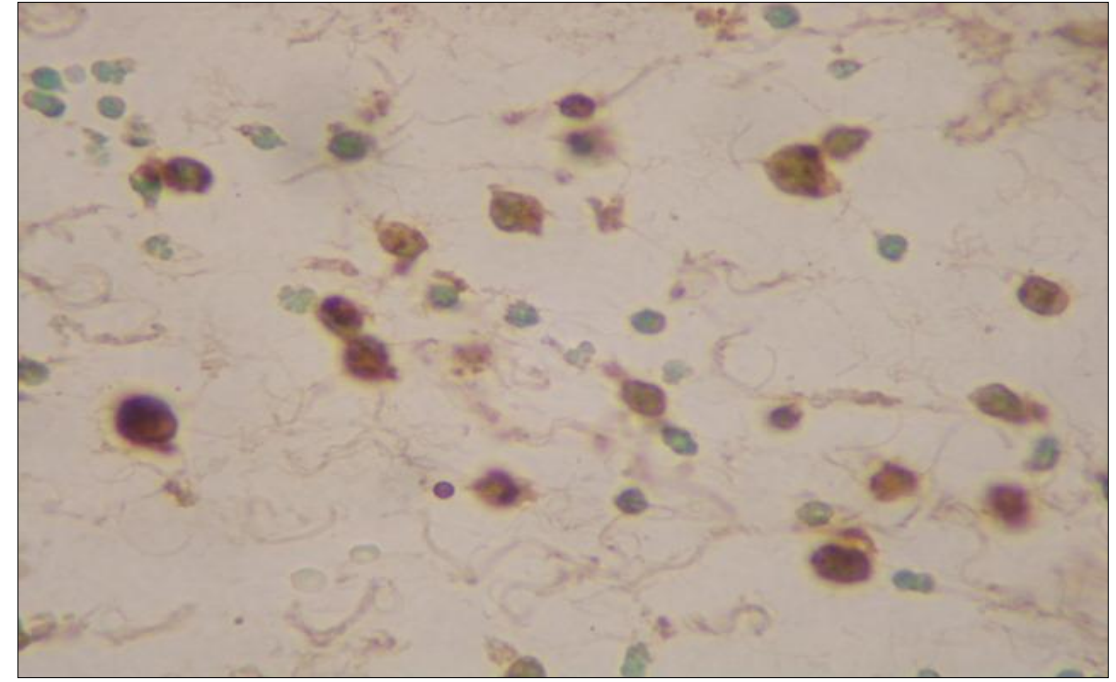
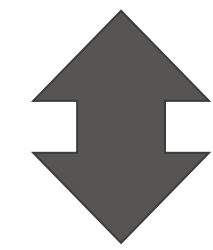
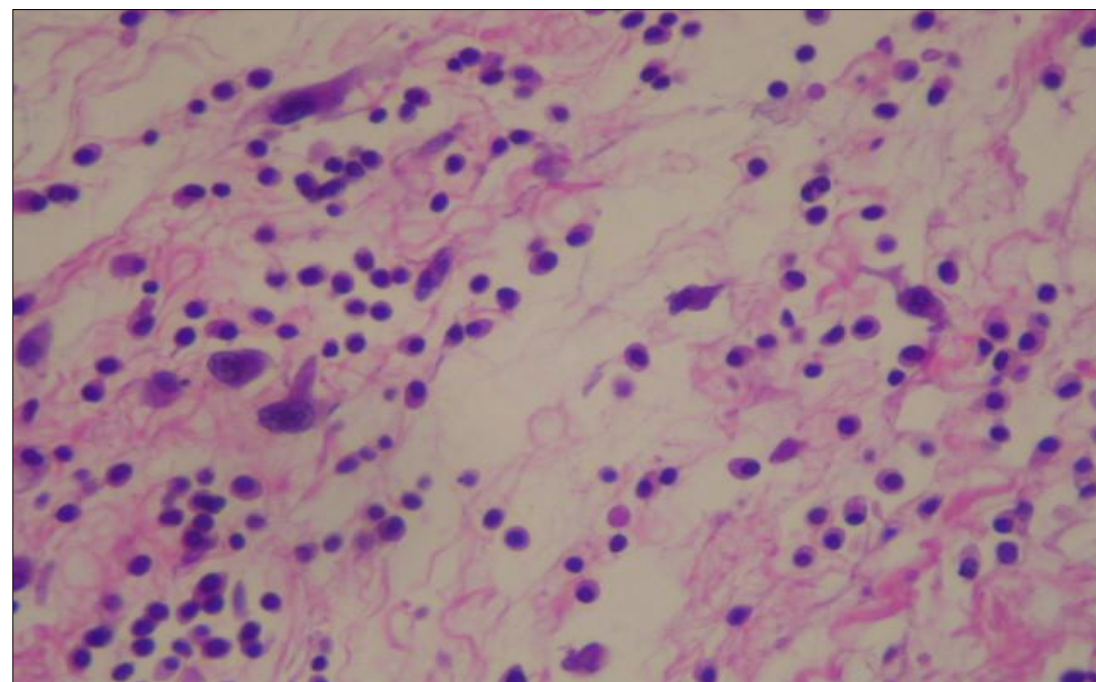
