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Review Article

A REVIEW ON CYTOTOXIC ACTIVITY OF (*GARCINIA COWA* ROXB.): POTENTIAL AS AN ANTICANCER

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ABSTRACT

Cancer is a disease of abnormal body tissue cells that turn malignant. From the data, it can be seen that new cases and the death rate from cancer continues to increase every year so that efforts are made in the search for new anticancer agents for the prevention and treatment of cancer. There are many natural ingredients that can be used for its benefits, one of which is the *Asam Kandis* plant (*Garcinia cowa* Roxb.) This plant is rich in phytochemicals. It can be an important source of natural cytotoxic compounds and has potential as an anticancer. The analysis showed that the extract or compound from the roots, bark, twigs, leaves, and fruit rind of *Asam Kandis* (*Garcinia cowa* Roxb.) has good cytotoxic activity and is active against cancer cell lines so that it can help in the development of cancer therapy.

Keywords: cytotoxic, *Garcinia cowa* Roxb, anticancer, cancer cells.

INTRODUCTION

Cancer is a disease of abnormal body tissue cells that turn malignant. These cells undergo uncontrolled proliferation like normal cells, so that they can grow and divide faster and can metastasize to other parts of the body and can cause death[1]. Based on data from the Global Cancer Observatory (GLOBOCAN), 18.1 million new cases and 9.6 million deaths were reported in 2018[2].

Based on data on cases and mortality rates that increase every year, several researchers are making efforts to find new anticancer agents. There are many natural ingredients in the world that can be used for their properties, one of which can be found in Indonesia, which is located in the tropics, Indonesia has a diversity of flora and fauna that can be used for the prevention and treatment of cancer. Cytotoxic tests of various plants that have the potential to act as anticancer have been carried out, one of the plants that can be used is (*Garcinia cowa* Roxb.) or known by the people of West Sumatra by the name of *asam kandis*, *Garcinia cowa* belongs to the Clusiaceae family[3]. Several studies of *asam kandis* (*Garcinia cowa* Roxb.) showed cytotoxic activity both in vivo and in vitro, cytotoxic is a compound or substance that can inhibit or kill the growth of certain cancer cells [4].

Apart from cytotoxic activity, the results of previous studies also showed that *asam kandis* (*Garcinia cowa* Roxb.) has antidiabetic[5], antioxidant, antimutagenic[6], antibacterial[7,8,9] and anti-inflammatory activities[10]. It is hoped that the explanation from this review can increase knowledge and can contribute to the development of anticancer drugs from natural ingredients.

METHODS

Data Collection

In compiling this review article, the technique used was literature studies by finding sources or literature in the form of books, national and international journals in the last 10 years (2010-2020). Also, in making this review article, the data search using online media was done with the keywords as follows: cytotoxic activity of *Garcinia cowa* Roxb. The search for main references in this review article was conducted through trusted websites such as ScienceDirect, Researchgate, Google Scholar, Pubmed, Sci-hub and other reliable journal publications.

DISCUSSION

Cytotoxic activity on the roots of *Garcinia cowa* Roxb

The initial screening to search for anticancer compounds is a positive correlation to determine its potential as an anticancer. The active compound from the ethyl acetate fraction of the root of *asam kandis* (*Garcinia cowa* Roxb.) has been isolated as a flavonoid compound in the form of light-yellow crystals. Based on spectrometer data, it is suspected that the compound is *Hegoflavone (B)* with the molecular formula $C_{30}H_{20}O_{11}$. Cytotoxic activity testing was carried out using the Brine Shrimps method. Brine Shrimps method is one of the initial methods for cytotoxic testing using shrimp larvae *Artemia salina* Leach was used as experimental animals by looking at the LCv_{50} value. Testing the ethyl acetate fraction and *Hegoflavone (B)* from the *garcinia cowa* compounds root showed LC_{50} values of 37.325 µg / ml and 1.95 µg / ml. These findings indicate ethyl acetate fraction and *Hegoflavone (B)* compounds have active activity against the *toxicity of Brine Shrimps*[11].

