The Role of Amygdalin in Treating Cancer *In Vitro*

Alyssa Stovall
The Center for Advanced Studies and Research at Thousand Oaks High School

Hypothesis: Amygdalin is effective in decreasing cell viability in multiple forms of cancer *in vitro.*

Abstract

This study researches the effects of amygdalin, a compound found in the pits and seeds of several fruits, on cancerous cells through *in vitro* tests on lung, breast, prostate, and cervical cancer cell lines. Data was collected from previous studies treating cancerous cells in mediums with concentrations of 2.5, 5, 10, and 20 mg/ml of amygdalin for 24 hours. The results showed that with an increase in the concentration of amygdalin, there was a decrease in cell viability. These results were found to be significant from *p*-values, which further support the original hypothesis that amygdalin is effective in treating the previously stated cancer types *in vitro.*

Introduction

First isolated by French chemists in 1830, amygdalin was later used as a cancer treatment in Russia in 1845 [1]. The compound's chemical formula, $C_{20}H_{27}NO_{11}$, is composed of glucose, benzaldehyde, and hydrocyanic acid (Fig. 1).

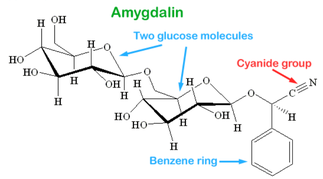


Figure 1. Structural model of amygdalin.

Each amygdalin compound contains a nitrile group which is released as a toxic cyanide anion to target cancerous cells, causing cell death [2]. Healthy cells contain rhodanese (Fig. 2), an enzyme that is able to detoxify cyanide and turn it into thiocyanate. Thiocyanate is a compound stored in the liver and helps to regulate blood pressure. However, cancerous cells do not have rhodanese, which allows the benzaldehyde to attack the [3]. The β-glucosidase, which is responsible for catalyzing the hydrolysis of bonds, breaks down the cyanide and benzaldehyde group, creating a toxic poison that enters the cell. Once inside the cell, the cyanide inhibits oxygen from entering the cell which causes the mitochondria to shut down and stop producing energy. With no energy production, the cell dies [4].

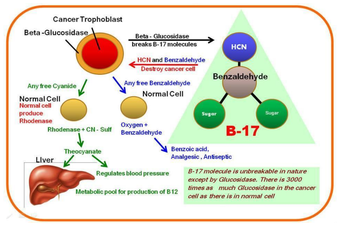


Figure 2. Process in which amygdalin is able to target and kill cancerous cells.

Clinical trials were started in the United States in 1980 with the goal of verifying the anticancer effects of amygdalin. Yet, researchers concluded that amygdalin did not have anticancer effects due to the improper dosing of amygdalin leading to cyanide poisoning [3]. Nevertheless, recent *in vitro* studies have revealed that amygdalin does have anticancer properties giving hope that it could offer potential treatment for the myriad of cases of untreatable cancers [5].

Purpose

To investigate the effect of amygdalin on cancer cells *in vitro*.

Methods

Data collection was completed through systematic review and synthesizing results of different studies to create a data set. All data collected was from articles that tested amygdalin on cell lines *in vitro*. Specifically, cell lines of lung, breast, prostate, and cervical cancers were used. Amygdalin from apricot kernels was dissolved in cell culture mediums with concentrations of 2.5, 5, 10, and 20 mg/ml for 24 hours. After 24 hours of treatment, cell numbers were counted to determine the cell viability within the sample.