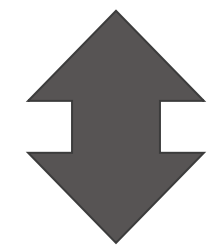
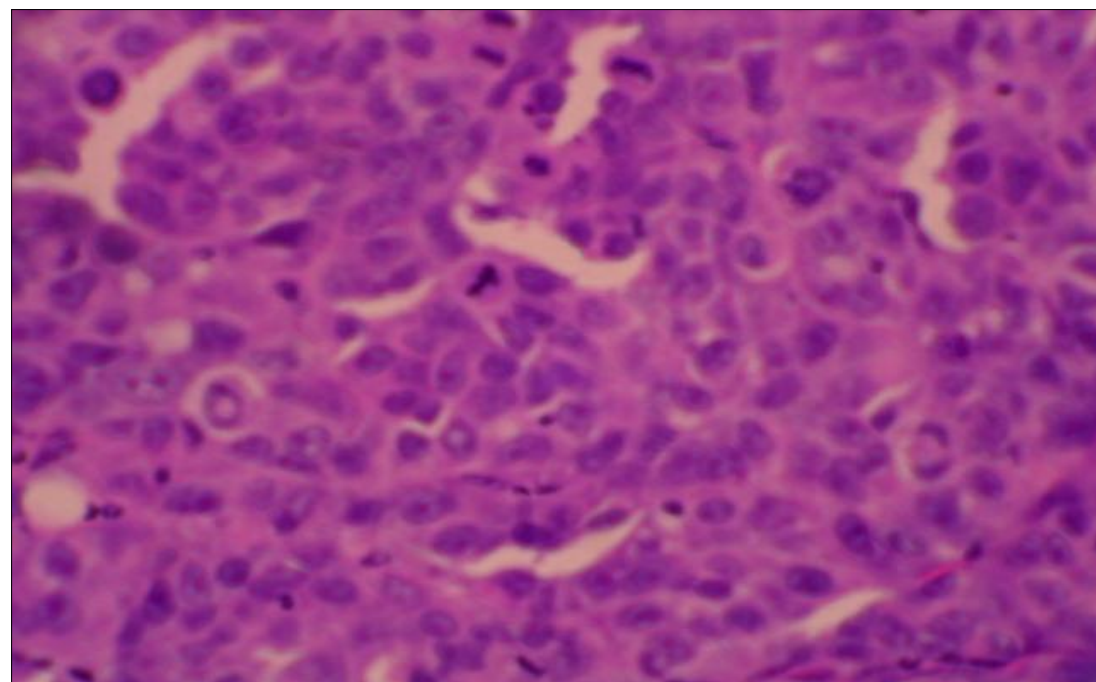
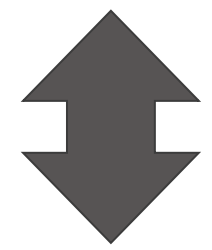




