



THE ANTI-CANCER ACTIVITY OF *AGARICUS BISPORUS* AGAINST HUMAN CANCERS

Tongtong Xu

Advisors: Dr. Robert B. Beelman & Dr. Joshua D. Lambert

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CANCER STATISTICS

- More than 100 different types of cancer
- Estimated in the United States in 2009:
 - New cases: 1,479,350 (not including nonmelanoma skin cancers)
 - Deaths: 562,340
- National Cancer Institute (NCI)'s budget for FY 2009 was \$6.03 billion.



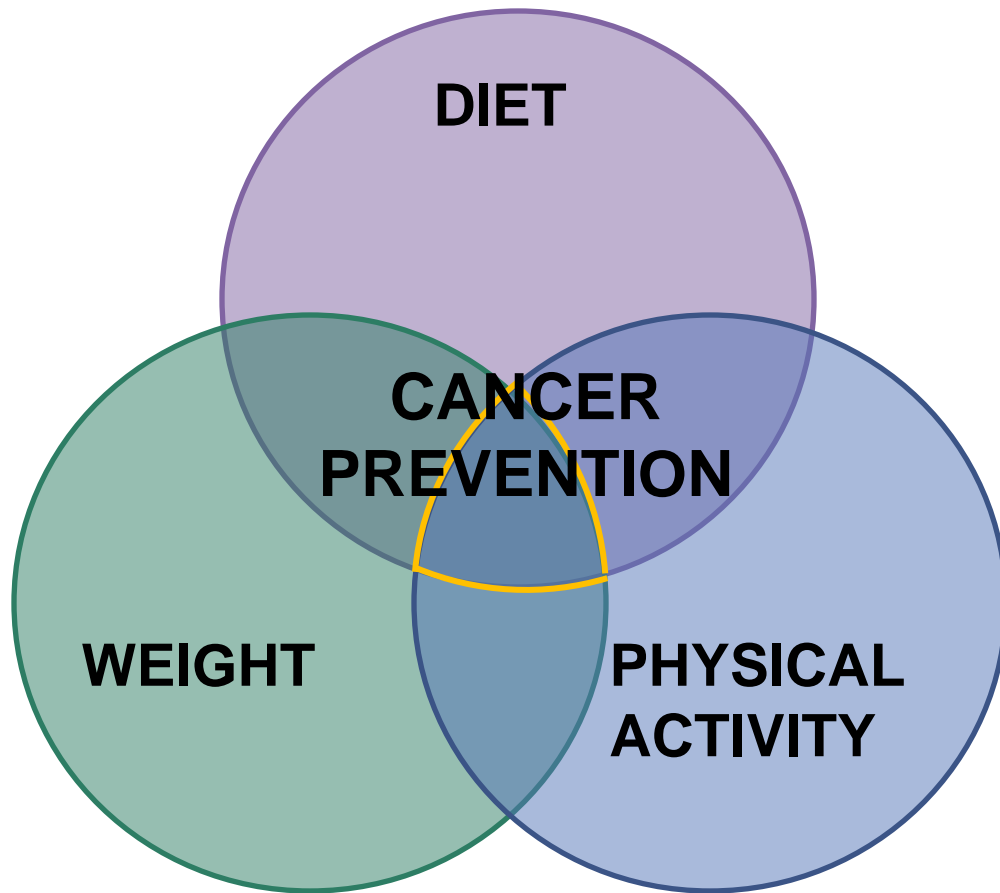
CANCER RESEARCH EXPENDITURES

NCI Office of Budget and Finance

Cancer Type	2006 Spending (in millions)	2007 Spending (in millions)	2008 Spending (in millions)
Lung	\$242.9	\$226.9	\$247.6
Prostate	293.2	296.1	285.4
Breast	584.7	572.4	572.6
Colorectal	244.1	258.4	273.7
Bladder	24.4	19.8	24.1
Non-Hodgkin Lymphoma	114.1	113.0	122.6
Melanoma	108.0	97.7	110.8
Kidney	33.0	31.4	43.4
Leukemia	223.5	205.5	216.4
Uterine	19.4	16.6	17.1
Total		4790	4830



CANCER RESEARCH



AS A POTENTIAL CANCER FIGHTING FOOD

	<i>A.bisporus/</i> white	<i>A.bisporus/</i> brown	<i>Lentinus</i> <i>edodes</i>
Protein g/100g	2.09	2.07	1.8
Total carbohydrates g/100g	4.5	4.6	5.8
Dietary fiber g/100g	1.5	1.6	3.3
Crude fat g/100g	0.33	0.31	0.31
Vitamin C, mg	1.3	1.6	2.1
Vitamin B1, mg	0.05	0.05	0.05
Vitamin D, µg	<0.02	<0.02	0.1
Folates, µg	35	46	25
Protocatechuic acid, µg	<2.3	8.3	11.7
p-hydroxy-benzoic acid, µg	3.9	50.3	66.4

ANTI-CANCER STUDIES

Cell line studies

- White button mushroom(WB)-derived lectin inhibited the growth of human colon cancer cells (Yu et.al., 1999).
- The hot water extract of WB inhibited aromatase activity and the growth of breast cancer cells (Grube et.al., 2001).
- The 20% methanol-water fraction from WB inhibited prostate cancer cell growth (Adams et.al., 2008).
- The hot water extract of WB induced apoptosis in breast cancer cells (Martin and Brophy, 2009).



ANTI-CANCER STUDIES

Animal studies

- Selenium-enriched WB reduced DNA adduct in carcinogen-treated rats (Spolar et.al., 1999).
- WB powder enhanced the natural killer cell activity in C57BL/6 mice, suggesting immune stimulating effects (Wu et.al., 2007).
- The 20% methanol-water fraction from WB inhibited prostate tumor growth in immune deficient mice (Adams et.al., 2008).



ANTI-CANCER STUDIES

Epidemiological studies

- Mushroom was found to be one of dietary factors that had a protective effect against gastric cancer (Kim et.al., 2002).
- The consumption of WB with green tea had an inverse association with breast cancer occurrence in Chinese women (Zhang et.al., 2009).
- The consumption of mushrooms had an inverse association with breast cancer occurrence in premenopausal women with hormone receptor positive tumors (Shin et.al., 2010).