Cytotoxic test of the ethanol extract of the root of *asam kandis* (*Garcinia cowa* Roxb.) was carried out in vivo on female white mice using the Micronucleus Assay method. The percentage of the number of micronuclei cells was calculated from the femoral bone marrow slide using a microscope. The results showed that the ethanol extract of the root of *asam kandis* (*Garcinia cowa* Roxb.) could reduce the percentage of micronuclei cells, the lowest indicated by the extract with a dose of 100 mg / KgBB for 15 days, namely 16.50%, the decrease in the number of micronuclei cells was thought to be caused by the xanthone and phenolic content present on the root of *Garcinia cowa*. From the results of the study, it is known that the ethanol extract of *Garcinia cowa* root has the potential to be used as an anticancer, its activity can be seen in the decrease in the number of micronuclei cells of female white mice that have been cancer-induced after giving the extract[12].

Table 1. IC_{50} values that show the cytotoxic activity of the root of *asam kandis* (*Garcinia cowa* Roxb.) against cancer cells

Pure extracts / compounds	Cell Line	IC_{50} values	Reference
Ethyl acetate fraction	T47D	0.52 ± 3.55 µg / mL	[13]
Water fraction	T47D	81.44 ± 7.99 µg / mL	[13]
Kaennacowanol A	KB	20.97 µM	[14]
	Hela	16.70 µM	[14]
Kaennacowanol B	KB	11.01 µM	[14]
	Hela	12.23 µM	[14]
Kaennacowanol C	KB	32.38 µM	[14]
	Hela	32.79 µM	[14]
fuscaxanthone I	KB	24.43 µM	[14]
	Hela	17.20 µM	[14]
cowanol	KB	11.98 µM	[14]
	Hela	12.19 µM	[14]
Cowanin	KB	11.96 µM	[14]
	Hela	11.68 µM	[14]
garcinone D	KB	22.31 µM	[14]
	Hela	22.58 µM	[14]
α-mangostin	KB	14.14 µM	[14]
	Hela	13.69 µM	[14]
pruniflorone C	KB	32.75 µM	[14]
	Hela	39.03 µM	[14]
β-mangostin	KB	12.05 µM	[14]
	Hela	12.78 µM	[14]
fuscaxanthone D	KB	15.48 µM	[14]
	Hela	33.46 µM	[14]
fuscaxanthone C	KB	> 100 µM	[14]
	Hela	> 100 µM	[14]
cowaxanthone B	KB	12.85 µM	[14]
	Hela	14.96 µM	[14]
fuscaxanthone F	KB	14.50 µM	[14]
	Hela	61.13 µM	[14]
norcowanin	KB	10.38 µM	[14]
	Hela	9.34 µM	[14]
Cowaxanthone	KB	13.59 µM	[14]
	Hela	15.75 µM	[14]
1-*isomagostin hydrate*	KB	7.97 µM	[14]
	Hela	10.31 µM	[14]
1-*isomagostin*	KB	39.67 µM	[14]
	Hela	34.04 µM	[14]
9-*hydroxycalabaxanthone*	KB	13.83 µM	[14]
	Hela	21.83 µM	[14]
5-*hydroxy*-8,9-*dimethoxy*-2,2-*dimethyl*-7- (3-*methyl*-2-*butenyl*) -2*H*, 6*H*pyrano[3,2-*b*]*xanthen*-6-*one*	KB	> 100 µM	[14]
	Hela	> 100 µM	[14]
fuscaxanthone A	KB	> 100 µM	[14]
	Hela	> 100 µM	[14]
jacareubin	KB	9.10 µM	[14]
	Hela	11.43 µM	[14]
rubraxanthone	MCF-7	37.4 ± 6.3 µM	[15]
	H-460	17.5 ± 2.4 µM	[15]
	DU-145	42.3 ± 13.7 µM	[15]
cowanine	MCF-7	4.1 ± 1.0 µM	[15]
	H-460	5.4 ± 2.3 µM	[15]
	DU-145	11.3 ± 10.0 µM	[15]

The cytotoxic activity test of the ethanol extract fractionation, namely the ethyl acetate fraction and the water fraction from the root of *asam kandis* (*Garcinia cowa* Roxb.) was conducted on breast cancer cells (T47D) in vitro. The ethanol extract fractionation of the root of *asam kandis* was tested using the *Microculture Tetrazolium* (MTT) method with concentrations of 0.1, 1, 10, and 100 µg / mL. From the tests carried out, the ethyl acetate fraction had a cytotoxic effect on breast cancer cells

(T47D) with an IC_{50} value of 0.52 µg / ml, while the water fraction had no cytotoxic effect on breast cancer cells (T47D) with an IC_{50} value of 81.14 µg / ml. Ethyl acetate fraction of *asam kandis* root (*Garcinia cowa* Roxb.) was able to significantly inhibit the growth of breast cancer cells (T47D) at a concentration of 100 µg / mL. From these findings it can be stated that the ethyl acetate fraction has a strong cytotoxic potential[13].