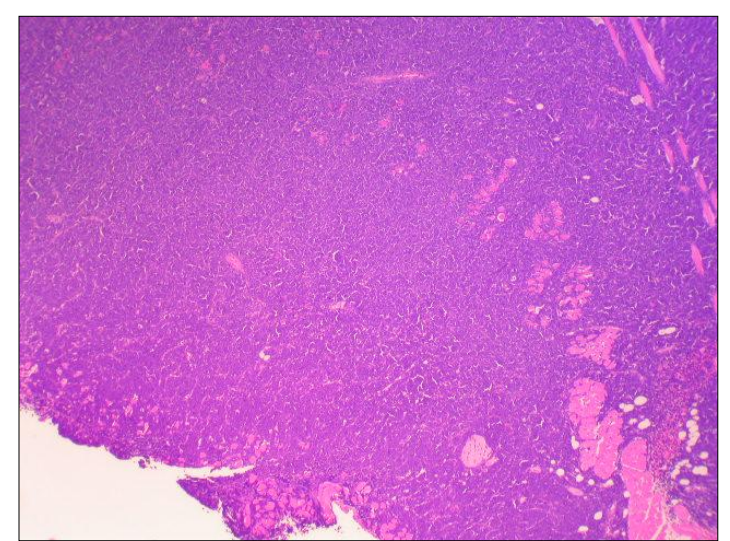
# MELANOMA



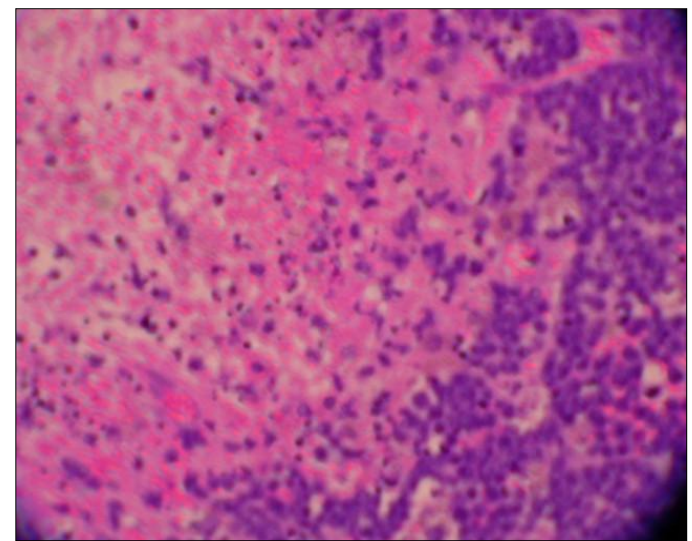
# KAPOSI SARCOMA



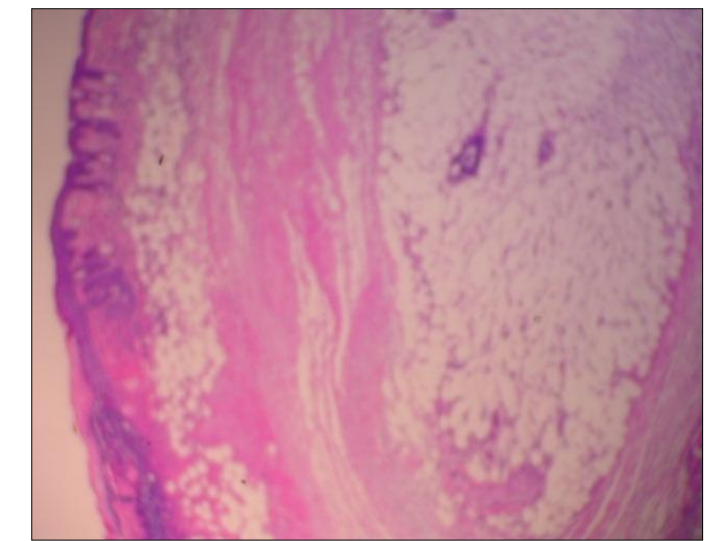
# KAPOSI SARCOMA



Control



Plant Extract



Plant Extract and Taxol