POTENTIAL ANTI-CANCER COMPOUNDS IN MUSHROOM

- High-molecular compounds
 - Polysaccharide
 - Protein-binding polysaccharide PSK
 - Polysaccharide-P PSP
- Low-molecular compounds
 - Mushroom-derived terpenes
 - Enzymes (eg. Lectin from *A. bisporus*)



LIMITATIONS OF CURRENT KNOWLEDGE

- The anti-cancer effect of WB has been examined in limited cancers.
- Limited animal model has been reported.
- Few studies have focused on the anti-cancer mechanisms.
- Additional bioactive compounds remain to be identified.



OBJECTIVES

- To investigate the anti-cancer activity of WB against different human cancers
- To explore the mechanism of the anti-cancer activity
- To identify the anti-cancer bioactive compounds in WB

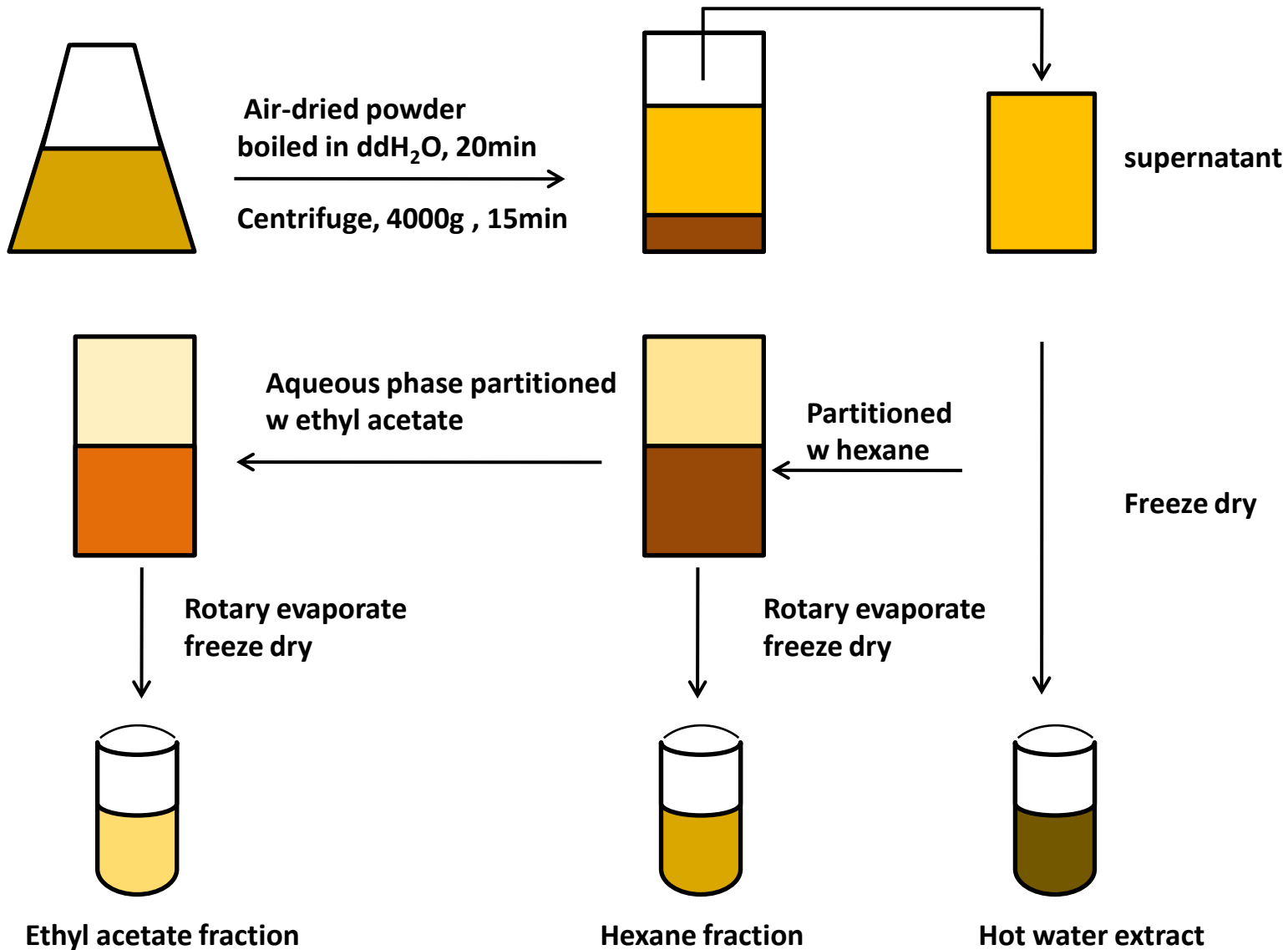


CURRENT STAGE OF MY RESEARCH

- To investigate the anti-cancer activity of WB against different human cancers
- To explore the mechanism of the anti-cancer activity
- To identify the anti-cancer bioactive compounds in WB



