**Table S3:** Available nanoformulations in the treatment of Breast Cancer and their preclinical outcomes

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| **Type of nanoformulations** | **Conjugated drug/compound** | **Their outcomes in BC models/ their preclinical outcome** | **References** |
| Aminated NDs | DOX  Poly(1-O-MAFru)62 | Improved anticancer activity after 8 days of therapy in 3D MCF-7 spheroid models. | [183] |
| Pristine NDs | Cetuximab  PTX | ND-PTX reduced cell viability more effectively than PTX in MDA-MB-231 cell lines but did not affect MCF-7 cells. | [184] |
| Oxidated ND gel | mi-R34a Protamine sulfate  FA | Cell death and tumor growth suppression preclinically. | [185] |
| Pristine NDs | Melittin | Melittin complex with nanographene oxide has a stronger toxic effect on breast cancer cells than melittin alone in MCF-7 and MDA-MB-231 cell lines | [186] |
| RNA NPs | Anti-miR21 CD133 Aptamer | The CD133 aptamer increased delivery of anti-miR21 as a result, repressed the response of endogenously oncogenic miR21 in MDA-MB-231 cells | [187] |
| Polystyrene–polysoyaoil–diethanolamine NPs | CUR  α-tocopheryl succinate | Improved NP uptake by MDA-MB-231 cells | [188] |
| β-carotene-loaded zein NPs (βC-NPs) | MTX | βC-NPs+MTX showed the greater antitumor action after 72 hr than free βC, free MTX, βc + MTX, and βc-NPs in MCF-7 cell lines. | [189] |
| Doxorubicin NPs | LD  PLD | Improve therapeutic efficacy of the drug, reverse an MDR phenotype, reduce drug efflux, and specifically target CCs in DOX-based therapy | [190,191] |
| Liposomes | Anti-IL6R antibody,  DOX | Improved tumor targeting efficacy and anti-tumor metastatic properties | [192,193] |
| Nano-encapsulated metformin- CUR | PEGylated Poly lactic-co-glycolic acid (PLGA) NPs | Conjugated NPs have a larger synergistic antitumoral effect and inhibit the cell cycle CC proliferation | [194] |
| Liposomes | DOX for CT; chloroquine as an autophagy inhibitor | In MCF-7/ADR cells, IC50 was lowered by 5.7-fold and had a greater anti-cancer effect than liposomal DOX or DOX alone | [195] |
| Folate-conjugated  lipid NPs | PTX for CT;  CUR | Enhanced the intake of PTX and CUR into MCF-7/ADR cells | [196] |
| PLGA NPs | DOX for CT;  resveratrol  Quercetin | Downregulation of NF-κB and BCL-2 activation inhibited P-gp, Multi resistance protein (MrP-1), and BCRP expression and caused cell death  Improved Quercetin anticancer activity in HepG2 cell line. | [197]  [198,199] |
| Multifunctional  liposomal NPs consisting of iRGD | ICG-conjugated  liposomes (iRGD–ICG-LPs) for therapy of MCF-7 BC cells | iRGD–ICG-LPs had a substantially better cellular absorption in HUVECs and 4T1 cells, owing to their upregulation of integrin avß3, contrasting to MCF-7 cells | [200] |
| Graphene oxide NPs | Targeted with transferrin | Drug released in a pH-dependent manner and shown potent cytotoxicity in MCF-7 and MDA-MB-231 cells | [201,202] |
| Gold NPs | Targeted with RGD peptides  Conjugated with  CPP TAT accumulated in the brain tissue | Efficiently targeted and sensitized MDA-MB-231 cells to radiotherapy  Allowed effective DOX delivery, induced apoptosis | [203]  [204] |
| Resveratrol loaded polymeric micelles | Resveratrol | Res-loaded NPs are efficacious and selectively suppressed cell growth in MDA-MB-231 and MCF-7 CC lines | [205] |
| Polymeric micelles | Loaded with  Zileuton | Lowered the number of CSCs in the tumor and successfully prevented metastasis | [206] |
| Carbon dots functionalized with PEG and FA i.e.  (CDs-PEG-FA/DOX) | Doxorubicin | CDs-PEG-FA/DOX had a stronger cytotoxic action in BT549 cells, with an IC50 value of ~1 μM  Regulated delivery of DOX from the formulation DDS demonstrated greater apoptotic potential against TNBC cells than non-TNBC cells. | [207] |
| Autologous cancer cell-derived (ACCD)-EVs | MTX-EVs (Extravascular vesicles) | Administration of MTX packaged EVs reduced tumor size and cell count | [208] |
| Diacerein-loaded liposomes (DNL) | synthetic somatostatin analog (SST) | SST-DNL-treated group significantly reduced angiogenesis  SST-DNL could also improve BC treatment with a strong anti-angiogenic effect | [209,210] |
| Polyethyleneimine NPs | Codelivery with P-gp siRNA and DOX | PEG-DOX-b-(CL-g-PEI)-b-CL-high siRNA's therapeutic effects its ability to counteract drug efflux pump-mediated resistance | [211,212] |
| VLP ( Virus-like particles) | HER2-VLP vaccine | Prophylactic immunization with the HER2-VLP vaccine suppressed the breast carcinomas growth by 50% to 100%  Prevents proliferation of HER2+ tumors transplanted in wild-type mice  Antibodies generated by the HER2-VLP vaccine suppressed 3D development of HER2+ human BC cells (i.e., BT-474) comparable to TZ, and even the TZ-resistant clone BT-474 C5. | [213] |
| VLP-based  vaccine | Surface-displayed HER2 protein derived from Acinetobacter phage AP205 coat protein | Vaccination could suppress tumor growth in FVB mice. | [214] |
| PAA loaded mesoporous silica NPs (PAA-MSNs) | Encapsulated with cisplatin and DOX | Increase cellular uptake encapsulated drugs in human BC MCF-7 cells | [215,216] |
| Gum Acacia Functionalized Colloidal gold NPs (LTZ @ GA-AuNPs) | Letrozole | Increased antitumor effect than LTZ, with dose-dependently in MCF-7 BC cells | [217] |
| 17α-Ethynylestradiol-Conjugated Silica-Coated AuNPs | Synthetic estrogen 17α-ethynylestradiol  (Mesoporous silica-coated Au nanorods  (mSiO2@Au) | AF647/Diol-mSiO2@Au NPs can specifically accumulate in malignant tissue | [218] |