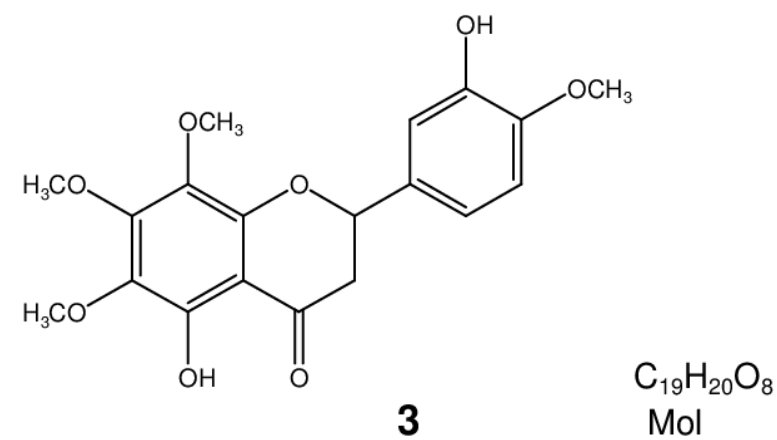
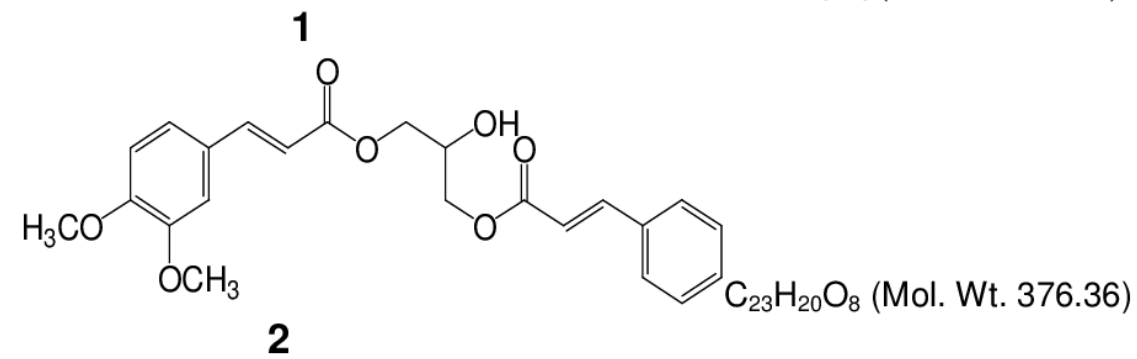
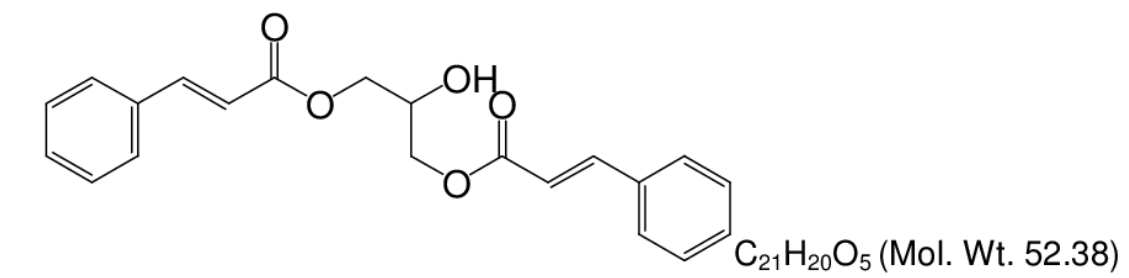
## Objective (2007)

Can extracts of ball moss exhibit anti-cancer activities *in vitro* and *in vivo*?

