Individual Anteaox Phenols and Breast Cancer

Cinnamic Acid

"Thus, from the above observations we can conclude that CA is an effective anticancer agent that can induce apoptosis in breast cancer cells via TNFA-TNFR1 mediated extrinsic apoptotic pathway." 59. Anti-cancer Agents in Medicinal Chemistry, 2020

Ferulic Acid

"Ferulic acid was identified for the first time as a synergistic inhibitor which could enhance the epirubicin-induced apoptosis in MDA-MB-231 cells. The enhance mechanism may go through the Bax/Bcl-2/Caspase3 pathway and PDI/IRE1α/PERK module of the ER stress signaling pathway. Our findings suggest that ferulic acid could serve as a potential official adjuvant for breast cancer treatment." 60. Journal of Functional Foods, 2020

"We first showed that ferulic acid treatment resulted in decreased viability, increased apoptosis and suppression of metastatic potential in breast cancer cell line MDA-MB-231. Furthermore, it was demonstrated that the antitumor activity of ferulic acid and its role in suppressing metastasis were regulated by the reversal of epithelial-mesenchymal transition (EMT).. Taken together, these results indicate that ferulic acid may be used as an effective therapeutic agent against breast cancer."
61. Oncology Reports, 2016

Caffeic Acid and Caffeic Acid Phenethyl Ester (CAPE)

"Research has shown that two natural substances…caffeic acid (CA) and caffeic acid phenethyl ester (CAPE), have significant anticancer effects. The purpose of our in vitro study was to compare cytotoxic activity and migration rate inhibition using CA and CAPE.. against triple-negative, MDA-MB-231 breast adenocarcinoma line cells, drawn from Caucasian women.. We strongly believe, based on our results and other reports, that CA and CAPE can be used for chemoprevention."
62. Nutrients, 2017

Ellagic Acid

"EA has been shown to inhibit the proliferation of SUM159 and HCC1954 breast cancer cells. EA also induced apoptosis by increasing poly ADP-ribose polymerase (PARP) expression in SUM159, SKBr3, MDAMB-231, and HCC1954 cells. EA reduced the signals of AKT/mTOR, which control many cellular functions including proliferation, metabolism, tumorigenesis, angiogenesis, autophagy, and apoptosis." 63. Breast Cancer, 2018

"The antitumor activity of EA has been mostly attributed to direct antiproliferative and apoptotic effects. Moreover, EA can inhibit tumour cell migration, extra-cellular matrix invasion and angiogenesis, all processes that are crucial for tumour infiltrative behaviour and the metastatic process. In addition, EA may increase tumour sensitivity to chemotherapy and radiotherapy."
64. Nutrients, 2018

Formononetin

"The antiproliferative property of formononetin has been observed in ER-positive breast cancer cells, such as MCF-7 and T-47D , and displayed minimal effect against ER-negative breast cancer cells, namely MDA-MB-231 and MDA-MB-435.. Other studies showed that formononetin successfully promoted apoptosis in prostate cancer (DU-145 and PC-3), breast cancer (MCF-7 and MDA-MB-231).. Formononetin has been demonstrated to be highly effective in suppressing the oncogenic PI3K/AKT

pathway [122–132] and inducing cell cycle arrest in numerous cell lines, including breast cancer (MCF-7).” 65. Cancers, 2019

“In summary, our study demonstrated that formononetin can improve the tumoricidal effect of everolimus. Formononetin can augment everolimus in inhibiting the mTOR pathway by effectively inhibiting mTORC2. The combination treatment of formononetin and everolimus may be an effective approach for breast cancer chemotherapy.”
66. Evidence-Based Complementary and Alternative Medicine, 2019

Kaempferol

“In general, a large number of preclinical studies have confirmed the role of kaempferol in the prevention and treatment of breast cancer.” 67. Biomedicine and Pharmacotherapy, 2019

“The scrutiny of kaempferol extraordinary list of cancer-fighting properties highlights its full potential. These studies are promising, especially because kaempferol selectively inhibits cancerous cells without affecting healthy ones. In vitro studies unveiled the broad spectrum of kaempferol anticancer targets, including apoptosis, metastasis, inflammation, and angiogenesis. Therefore, cancer cells that often adapt to VEGF inhibition, following treatment with kaempferol, may not escape other detrimental actions induced by this natural flavonoid.” 68. Molecules, 2019