WB MUSHROOM EXTRACT PREPARATION

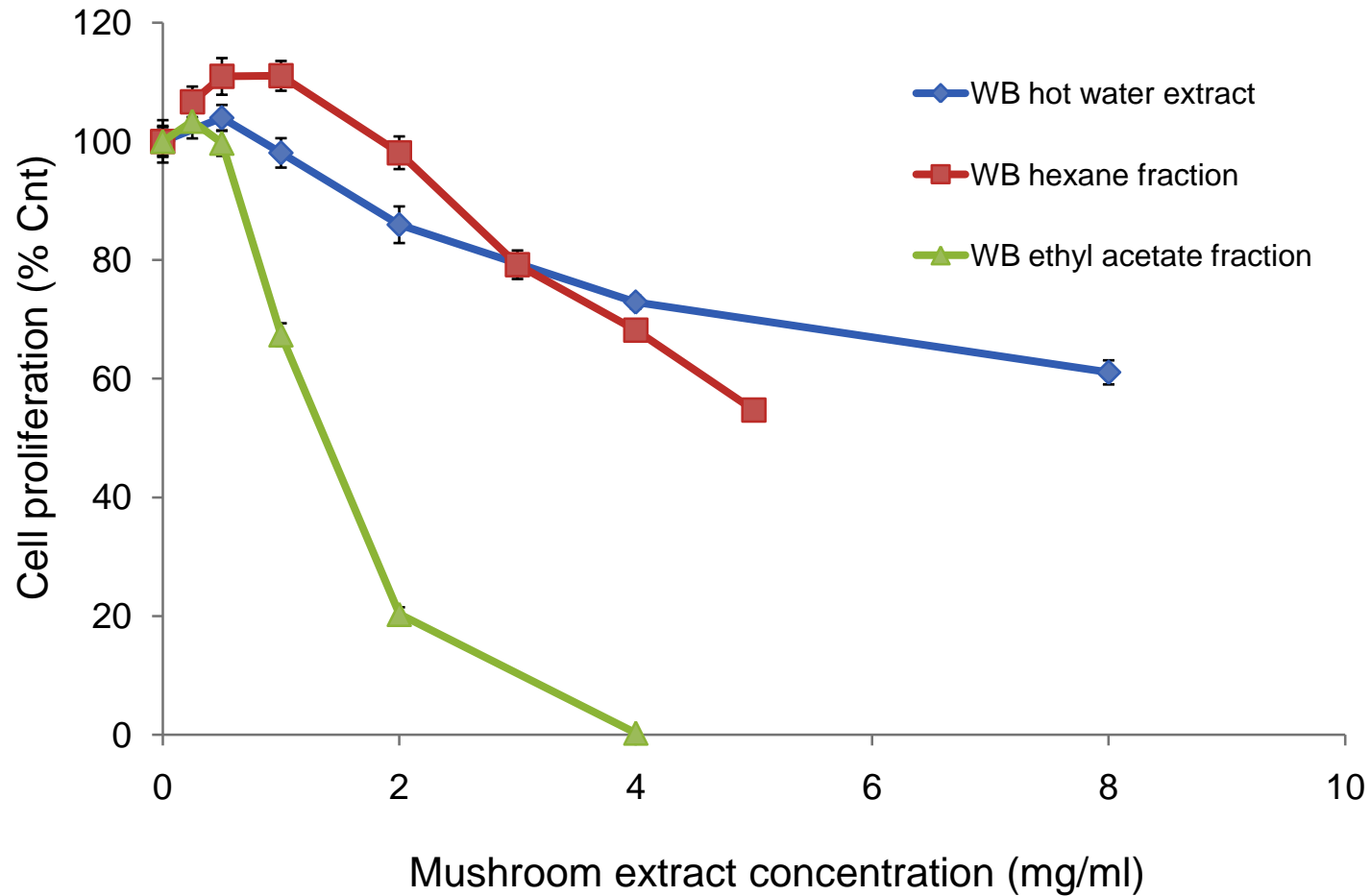


CANCER CELL LINES

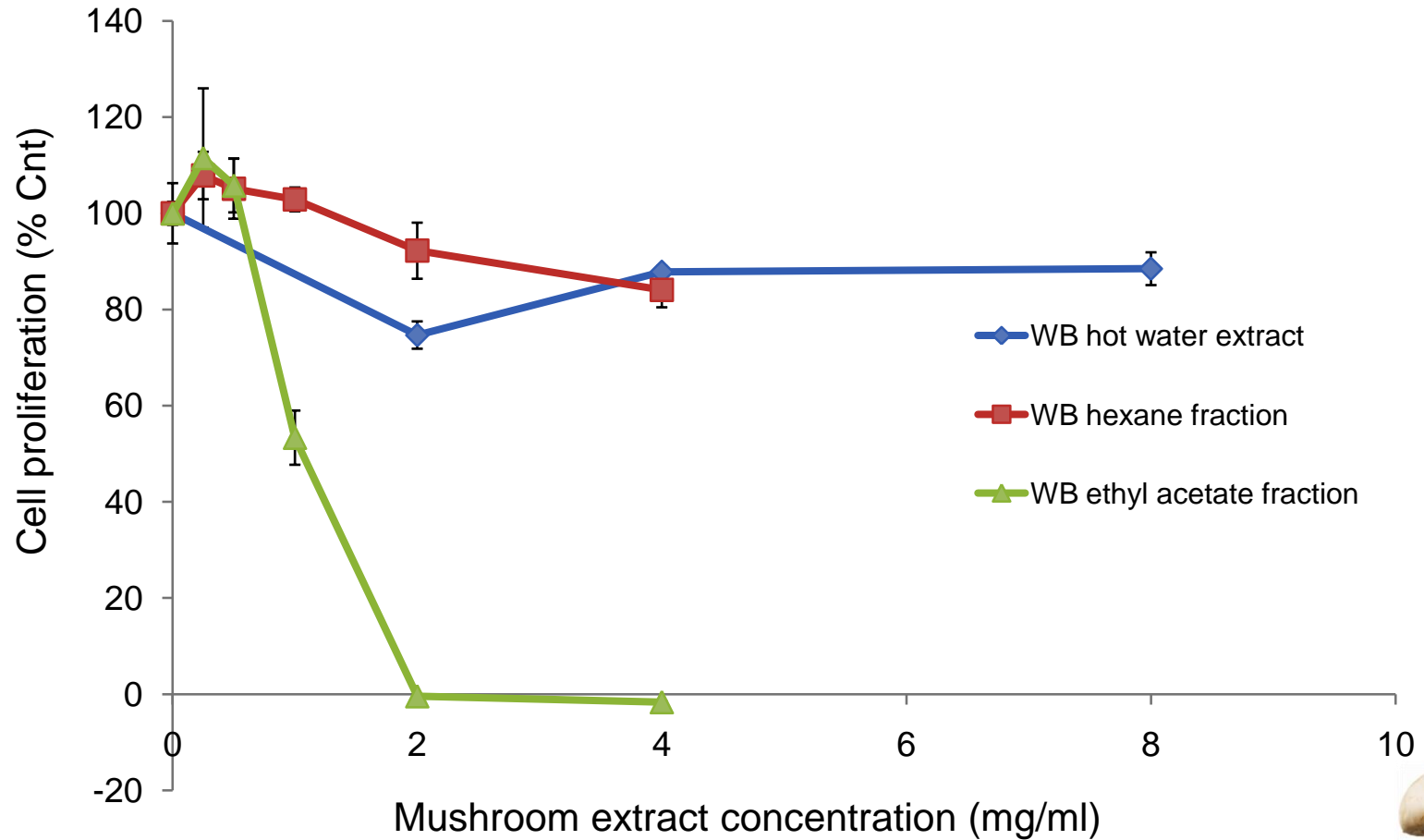
- Four types of human cancer cell lines
 - HT-29 human colon cancer cells
 - MCF-7 breast cancer cells
 - H1299 lung cancer cells
 - LNCaP prostate cancer cells