From the isolation of the *asam kandis* (*Garcinia cowa* Roxb.) root, three new xanthones, named *kaennacowanols A - C* (1–3), with nineteen known xanthones isolated from the root of *asam kandis* (*Garcinia cowa* Roxb.) All isolated compounds were evaluated for cytotoxicity against epidermoid carcinoma (KB) and cervical carcinoma (HeLa) cells using 3 - [*dimethylthiazole* 4,5-2yl] -2,5-*diphenyltetrazolium bromide* (MTT) test method. Of the 22 compounds, 1-*isomagostin hydrate* and *jacareubin* compounds showed good cytotoxicity against epidermoid carcinoma (KB) cells with IC_{50} values of respectively 7.97 and 9.10 µM. In addition, *norcowanin* compounds showed good cytotoxicity against cervical carcinoma (HeLa) cells with an IC_{50} value of 9.34 µM[14].

Cytotoxic tests on *Rubraxanthoneco* and co*wanine* compounds from the isolation of the root of *asam kandis* (*Garcinia cowa* Roxb.) were carried out on breast cancer cells (MCF-7), prostate cancer cells (DU-145), and lung cancer cells (H - 460), using the 3- [*dimethylthiazol*4,5-2yl] -2,5-*diphenyltetrazolium bromide* test method. The level of cytotoxicity was determined by calculating the IC_{50} level based on the percentage of cell death after 24 hours incubation. IC_{50} compounds values for *cowanine* were 4.1 ± 1.0 µM, 5.4 ± 2.3 µM and 11.3 ± 10.0 µM and have the potential to fight against MCF-7, H-460 and DU-145, while *Rubraxanthone* compounds were found to be active in each cancer cell. These findings suggest that *Garcinia cowa* root could be an important source of natural cytotoxic compounds[15].

Cytotoxic activity on the bark of *Garcinia cowa* Roxb

Table 2. IC_{50} value that shows the cytotoxic activity of the stem bark of *asam kandis* (*Garcinia cowa* Roxb.) against cancer cells

Pure extracts / compounds	Cell Line	IC_{50} value	Reference
70% ethanol extract	T47D	5.10 ± 1.68 µg / mL	[16]
6-*Hydroxy-calabaxanthone*	MCF-7	21.2 ± 8.4 µM	[17]
	H-460	11.4 ± 4.0 µM	[17]
	DU-145	6.4 ± 2.5 µM	[17]
2- (3-*methyl*-2-*butenyl*) -1,5,6-*trihydroxy*-3-*methoxy*-4- (1,1-*dimethyl*-2-*propenyl*) -9*H*-*xanthen*-9- *One*	MCF-7	11.5 ± 3.7 µM	[17]
	H-460	11.3 ± 2.9 µM	[17]
	DU-145	10.9 ± 6.3 µM	[17]
Rubraxanthone	MCF-7	37.4 ± 36.3 µM	[17]
	H-460	17.5 ± 2.4 µM	[17]
	DU-145	42.3 ± 13.7 µM	[17]
α- mangostin	MCF-7	4.1 ± 1.0 µM	[17]
	H-460	5.4 ± 3.3 µM	[17]
	DU-145	11.3 ± 10.0 µM	[17]
1,3,6-*trihydoxy*-7-*methoxy*-4- (4-*acetoxy*-3-*methyl*-2-*butenyl*) -8- (3,7-*dimethyl*-2,6-*octadienyl*)*xanthones*	MCF-7	57.3 ± 36.3 µM	[17]
	H-460	28.8 ± 26.2 µM	[17]
cowanin	MCF-7	5.3 ± 2.1 µM	[17]
	H-460	12.3 ± 3.4 µM	[17]

Cytotoxic test of the ethanol extract of *asam kandis* stem bark (*Garcinia cowa* Roxb.) against breast cancer cells (T47D) was carried out using the 3- (4,5-*dimethylthiazol*-2-*yl*) -2,5-*diphenyltetrazolium bromide* (MTT) assay method. The extract was added at various concentrations (0.1, 1, 10 and 100 µg / mL). The level of cytotoxicity was determined by calculating the IC_{50} level which was based on the percentage of cell death after 24 hours of exposure to the extract. Changes in cell morphology were observed using an inverted microscope. *Asam kandis* (*Garcinia cowa* Roxb.) showed a significant cytotoxic effect on breast cancer cells (T47D) with an IC_{50} value of (5.10 ± 1.68) µg / mL which means that it has very strong cytotoxic activity, and changes in the morphology of the number of cells including reduction in size cells[16].