Results

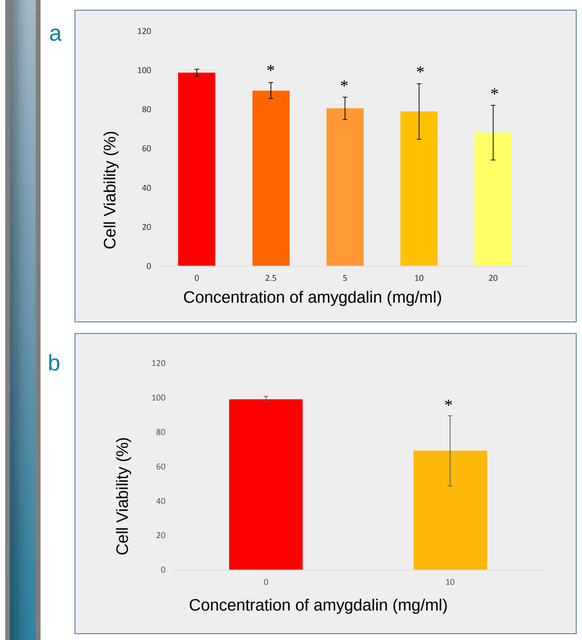
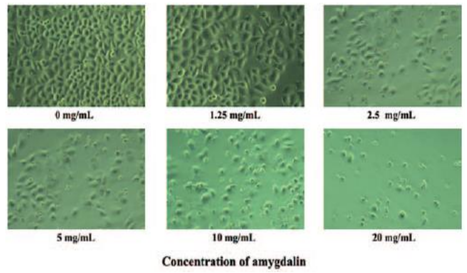


Figure 3. Results from two studies conducted in this project involving cell viability after treatment with amygdalin [6].

Results (Cont.)



[6]

Figure 4. HeLa cells under a microscope following amygdalin treatment.

The control group displayed a cell viability of 98.8 ± 1.8%. At concentration of 2.5, 5, 10, and 20 mg/ml, the viability of cells was 89.68 ± 4.14% ($p < 0.001$), 80.58 ± 5.71% ($p < 0.01$), 79.00 ± 14.20% ($p < 0.05$), 68.20 ± 14.01% ($p < 0.01$) of the control value (Fig 3a). Overall, the data as a whole produced a *p*-value greater than 0.05.

In a separate study using 10 mg/ml concentration, there was a lower cell viability after the treatment. The control group exhibited a slightly lowered cell viability level of 99.1 ± 1.6%, while the test group of 10 mg/ml displayed a cell viability of 69.1 ± 20.44% ($p < 0.01$) (Fig 3b).

HeLa cells were observed under a microscope after 24 hours of treatment. Each image displays cells in an *in vitro* environment. As the concentration increases, the number of HeLa cells decreases. The shape of the cell also became rounder (Fig. 4).

Discussion

The results after 24 hours reveal that as the concentration of amygdalin increased, the cell viability decreased, supporting the idea that higher concentrations have a larger effect on cell viability. Cells within the control group died as a result of natural cell death, or apoptosis, as opposed to the result of an outside factor. In the test groups, the amygdalin targeted the cancerous cells and induced apoptosis. The compound did this through entering the cell after being broken down by the β-glucosidase and shutting down cell respiration. Even if cells were not killed by the compound, the tests show that amygdalin was successful in causing physical changes to the cell in shape and size.

Conclusion

This study indicates that amygdalin is an effective *in vitro* treatment for multiple types of cancer including lung, breast, prostate, and cervical cancers.

Further Work

In future work, clinical trials can be pursued. However, the process leading up to clinical trials includes more research and *in vitro* studies, *in vivo* studies, and tests on animals. *In vitro* studies are useful to understand how the treatment works on a cellular level, but in order to see how the body responds to the treatment, *in vivo* studies serve as the next step. Rats are used in these *in vivo* studies as they are typically analogous to humans and can help in the predictions of how the human body will react. Once these stages in the research process are complete, clinical trials can begin and be used to prove the safety and efficacy of amygdalin as a treatment for cancer.

In addition to further research of amygdalin, researchers should consider work being done in other countries. Hope4Cancer, an institute in Mexico, specializes in alternative treatments for cancer, including amygdalin. This clinic has reported favorable outcomes from their treatments. If amygdalin use in the United States reaches a point of clinical trials, doctors may consider contacting this clinic to receive assistance to keep their trials safe and effective.

Furthermore, it could be beneficial to look into the synergistic effect of amygdalin with more common treatments such as surgery, radiation, or chemotherapy.

References

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