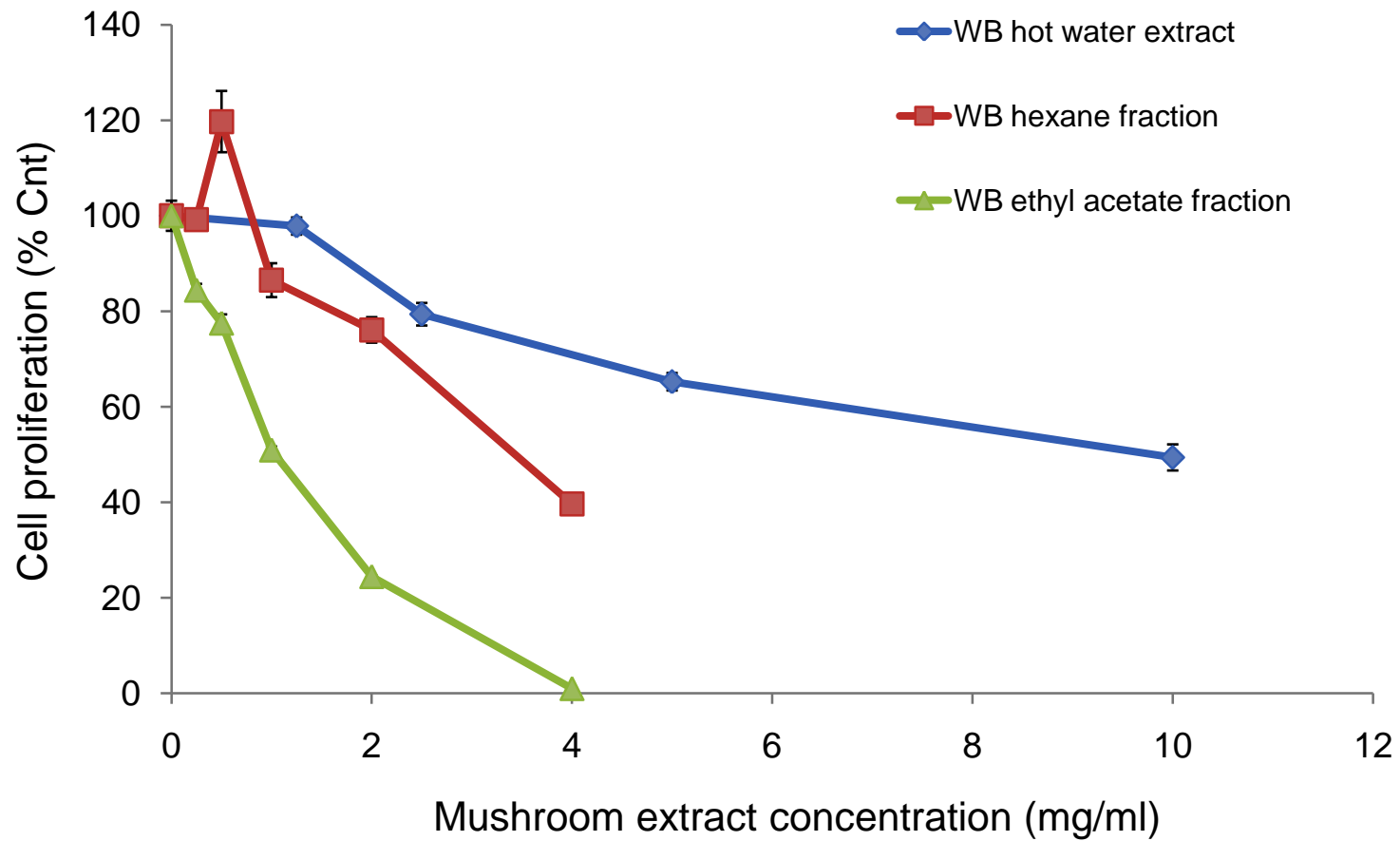
INHIBITION OF COLON CANCER CELL GROWTH



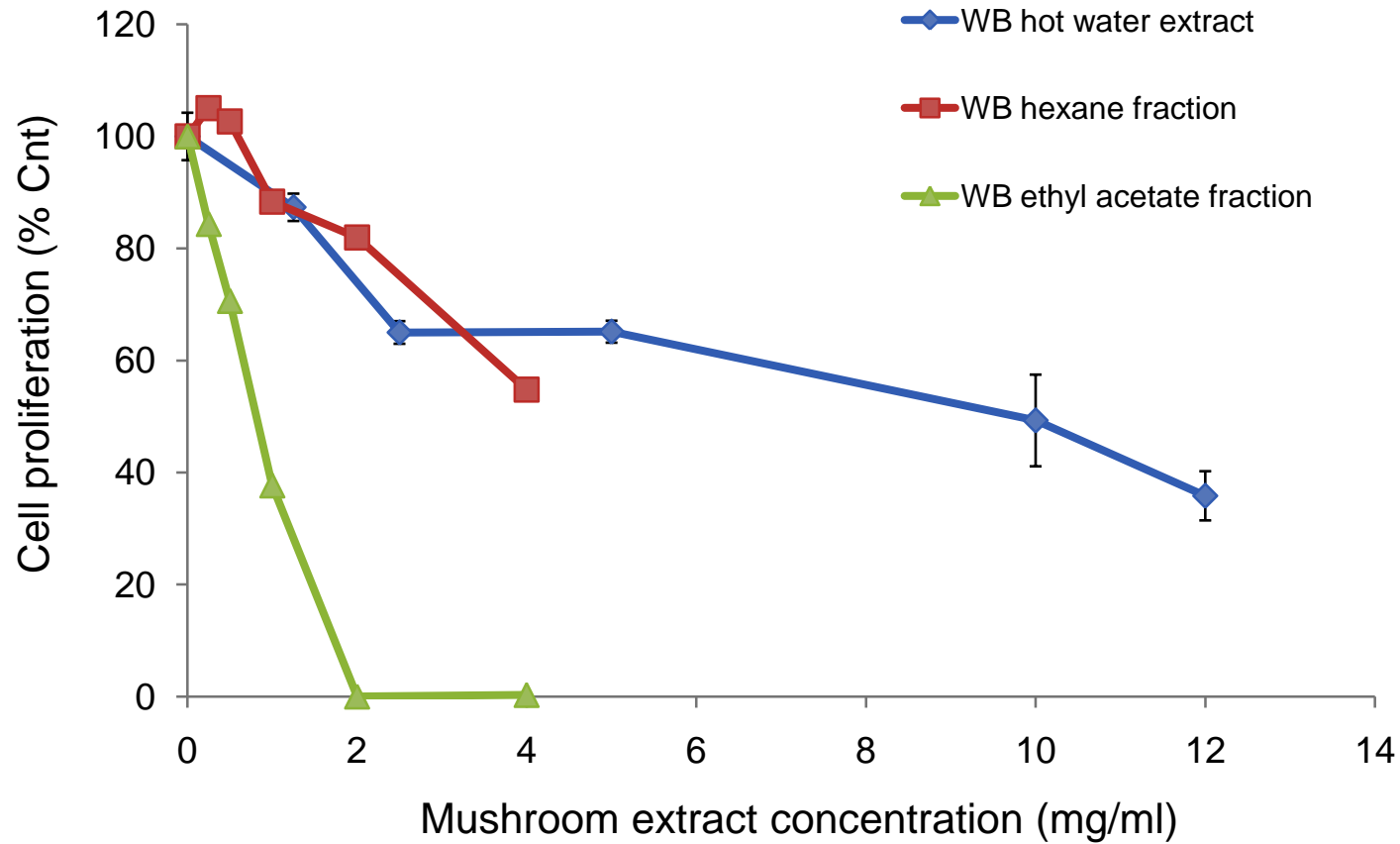
INHIBITION OF BREAST CANCER CELL GROWTH



INHIBITION OF LUNG CANCER CELL GROWTH



INHIBITION OF PROSTATE CANCER CELL GROWTH



SUMMARY OF INHIBITION EFFECT

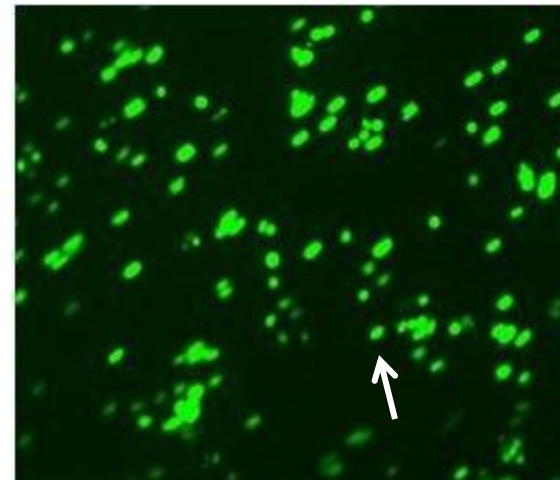
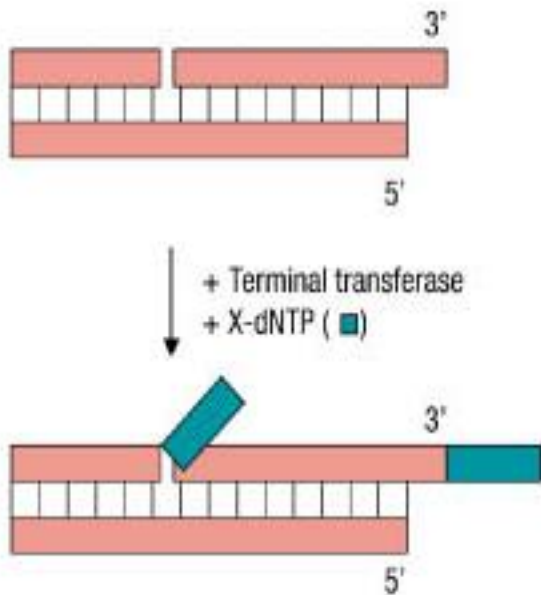
- WB mushroom extracts inhibit cancer cell growth in a dose-dependent manner.
- LNCaP prostate cancer cells are the most sensitive cells to the WB mushroom extracts.
- Ethyl acetate fraction has the strongest inhibition on cancer cell growth.



