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A Concise Review of Natural Derivatives for Breast Cancer Treatments

Jhakeshwar Prasad[1], Tushar Arun Rode[2], Dr. Pradeep C. Dave[3], Rashmi[4], Talquees Ahmad[5], Pydiraju Kondrapu[6], Rajeev Ranjan[7], Ms Ishwari R Chaudhari[8], Dr. Shubhangi Tripathi[9]*

[1]Assistant Professor, Shri Shankaracharya College of Pharmaceutical Sciences, Junwani - 490020, Bhilai, Chhattisgarh, India

[2]Assistant Professor, P. W. College of Pharmacy, Moha Phata, Dhamangaon road, Yavatmal. (MS) 445001.

[3]Associate Professor and Head, Department of Biochemistry, Bharati Vidyapeeth ((Deemed to be University) Dental college and Hospital, Sec-7, C. B. D Belpada, Opp. Kharghar ((Station), Navi Mumbai -400614

[4]Assistant Professor, Shri Shankaracharya College of Pharmaceutical Sciences, Junwani - 490020, Bhilai, Chhattisgarh, India

[5]Assistant Professor, Mesco Institute of Pharmacy, Amroha

[6]Assistant Professor, Aditya Pharmacy College, Surampalem, India

[7]Assistant Professor, Univ. Department of Chemistry, DSPM University, Ranchi-834008

[8]Assistant Professor, Pataldhamal wadhwani college of Pharmacy, Moha Phata yavatmal/SGBAU Amravati University, Pin code 445001

[9]Assistant Professor, J. N. L. College, Khagaul, Patna 801105, Patliputra University, Patna

***Corresponding Author Details:Dr. Shubhangi Tripathi,**
drshubhangitripathi@gmail.com

ABSTRACT:

Introduction: Cancer kills most of the people. Breast cancer will have the highest cases in 2020. Geography, genetics, hormones, oral contraceptives, and lifestyle may cause breast cancer, which may be treated in many ways. Radiation, chemotherapy, hormone treatment, and immunotherapy for breast cancer. Due to non-selectivity, multidrug resistance, and bioavailability, standard breast cancer treatments need to be enhanced. **Aim:** This review's main goal is to provide information about effective natural cancer treatments. **Method:** All the data were collected from published paper which are indexing in SCOPUS, Web of Science and UGC. **Result and Conclusion:** In recent decades, efforts have been made to find anticancer drugs based on phytochemicals. In order to better understand phytochemicals as possible medications and reliable research subjects, the authors wish to expand the field of inquiry. Therefore, understanding of anticancer phytochemicals is stressed for the treatment of breast cancer.

KEYWORD: *Phytochemicals, anticancer, preclinical, clinical, medicinal plants, breast cancer.*

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INTRODUCTION

The primary disease that claims the lives of women worldwide is breast cancer. Patients dying from breast cancer are dying at a higher rate. There is currently no cure for breast cancer despite the use of adjuvant chemotherapy, surgery, hormone therapies, and radiation.1. Natural products and their derivatives play a crucial role in the creation of new anticancer medications because they have properties such as a wide variety of biologic activity, structural diversity, low toxicity, and side effects. According to recent studies, dietary phytochemicals may inhibit a variety of breast cancer-related pathways, act as a cancer-preventive feedback system, and play a significant role in breast cancer prevention. This review examines natural substances that block these pathways, including the arachidonic acid route, the cell apoptosis pathway, epigenetic alterations, and aromatase activity, as well as the possibility of several phytochemicals to fight breast cancer.3-5. Some synthetic and plant-based drugs may help a patient's anxiety and mental discomfort while also reducing the harmful side effects of conventional cancer therapy.5,6. Numerous studies have shown the value of using natural remedies to cure breast cancer. Natural anticancer medicines, including Bleomycin, Dactomycin, and Doxorubicin7–12, were developed from both plants and microorganisms.

THERE ARE SOME MEDICINAL PLANT WHICH ARE USED IN THE TREATMNENT OF BREAST CANCER:

- Taxol (paclitaxol)
- Taxotere (dacetaxol)
- Vincristine
- Navelbine(vinorelbine)
- Etoposide
- Teniposide
- Topotecan

THERE ARE SOME MICROBIAL ORIGIN WHICH ARE USED IN THE TREATMENT OF BREAST CANCER

- Doxorubicin
- Dactomycin
- Bleomycin

TAXOL (PACLITAXEL)