This study aimed to isolate the methanol extract of the stem bark of *asam kandis* (*Garcinia cowa* Roxb.) and to evaluate its cytotoxic activity against breast cancer cell line (MCF-7), lung (H-460) and prostate cancer (DU-145). The isolated compounds tested for cytotoxicity were 6-*hydroxicalabaxantones*; 2- (3-*methyl*-2-*butenyl*) -1,5,6-*trihydroxy*- 3-*methoxy*-4- (1,1-*dimethyl*-2-*propenyl*) -9*H*-*xanthen*-9-*one*; *rubraxanthone*; *α-mangostin;* 1,3,6- *trihydoxy*-7-*methoxy*-4- (4-*acetoxy*-3-*methyl*-2-*butenyl*) -8- (3,7-*dimethyl*-2,6 *octadienyl*) *xanthones*; *cowanin* by using the *Microculture Tetrazolium* (MTT) method. All compounds isolated had cytotoxic activity against cancer cells based on IC_{50} values of. IC_{50} values less than 10 µM are considered potential, while IC_{50} values between 10 to 30 µM are considered potential because they have good activity and IC_{50} values between 30µM - 100µM are considered weak activities. Out of these compounds the more prominent is the *α-mangostin* and *cowanin* compounds that showed potential activity against MCF-7. The *α-mangostin* compound also has strong activity against H-460, while the 6-*hydroxycalabaxanthone* compound is strong against DU-145[17].

Cytotoxic activity on the branches of *Garcinia cowa* Roxb

Guttiferone K is a new compound isolated from the *asam kandis* (*Garcinia cowa* Roxb.) branch, the compound Guttiferae K is targeted for colon cancer. Based on the results of the research, the *guttiferone K* compound can reduce the viability of HT-29 cancer cells with an IC_{50} value of 5.39 ± 0.2 µM without reducing the viability of normal colon epithelial cells (CCD 841 CoN). Apart from that, *guttiferone K* compounds can induce G0 / G1 cell cycle arrest and apoptosis in colon cancer cells. So that in this discovery, the *guttiferone K* compound can be a compound that has high potential as a candidate for potent antitumor drugs against colon cancer cells[18].

Cytotoxic activity on the leaves of *Garcinia cowa* Roxb

Table 3. IC_{50} value that shows cytotoxic activity of *asam kandis* leaves (*Garcinia cowa* Roxb.) against cancer cells

Pure extracts / compounds	Cell Line	IC_{50} value	Reference
Ethanol extract	T47D	6.13 ± 3.51 µg / mL	[19]
Chamuangone	Hela	3.59 µM	[20]
Chamuangone	HT-29	12.82 ± 2.48 µg / mL	[21]
	MCF-7	15.95 ± 1.94 µg / mL	[21]
	A549	15.26 ± 2.67 µg / mL	[21]
methyl 2,4,6 -*trihydroxy*-3- (3-*methylbut*-2 *enyl*)*benzoate*	MCF-7	21.0 ± 10.2 µM	[22]
	H-460	> 100 µM	[22]
garcinisidone-A	MCF-7	21.2 ± 8.4 µM	[22]
	H-460	18.1 ± 6.7 µM	[22]
3- *(1-methoxycarbonyl*-4,6-*dihydroxyphenoxy)*-6-*methoxy*-3, 5-*di*(3- *methyl*-2-*butenyl)*-1,4-*benzoquinone*	MCF-7	17.2 ± 6.2 µM	[22]
	H-460	> 100 µM	[22]
cowaxanthone G	HeLa	8.09 ± 0.78 µM	[23]
	A549	12.57 ± 4.30 µM	[23]
	PANC-1	14.80 ± 8.68 µM	[23]
1,5,6-*trihydroxy*-2 -*prenyl*-6 ′, 6'-*dimethyl*-2*H*-*pyrano*(2 ′, 3 ′: 3,4)*xanthone*	Hela	7.06 ± 0.71 µM	[23]
	A549	8.19 ± 0.99 µM	[23]
	PANC-1	9.32 ± 4.58 µM	[23]
garcimultiflorones E	Hel a	17.61 ± 1.45 µM	[23]
	A549	7.57 ± 0.57 µM	[23]
	PANC-1	17.73 ± 1.56 µM	[23]
symphonone H	Hela	9.83 ± 0.61 µM	[23]
	A549	6.27 ± 0.71 µM	[23]
	PANC-1	11.24 ± 4.89 µM	[23]
jacareubin	Hela	1.09 ± 0.67 µM	[23]
	A549	6.90 ± 2.23 µM	[23]
	PANC-1	10.12 ± 7.91 µM	[23]
xanthones V_1	Hela	4.71 ± 0.52 µM	[23]
	A549	11.76 ± 6.29 µM	[23]
	PANC-1	6.56 ± 2.55 µM	[23]