TUNEL ASSAY

Terminal deoxynucleotidyl transferase mediated deoxy-UTP end labeling

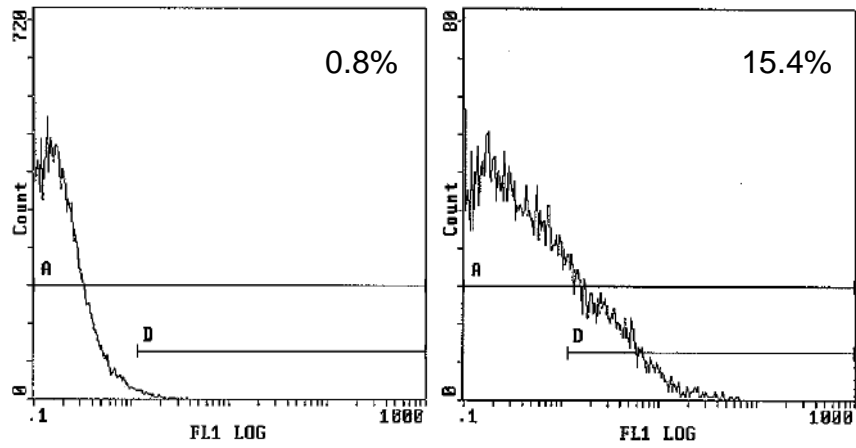
In situ end labeling (TUNEL)
(template independent)



