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Potential Anticancer Activity of Ethanol Extract from Garcinia mangostana L. Rind on Human MCF-7 Cells

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ABSTRACT:Breast cancer remains a significant global health issue, driving the need for therapies that are both safer and more effective. Recent research has concentrated on natural substances as potentialalternatives to conventional anticancer or adjuvant chemotherapy. The purpose of the study was to assess mangosteen rind extract cytotoxic effects on MCF-7 breast cancer cells. The MTT test was utilized to evaluate the cytotoxic effects of mangosteen rind extract (MRE) on MCF-7 breast cancer cells. A microplate reader set to 570 nm wavelength was used to analyze the test findings. Both MRE and doxorubicin (Dox) demonstrated concentration-dependent cytotoxic effects according to the MTT assay with IC_{50} values of 19.2 µg/mL and 1.1 µg/mL on MCF-7 cells, respectively.This study suggests that MRE could serve as a promising source of natural anticancer compounds, increasing the likelihood of creating innovative treatments for breast cancer in the future.

KEYWORDS: Cytotoxic activity, Garcinia mangostana, MCF-7 cells, Breast cancer

I. INTRODUCTION

Breast cancer remains one of the leading causes of death for women worldwide and a significant global health concern [1], [2], [3]. The rates of morbidity and mortality caused by cancer rise each year, while chemotherapy continues to be the primary treatment choice despite its high cost and significant side effects [4], [5]. Chemotherapeutic drugs like doxorubicin often lose effectiveness when cancer cells develop multidrug resistance pathways [3], [6], [7]. Prolonged administration of doxorubicin has been reported to result in cardiotoxic effects [8], [9], [10]. Although treatment has advanced, many current therapies for breast cancer are not selective, causing substantial harm to normal cells and reducing their overall efficacy [11], [12]. Therefore, it is crucial to develop new cancer drugs that specifically target and eliminate cancer cells, preserving healthy tissues to enhance therapeutic effectiveness and minimize side effects [13], [14]. One of the primary goals of current scientific studies is to explore strategies to maximize chemotherapy efficacy against cancer cells and reduce its harmful effects on non-cancerous tissue [15], [16]. Developing effective and targeted breast cancer treatments remains one of the most pressing and complex objectives in cancer research [17]. Numerous tropical plants have intriguing biological properties that may have medical uses [18], [19]. Plants with antioxidant and anti-inflammatory properties show potential as natural anticancer agents by mitigating oxidative damage and chronic inflammation [20], [21], [22], [23]. One of the plants that has the potential to be developed as a cytotoxic agent is Garcinia mangostana. Mangosteen rind has cytotoxic effects on SiHa cervical cancer cells[24], and K-562 cells [25] . Xanthones from the rind of Garcinia mangostana have been reported to have cytotoxic activity against human melanoma cells [26], MDA-MB-231 cells [27]. This demonstrates that the development of Garcinia mangostana as an anticancer agent is necessary. This study was conducted to investigated the cytotoxic effects of an ethanolic extract of Garcinia mangostanarind on MCF-7 breast cancer cells.

II. METHODS

Plant material

The Garcinia mangostanaL..rind was collected at Kota Baru, Luhak Nan Duo District, West Pasaman Regency, and West Sumatra. Dr. Nurainas, a botanist from Andalas University's Herbarium in West Sumatera, Indonesia, identified the Garcinia mangostana L. rind. Plant materials were sliced into tiny pieces and air-dried in a shaded area. Before extraction, the dehydrated plant components were ground into a powder.

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Sample preparation

Plant materials were sliced into tiny pieces (3-5 mm thick) and air-dried in a shaded area for 7 days. The dried bark of mangosteen rind was ground into a powder using a traditional grinder. The materials were then soaked for 24 hours at room temperature in 70% ethanol with intermittent stirring and then filtered. This process was repeated thrice. The filtrates were combined and concentrated under a vacuum using a rotary evaporator at 45℃ till a semisolid extract was formed. The extract was kept in a refrigerator at 4℃ for further pharmacological testing.

Cell culturing procedure

MCF-7 cells were grown in Dulbecco's modified Eagles medium, which contained 10% fetal bovine serum (Gibco, Grand Island, NY, USA), 1% penicillin-1% streptomycin (Gibco, Grand Island, NY, USA), and 0.5% fungizon (Gibco, Grand Island, NY, USA), in a flask in a humidified atmosphere (5% CO_2) at 37˚C.

Cytotoxic assay

MCF-7 cells were seeded in a 96-well plate with 8.61 x 10^5 cells/well and divided into control and treatment groups. Then, incubated at 37˚C with 5% CO_2 for 24 hours. Cells were treated with final concentrations of MRE were 0.1, 1, 10, and 100 µg/mL while the concentrations of Dox were 0.1, 1, 10, and 100 µg/mL. The culture media was withdrawn and the cells were cleaned with PBS (Sigma) after a 24-hour incubation period. 100 µL of diluted 5 mg/mL MTT on PBS (Sigma) was applied to each well after being diluted with Dulbecco's Modified Eagle Medium (DMEM).