Ethanol extract of *asam kandis* leaves (*Garcinia cowa* Roxb.) was obtained by maceration method using 70% ethanol solvent, cytotoxic test was carried out using the *Microculture Tetrazolium* (MTT) method, from various extract concentrations (0.1, 1, 10 and 100 µg / mL) against T47D cancer cells, the level of cytotoxicity was determined by calculating the IC_{50} value. The IC_{50} value shows that the ethanol extract of *Garcinia cowa* leaves was able to fight T47D breast cancer cells with IC_{50} 6.13 ± 3.51 µg / mL. *Microculture Tetrazolium* (MTT) is a colorimetric cytotoxic test method to determine the number of living cells based on changes in 3- (4,5-*dimethylthiazole*- 2-*yl*)- *2,5diphenyl tetrazolium bromide* solution that changed from yellow to purple formazan crystals by active mitochondria in living cells. The ethanol extract of *Garcinia cowa* leaves was able to significantly inhibit the growth of T47D breast cancer cells at concentrations of 10 µg / mL and 100 µg / mL so that it has potential as an anti-cancer[19].

Chamuangone compounds were isolated from *Garcinia cowa* leaf extract which was extracted with n-hexane solvent using the *microwave extraction* (MAE) method. The cytotoxic activity of *chamuangone* compounds against cervical cancer cells (Hela) was determined using the *Microculture Tetrazolium* (MTT) test, and the cytotoxicity level was determined by calculating the IC_{50} value. *Chamuangone* compound has an IC_{50} value of 3.59 µM. This showed a strong cytotoxic activity against cervical cancer cell line (HeLa) and more prominent than the gefitinib drug that has IC_{50} value of 17.94 µM on HeLa cells. In addition, *chamuangone* compounds can also cause apoptosis of HeLa cell death. *Chamuangone* compounds also tested for EGFR-TK inhibitory activity, research showed that the docking energy score of *chamungone* compounds is higher than the gefitinib drug. Based on these findings *chamuangone* is a potential chemotherapy agent[20].

Chamuangone are compounds isolated from *Garcinia cowa* leaf extract that used rice bran oil as an alternative green solvent for extraction of anticancer compounds that is safer and cheaper. The extraction was carried out with the aid of microwaves and high-performance liquid chromatography. The cytotoxic activity test was carried out using the sulforhodamine B test method. In this study the IC_{50} value of colorectal cancer cells (HT-29) = 12.82 ± 2.48 µg / mL, breast cancer cells (MCF-7) = 15.95 ± 1.94 µg / mL, Lung cancer (A549) = 15.26 ± 2.67 µg / mL, this showed strong cytotoxic and non-cytotoxic against normal gingival fibroblast (HGF) cells. These findings indicated that the *Chamuangone* compound from *asam kandis* (*Garcinia cowa* Roxb.) leaves extract with rice bran oil, has the potential to be an anti-cancer agent and useful for nutraceutical applications[21].