Curcumin

“Curcumin has been found to suppress carcinogenesis of the breast and other organs in vivo and against diverse tumors in vitro, exerting significant antiproliferative and proapoptotic effects. Curcumin-induced activation of caspases and release of cytochrome C and the repression of cell survival factors via the inhibition of the NFκB pathway are discussed as molecular mechanisms underlying the strong anticancer effect of Curcumin.. Further effects of Curcumin include the inhibition of Akt/protein kinase B (PKB) phosphorylation in breast cancer cells, leading to increased apoptosis.” 69. Int Journal of Molecular Sciences, 2018

Resveratrol

“Overall, our results indicated several resveratrol analogues to be active in ER-negative phenotypes, acting through an ER receptor-independent manner, supporting further investigation into their mechanism of action and use as potential chemotherapeutics in higher-risk breast cancer cases.”
70. Oncology Reports, 2019

“A vast body of experimental in vivo and in vitro studies and a few clinical trials has presented evidence of resveratrol’s great potential as an anti-cancer agent, both for the prevention and therapy of a large range of cancers. Resveratrol has a very low toxicity, and, although it has multiple molecular targets, it acts on different protective and common pathways that are usually altered in a great number of tumors. This suggests that resveratrol may be more suitable for use as an anti-carcinogen and it can also effectively exert it antineoplastic effects in conjunction with diverse chemotherapeutics and targeted therapies.” 71. Int Journal of Molecular Sciences, 2017

Benzoic Acid

“Likewise, a separate study showed the induction of cell cycle arrest at G2/M phase when breast cancer cells MDA-MB-231 and MCF-7 were exposed to 4-(3,4,5-Trimethoxyphenoxy) benzoic acid.”
72. Nutrition Journal, 2016

Catechin and EGCG

"Catechins suppress proliferation and induce apoptosis of breast cancer cells by inducing cell cycle arrest and Ca2+-associated apoptosis, promoting TP53/caspase-mediated apoptosis, down-regulating anti-apoptotic factors, inhibiting FAS, and regulating the NO/NOS system. Tea catechins inhibit metastasis of breast cancer cells via the modulation of proteolytic enzymes, suppressing the EMT, and down-regulating MT1-MMP transcription." 73. Nutrients, 2016

Gallic Acid, EGCG, Curcumin, Catechin, Quercetin, Kaempferol, Resveratrol

"Breast cancer cells undergoing metastasis acquire resistance to death signals and increase of cellular motility and invasiveness. Plants are rich in polyphenolic compounds, many of them with known medicinal effects. Various phyto-polyphenols have also been demonstrated to suppress cancer growth. Their mechanism of action is usually pleiotropic as they target multiple signaling pathways regulating key cellular processes such as proliferation, apoptosis and differentiation. Importantly, some phyto-polyphenols show low level of toxicity to untransformed cells, but selective suppressing effects on cancer cells proliferation and differentiation." 74. Molecular Medicine, 2018

p-Coumaric Acid

"The results of this study showed that p- coumaric acid had effective appoptic activity against MCF-7 cells. The results can be helpful in understanding the anticancer mechanism of p- coumaric acid and using it was suggested as an alternative or complementary drug in cancer chemotherapy."
75. Journal of Shahid Sadoughi University of Medical Sciences, 2016

Protocatechuic Acid

"Growing evidence suggests the significant biological potential of PCA through the modulation of cellular signals involved in the control of oxidative stress and inflammation. Moreover, its antiapoptotic effects in normal cells and proapoptotic effects in cancer cells suggest definite benefits as a potential chemotherapeutic agent."
76. Evidence-Based Complementary and Alternative Medicine, 2015

3,4 Dihydroxyphenylacetic Acid

"Phenolic acids affect the proliferation of T47D cells…A second group of the phenolic acids is composed of ferulic acid, protocatechuic acid and PAA (3,4 Dihydroxyphenylacetic acid). All three compounds inhibited cell growth by 40%...The present work suggests that phenolic acids exert a direct antiproliferative action. This action is evident at low concentrations, comparable with those found in biological fluids after ingestion of foods rich in phenolic acids."
77. Breast Cancer Research, 2004