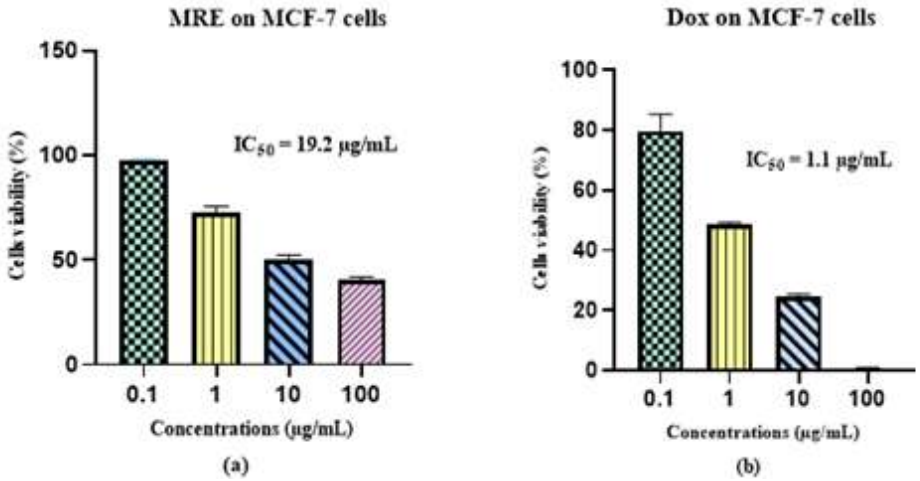

Figure 1. Cell viability (%) of MCF-7 cells following treatment with MRE (a) and Dox (b) for 24 h single test application. Viability values are presented as mean (n = 3) ± SEM

After four hours of incubation, 10 µL DMSO was added to stop the reaction. After that, the plate was incubated for 30 minutes at room temperature. The plate was agitated for ten minutes to ensure that the formazan had dissolved, and then the absorbance was measured at a wavelength of 570 nm using an ELISA reader (Bio-Rad, USA). Every treatment was administered in triplicate, and the cytotoxic activity was quantified using the IC_{50} method, which determines the quantity needed to lower the population's absorbance of cells by 50% in comparison to the untreated (control) cells.

Analysis

The in vitro experiment data were presented as mean ± S.E.M. Using the obtained absorbance, the percentage (%) of cell viability was determined. A plot of log concentration against % cell viability produced the equation y=ax+b, which was utilized to calculate the IC_{50} value, representing the concentration required to inhibit 50% of cell proliferation. Graphical illustration of the viability percentage was analyzed and presented using GraphPad Prism (GraphPad Prism, 9.0.0).

III. RESULT AND DISCUSSION

According to the National Cancer Institute (NCI), IC50 values serve as the basis for classifying cytotoxicity. Extracts with IC_{50} values less than 20 µg/mL are considered highly active, moderately active if IC_{50} 21-200 µg/mL, weakly active if IC_{50} = 201–500 µg/ml and IC_{50} values

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above 500 µg/mL indicate inactive or no cytotoxicity [28].

The inhibitory concentration (IC_{50}) is the amount needed to prevent 50% of cell growth. Lower IC_{50} values signify larger efficacy in inhibiting cell division [29]. The MRE exhibited an IC_{50} of 19.2µg/mL on MCF-7 cells, indicating highly active and dox showed a significantly lower IC_{50} of 1.1µg/mL, highlighting its highly activeas a chemotherapeutic agent. Both substances displayed a dose-dependent response, indicating increased cell death with increasing concentrations (Figure 1.).

The results of the MTT assay demonstrated that both MRE and Dox exhibited cytotoxic effects on MCF-7 breast cancer cells. However, the potency of these compounds differed significantly. Doxorubicin, a well-established chemotherapeutic agent, displayed a much lower IC_{50} value (1.1 µg/mL) compared to MRE (19.2 µg/mL), indicating that doxorubicin was more effective in reducing cell viability. The dose-dependent manner of cytotoxicity observed for both MRE and Dox suggests that increasing concentrations of these compounds led to a corresponding increase in cell death. This finding is consistent with previous studies that have reported the cytotoxic effects of MRE and doxorubicin on various cancer cell lines such as MDA-MB-231 cells [30], and K-562 cells [25]. The cytotoxic effect of MRE can be attributed to its bioactive compounds, such as xanthones, which have been shown to induce apoptosis [31], inhibit cell proliferation [32], and arrest the cell cycle in cancer cells [33]. Doxorubicin, on the other hand, exerts its cytotoxic effects by intercalating into DNA, causing DNA damage and inhibiting topoisomerase II [34].

Further studies are needed to isolate and analyze the bioactive elements of MRE responsible for its cytotoxic properties. In vivo trials will play a crucial role in confirming its safety and therapeutic potential. Employing targeted drug delivery systems may improve MRE's efficacy, minimize required dosages, and reduce toxicity toward healthy cells. This research serves as a vital starting point for establishing MRE as a safe and effective natural anti-cancer agent.

IV. CONCLUSION

The findings of this study demonstrate that Mangosteen Rind Extract (MRE) exhibits notable cytotoxic effects on MCF-7 breast cancer cells. While its efficacy is less potent than the chemotherapeutic standard, Doxorubicin, MRE holds potential as a promising natural anticancer candidate.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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