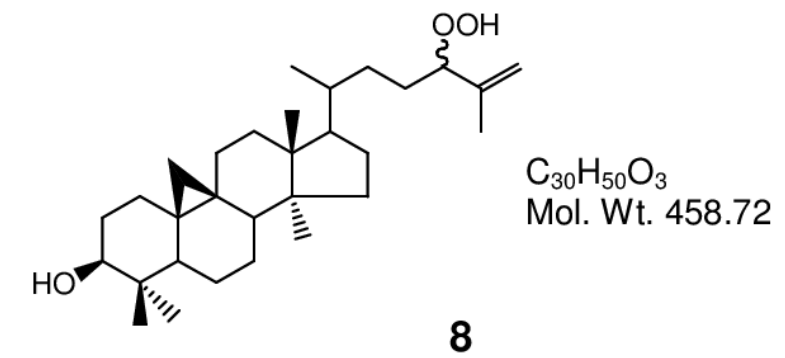
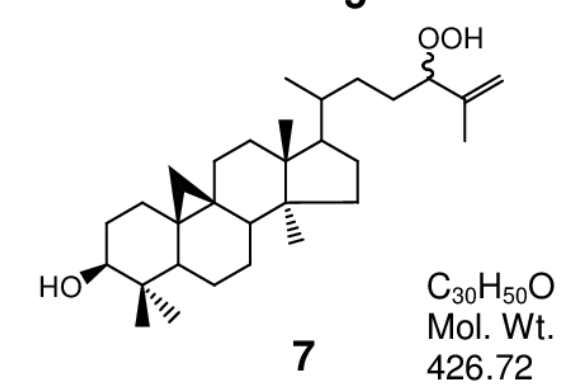
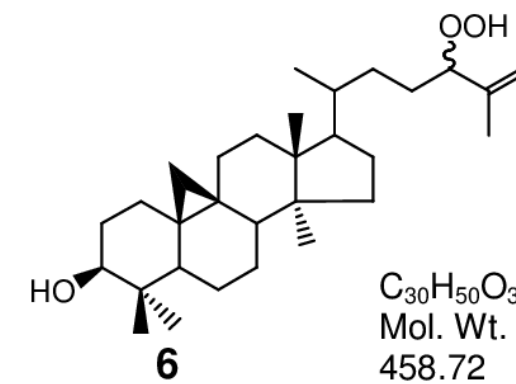
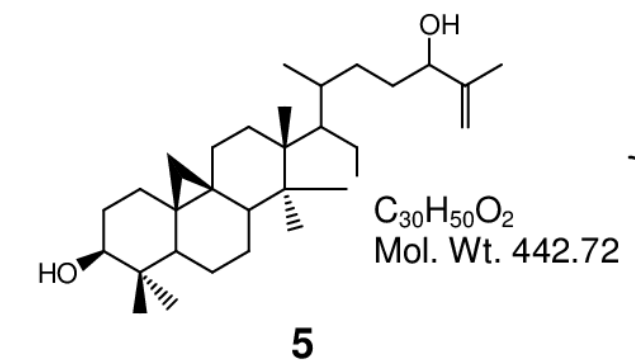
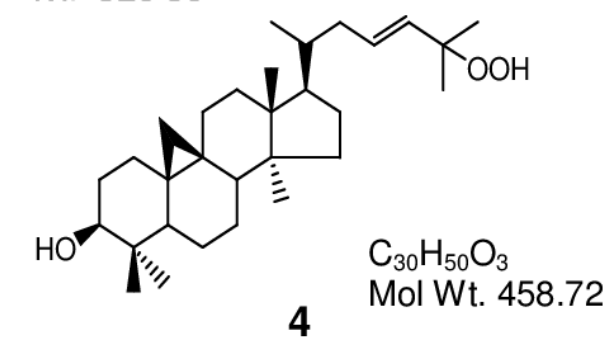
## Conclusion (2007 - 2014)

Water, methanol and chloroform extracts show significant anti-cancerous activities through cell death and/or apoptosis.