Flow cytometer detects the apoptotic cell number

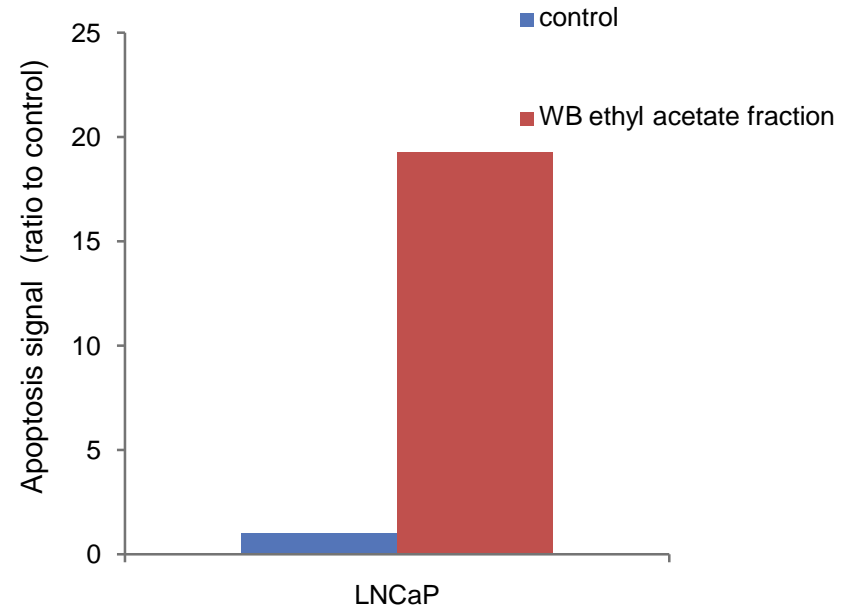


TUNEL ASSAY

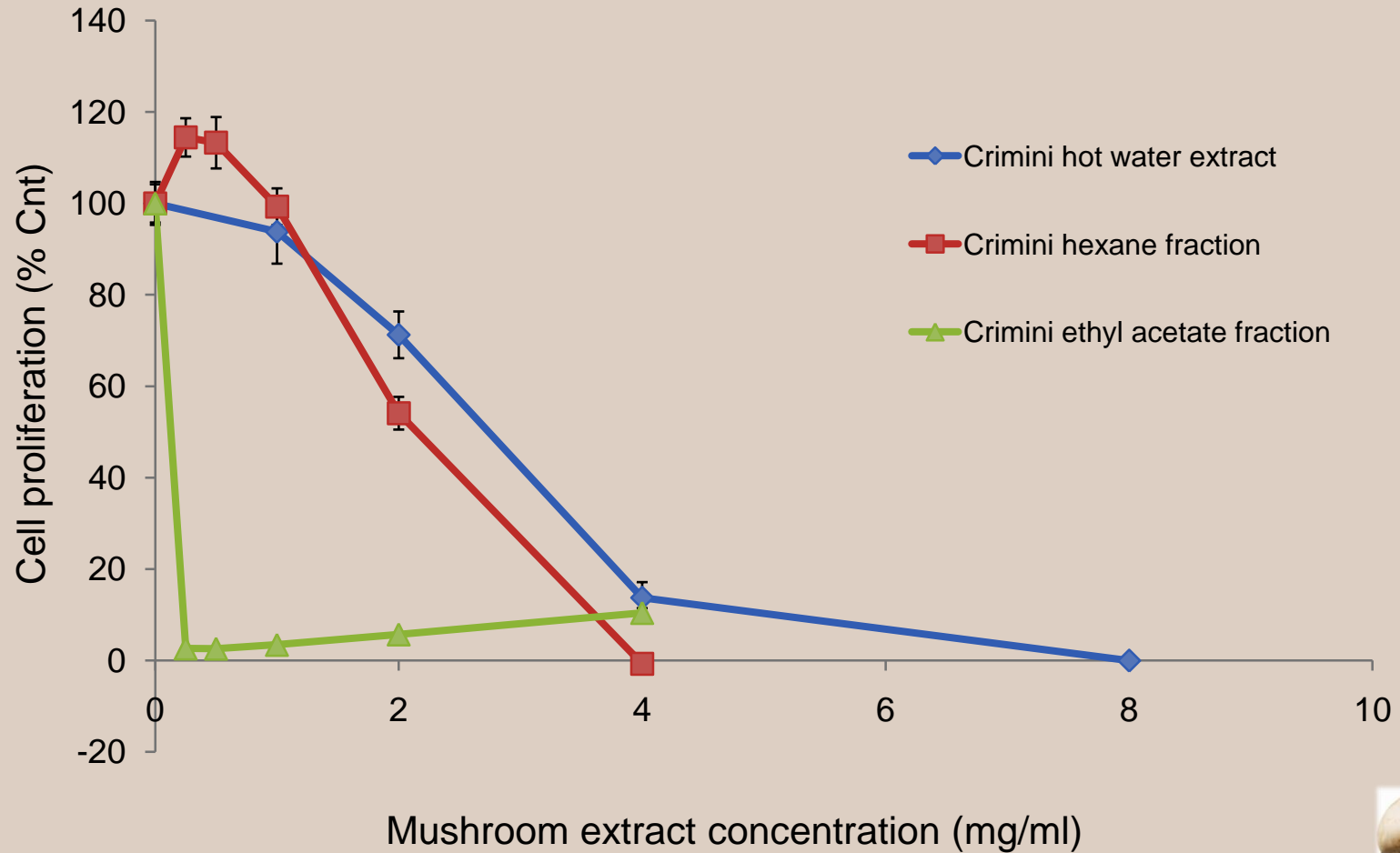


Control

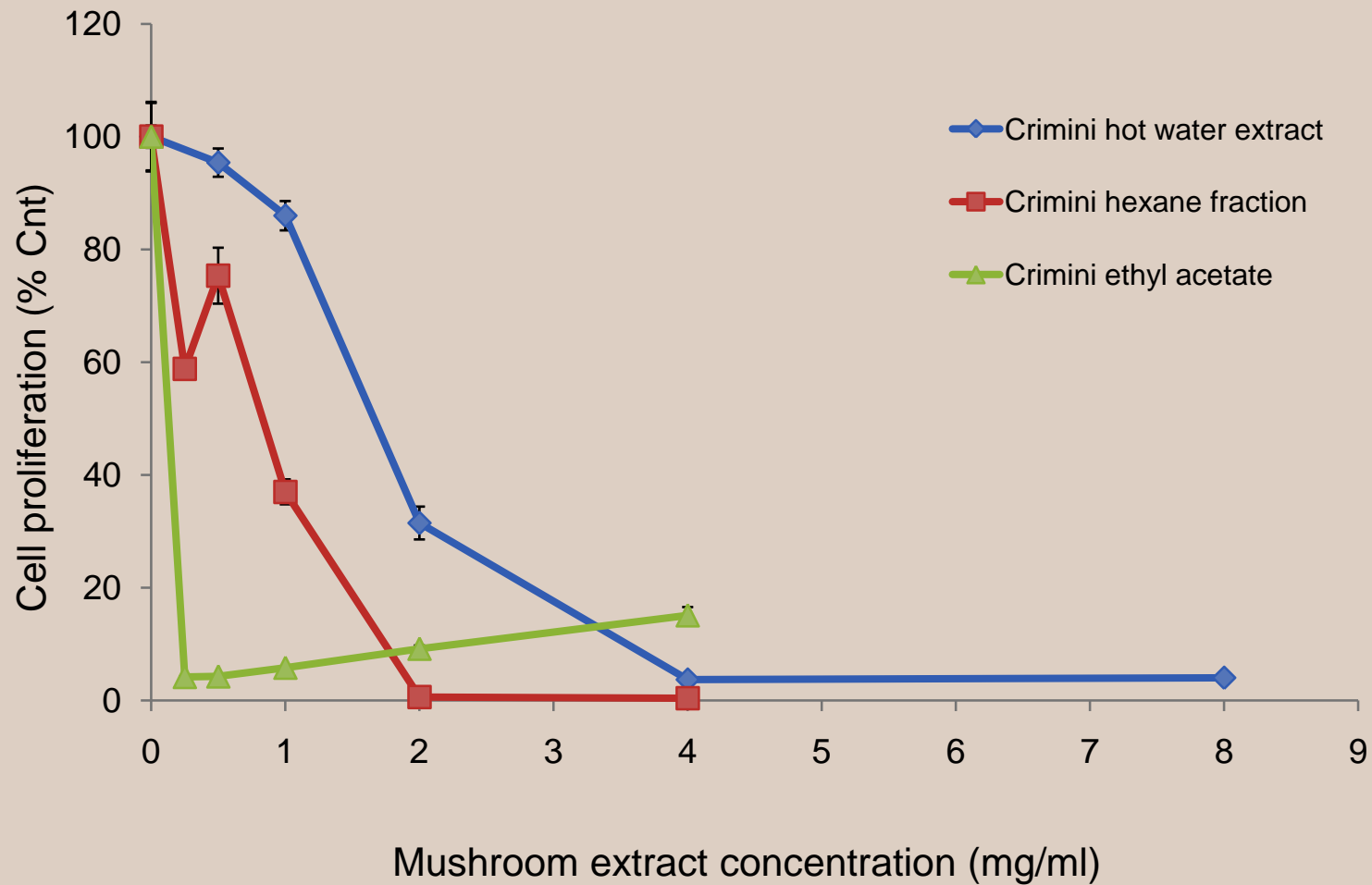
WB ethyl acetate fraction



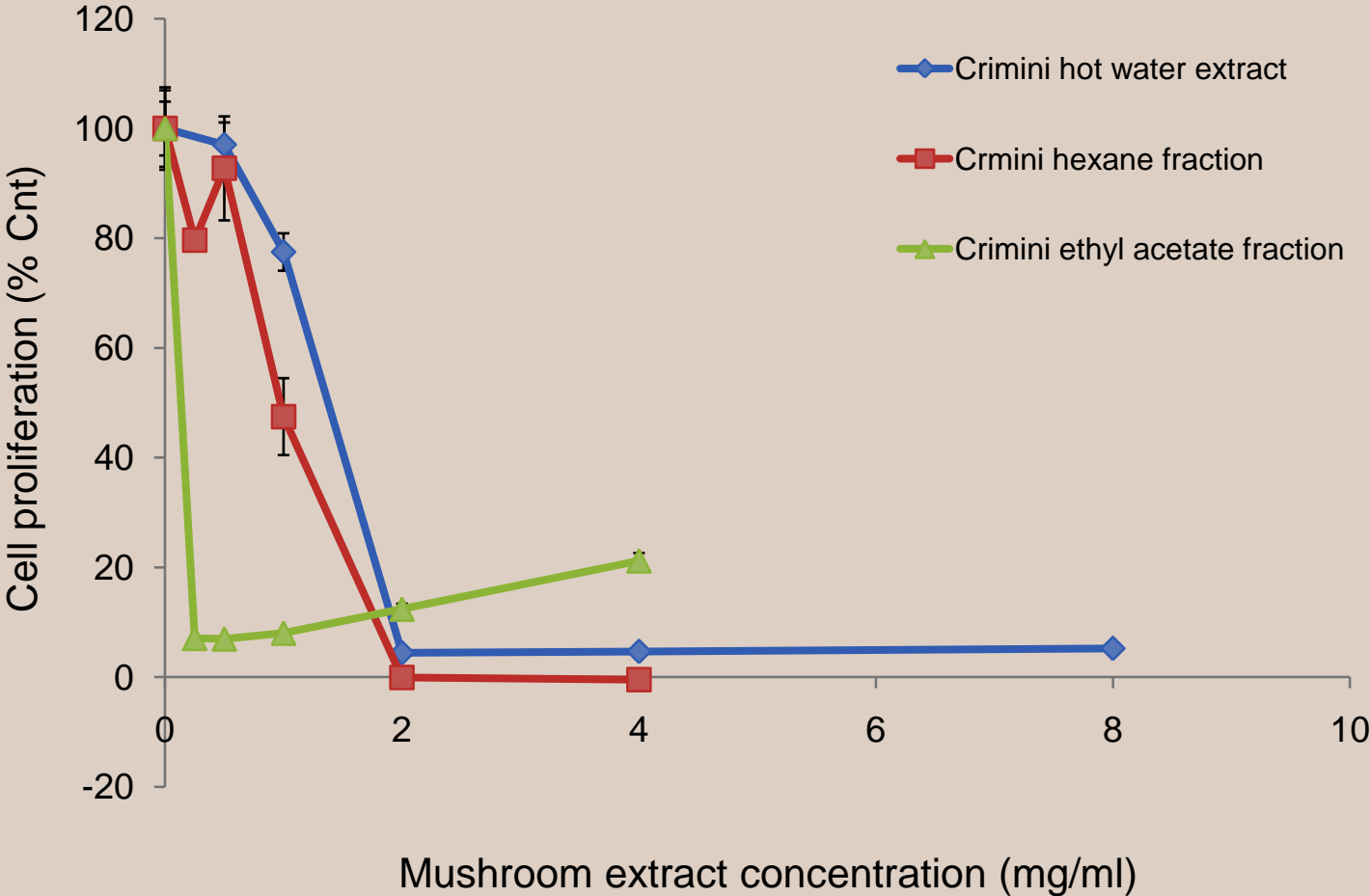
INHIBITION OF COLON CANCER CELL GROWTH



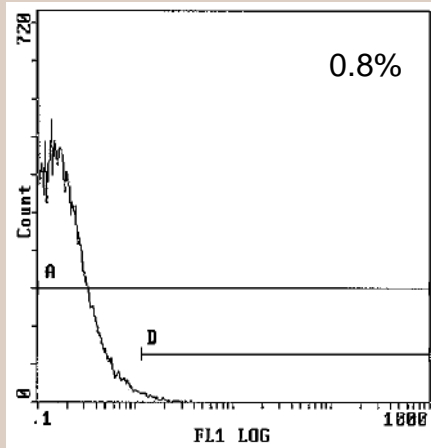
INHIBITION OF LUNG CANCER CELL GROWTH