Three compounds were isolated from the leaves of *Garcinia cowa*, namely *methyl* 2,4,6-*trihydroxy*-3- (3-*methylbut*-2-*enyl*)*benzoate*; *garcinisidone-A*; 3-*(1-methoxycarbonyl*-4,6-*dihydroxyphenoxy)*-6-*methoxy*-3, 5-*di*(3-*methyl*-2-*butenyl)*-1,4-*benzoquinone*. This study aimed to isolate the methanol extract of *Garcinia cowa* leaves and evaluate its cytotoxic activity against breast cancer cell lines (MCF-7) and lung cancer cells (H-460). The cytotoxic test was carried out by using the *Microculture Tetrazolium* (MTT) method, *methyl* 2,4,6-*trihydroxy*-3- (3-*methylbut*-2-*enyl*)*benzoate*; *garcinisidone-A* and 3-*(1-methoxy carbonyl*-4,6-*dihydroxyphenoxy)*-6-*methoxy*-3, 5-*di*(3-*methyl*-2-*butenyl)*-1,4 *benzoquinone* demonstrated cytotoxic activity with IC_{50} values of 21.0 ± 10.2 µM, 21.2 ± 8.4 µM and 17.2 ± 6.2 µM against breast cancer cells (MCF-7), whereas against lung cancer

cells (H-460) the *garcinisidone-A* compound was found to be active with an IC_{50} value of 18.1 ± 6.7 μM[22].

Cowaxanthone G; 1,5,6-*trihydroxy*-2-*prenyl*-6′,6′-*dimethyl*-2*H pyrano*(2′,3′: 3,4)*xanthone*; *garcimultiflorones E*; *symphonone H*; *jacareubin*; *xanthone V₁* compounds that were isolated from *Garcinia cowa* acetone leaf extract showed significant cytotoxicity results against cervical cancer cells (Hela), lung cancer cells (A549), and pancreatic cancer cells (PANC-1). Cell cycle analysis using flow cytometry showed that 1,5,6-*trihydroxy*-2-*prenyl*-6′, 6'-*dimethyl*-2*H pyrano*(2′,3′:3,4)*xanthone* stop the cell cycle in the S phase in a dose-dependent manner, *cowaxanthone* G and *jacareubin compounds* in the G2 / M phase, and *xanthones V₁* in the G1 phase, while the *jacareubin* and *xanthones V₁* induces apoptosis[23].

Cytotoxic activity on the rind of *Garcinia cowa* Roxb

Cytotoxic activity tests were carried out on ethanol extract of *asam kandis* (*Garcinia cowa* Roxb.) fruit rind against breast cancer cells (T47D) in vitro using the *Microculture Tetrazolium* (MTT) test. The extract concentrations used were 100, 10, 1, and 0.1 μg / mL. This test showed that the ethanol extract of the *asam kandis* (*Garcinia cowa* Roxb.) fruit rind has a cytotoxic effect on breast cancer cells (T47D) with an IC_{50} value of 19.33 μg / ml. The increase in the concentration of the ethanol extract of the *asam kandis* fruit rind significantly affected the percentage of breast cancer cell viability (T47D) ($P < 0.05$) at a concentration of 100 μg / ml, a concentration of 10 μg / ml, and a concentration of 1 and 0.1 μg / ml[24].

The dichloromethane fraction from the rind of *asam kandis* (*Garcinia cowa* Roxb.) was tested to determine the apoptosis induction of cervical cancer (Hela) cells which was observed using the double staining method. It showed apoptosis which is characterized by yellowish green fluorescence. The yellowish green fluorescence indicated that the cell has DNA fragmentation and chromatin condensation. The average percentage of apoptosis of cells treated was higher (70.38%) compared to controls (12.26%). The apoptotic ability of the dichloromethane fraction from the rind of *asam kandis* (*Garcinia cowa* Roxb.) was thought to be due to the presence of xanthone compounds, increasing the potential of *Garcinia cowa* as a chemopreventive agent which will greatly assist in the development of cancer therapy and to minimize side effects and costs of chemotherapy treatment[25].

CONCLUSION

The *asam kandis* (*Garcinia cowa* Roxb.) plant is a plant that is rich in phytochemicals. *Asam kandis* is very potential as an anticancer that has high cytotoxic activity, based on this review, it has been shown that extracts or compounds from the roots, bark, twigs, leaves and rind of *asam kandis* (*Garcinia cowa* Roxb.) has good cytotoxic activity and are active against cancers cell lines, such as for the breast cancer cells (T47D, MCF-7), cervical cancer (Hela), colorectal cancer (HF-29), lung cancer (H-460, A-549), pancreatic cancer (PANC-1), prostate cancer (DU-145), and epidermoid carcinoma (KB). *Asam kandis* (*Garcinia cowa* Roxb.) can be a source of cytotoxic compounds which are very helpful in the development of cancer therapy.

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