# Phytochemistry: Major compounds isolated from Ball Moss



Dicinnamates



Cycloartanes

Caffeic acid

# Mode of Action: Prostate Cancer

Cancer initiation can be caused when the checkpoint systems themselves are not functioning as they should, be it via the process of carcinogenesis or hereditary. When this occurs, there is no mechanism in place to initiate problem solving or apoptosis.

It has therefore become a recent and therapeutically germane direction to identify molecular entities, be them inducers or inhibitors that can regulate particular kinases in hopes of restoring the normal balance to cell proliferation.

Methanol extracts inhibited particular kinases (CSNK2A2, MEK5, GAK, FLT, DRAK1). **Since MEK5 and GAK kinases have been associated with aggressive prostate cancer, the inhibitory properties of the ball moss against them coupled with its previously found bioactivity towards PC-3 cell line and its ability to reduce angiogenesis makes it even more promising in the arena of drug discover towards prostate cancer amongst others.**



**TECHNOLOGI  
ES**

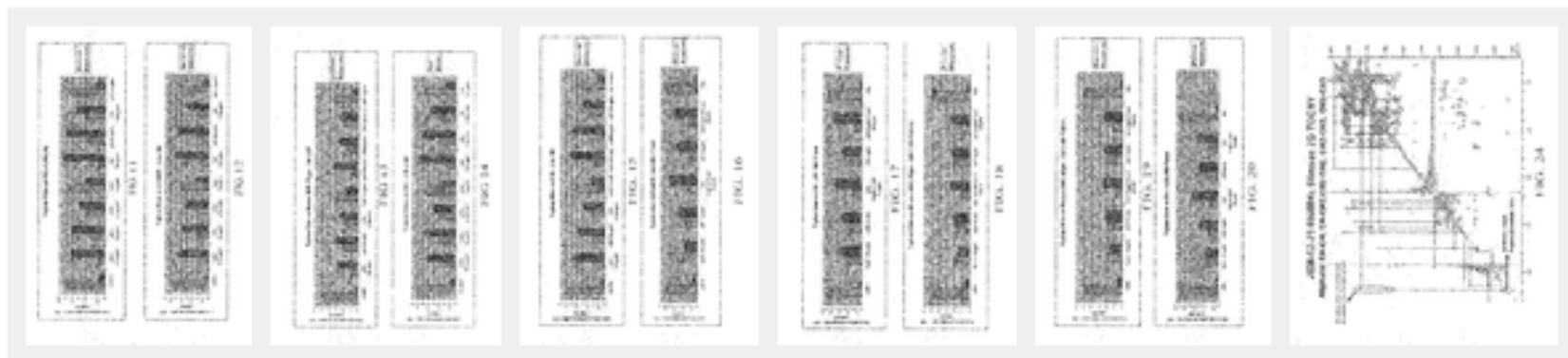
# Intellectual Property Protection

## Anti-tumor and anti-inflammatory extracts of plant biomass and their uses

### Abstract

Extracts from an indigenous Jamaican plant that exhibit an anti-tumor activity and/or an anti-inflammatory activity and, more particularly, an extract of Jamaican Ball Moss (*Tillandsia Recurvata*) that has a therapeutic pharmacological activity, in particular an anti-cancerous activity by inducing tumorous cell death by apoptosis, and active compounds isolated thereof are described. Furthermore, methods for the extraction of the extracts are disclosed. Also, a pharmaceutical composition or product for the treatment of cancer which includes an effective amount of the described extract or an active compound thereof, a therapeutic compound and optionally a pharmaceutical acceptable carrier are described.