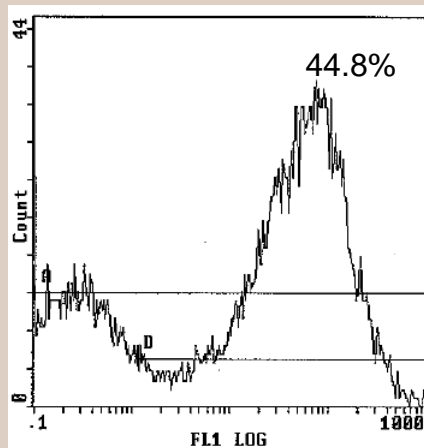
INHIBITION OF PROSTATE CANCER CELL GROWTH



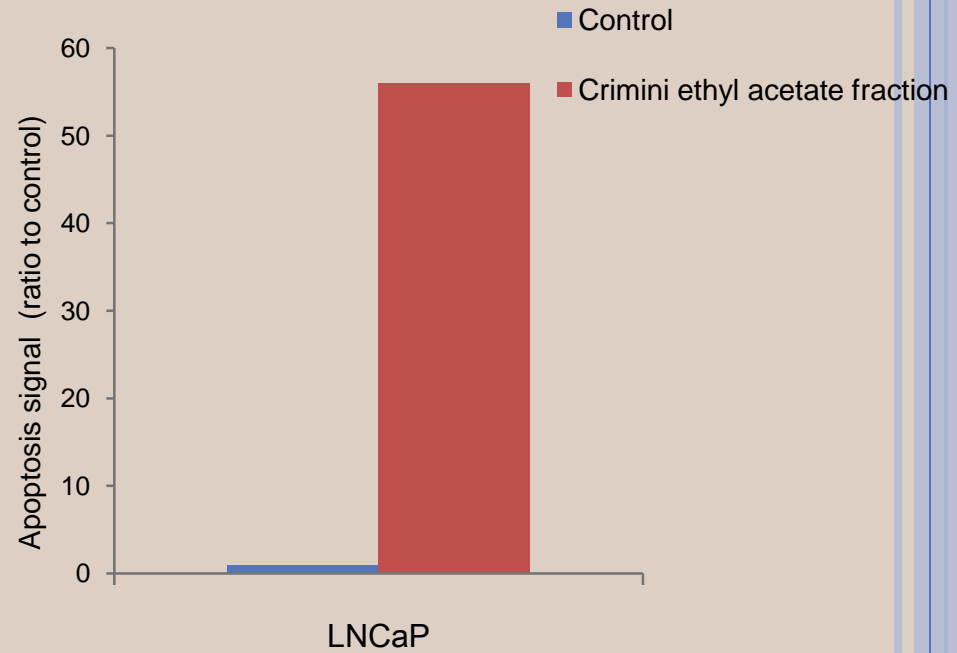
TUNEL ASSAY



Control



Crimini ethyl acetate fraction



CONCLUSIONS

- Button mushroom extracts inhibit cancer cell growth.
- LNCaP prostate cancer cells are the most sensitive.
- Ethyl acetate fraction has the strongest inhibition.
- The cell growth inhibition may be through apoptosis.



FUTURE RESEARCH

Cell line study

- Confirm apoptosis & cell cycle.
- Identify the effective bioactive compounds in the extracts.

Animal study

- Determine the growth inhibitory effects of WB ethyl acetate fraction against tumors in immune deficient mice.



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Thank you!