### Images (6)



### Classifications

■ [A61K36/18](#) Magnoliophyta (angiosperms)

US20080145464A1

United States

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Inventor: [Henry Lowe](#)

### Worldwide applications

2007 - [US](#)

### Application US12/001,207 events

- 2006-12-08 • Priority to US87383206P
- 2007-12-10 • Application filed by Henry Lowe
- 2007-12-10 • Priority to US12/001,207
- 2008-06-19 • Publication of US20080145464A1
- 2010-05-11 • Application granted
- 2010-05-11 • Publication of US7713556B2
- 2019-11-03 • Application status is Active



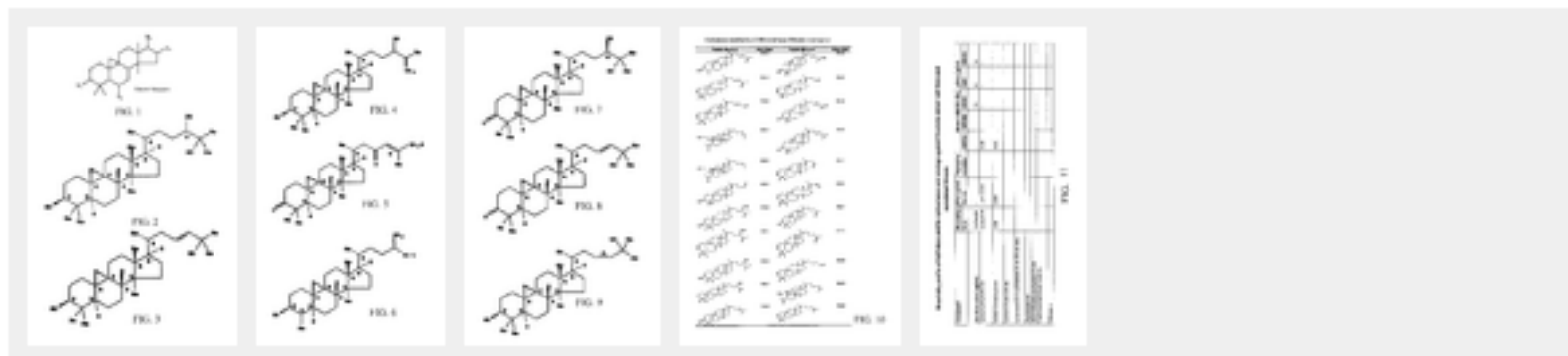
# Intellectual Property Protection

## Methods for inhibiting prostate cancer by kinases and angiogenesis inhibitory mechanisms of ball moss extract

### Abstract

A method of treating prostate cancer by administering a pharmaceutically-acceptable amount of a crude extract of the indigenous Jamaican plant Ball Moss (*Tillandsia Recurvata*) comprising one or more cycloartane isolates, and the isolates used in the method for eliciting thereby a kinase inhibitory response of prostate cancer cells by selectively inhibiting MRCK $\alpha$  kinase and angiogenesis of (growth of new blood vessels) to reduce the viability of prostate cancer cells. The method and compounds holds promise as a chemopreventive agent, without causing excessive damage to normal cells.

### Images (5)



### Classifications

- **A61K31/575** Compounds containing cyclopenta[a]hydrophenanthrene ring systems; Derivatives, e.g. steroids substituted in position 17 beta by a chain of three or more carbon atoms, e.g. cholane, cholestane, ergosterol, sitosterol

US8715748B2

United States

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**Inventor:** [Henry Lowe](#), [Joseph L. Bryant](#)

**Current Assignee :** [University of Maryland, Baltimore](#)

### Worldwide applications

2013 • [US](#) 2014 • [US](#)

### Application US13/910,692 events

- 2012-06-05 • Priority to US201261655694P
- 2013-06-05 • Application filed by Henry Lowe, Joseph L. Bryant
- 2013-06-05 • Priority to US13/910,692
- 2013-12-05 • Publication of US20130323330A1
- 2014-05-06 • Application granted
- 2014-05-06 • Publication of US8715748B2
- 2015-10-28 • Assigned to UNIVERSITY OF MARYLAND,

# Commercially Available Products



◀ Alpha Prostate is registered by the Ministry of Health and has been awarded the National Innovation Award and IDB Innovator's Award. It is the number one selling product under EG Wellness Brands with demand all over the world.



# Product Pipeline



**THE FUTURE**

# Key Considerations for One Health





*Educational  
Scientific Limited*



And that's just ONE  
plant!





# REFERENCES

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# Get in touch with us!

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