Taxanes are anticancer drugs that cause cytotoxicity via a special mechanism.As a result, authorities in the United States and many other nations have authorised the drug paclitaxel for use in the palliative care of breast cancer and ovarian cancer patients who have developed resistance to chemotherapy. Making paclitaxel-based treatment strategies for cancers where a cure or improved survival may be possible is the current problem. It was found that the active component of the extract was paclitaxel in 1971. Initially, it was discovered that women with metastatic breast cancer might significantly reduce their malignancy by taking paclitaxel on a 24-hour schedule.Taxel is administered every 24 hours.51,8625 females with metastatic disease who had only had one round of chemotherapy,Nine months was the average time for the condition to develop, and 56% of patients responded significantly.51 A confirmatory experiment in which women who had either adjuvant therapy alone or no prior therapy were given paclitaxel (250 mg per square metre) and granulocyte colony-stimulating factor revealed

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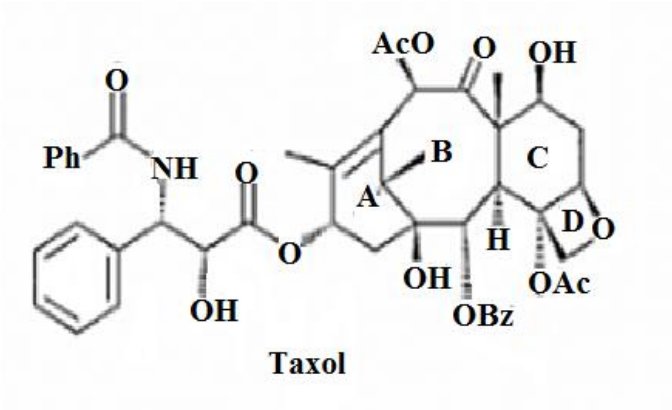
that there was a high level of activity; 62% of these women showed significant responses. The chance of a significant response was not correlated with the hormone receptor status or prior adjuvant medication. Both studies saw responses in metastasis locations across the board, even those that were clearly anthracycline-resistant cancers.These positive results with paclitaxel in patients with metastatic breast cancer are comparable to those shown in early studies on the anthracyclines, one of the most effective therapies for the condition. As paclitaxel is developed further for the treatment of breast cancer, its function will be examined at ever-earlier stages of the illness and eventually in adjuvant therapy. The Eastern Cooperative Oncology Group is treating previously untreated patients with metastatic breast cancer with either paclitaxel, doxorubicin, or both. If paclitaxel-based therapy proves to be more successful, it will be included in adjuvant studies.

Fig:1 Structure of Taxol



The efficacy of paclitaxel as an adjuvant therapy for high-risk patients is also being investigated in a multicenter trial utilising high, moderate, and low dosages of doxorubicin and cyclophosphamide followed by either paclitaxel and then tamoxifen or simply tamoxifen. Paclitaxel administration and scheduling for women with metastatic breast cancer are being studied. According to preliminary findings of a European trial using three-hour infusions of paclitaxel at 135 or 175 mg per square metre, there are no appreciable differences in response rates (29 percent [high dose] vs. 22 percent [low dose]) or median survival (11.7 months [high dosage] vs. 10.5 months [low dose][13-15].

Mechanism of Action: The cancer treatment paclitaxel works by concentrating on microtubules. Structure of Microtubules are cylindrical hollow structures and average diameter is 25–30 nm. Which are in dynamic equilibrium with tubulin heterodimers, which are made up of beta and alpha protein subunits. Microtubules' primary work during cell division is to form the mitotic spindle. they are essential for maintaining cell shape, motility, and cytoplasmic. Microtubules are assembled and tubulin is produced during the G2 and prophases of mitosis. A dynamic equilibrium exists between tubulin subunits contained in microtubules, arranged head to tail, with faster development (plus ends) at one end and slower growth (minus ends) at the other. Under steady-state conditions, the net tubulin assembly rate equals the net disassembly rate, maintaining the microtubule length constant. The minus ends of microtubules are frequently anchored primarily in the centrosome, whereas the plus ends explore the cytoplasm and interact with cellular structures..Dr. Horwitz discovered that paclitaxel prevents cell division by encouraging the synthesis of stable microtubules and preventing their

ISSN: 0975-3583,09 76-2833 VOL14, ISSUE 07, 2023

depolymerization, especially from -tubulin heterodimers. In order to inhibit cell reproduction, exposed cells are subsequently trapped in the G2/M phase of the cell cycle and eventually perish. Paclitaxel selectively and irreversibly binds to the N-terminal 31 amino acids of the beta-tubulin subunit in the microtubules in place of tubulin dimers[16-18].

TAXOTERE (DACITAXOL)

In recent years, there hasn't been much of a shift in the therapy for advanced breast cancer; the main objectives remain palliative. One tactic to increase the treatment's success is the inclusion of additional, active drugs. Taxus baccata needles were found to contain a taxoid derivative known as Taxotere® (docetaxel). Taxotere promotes microtubule assembly and inhibits their depolymerization. One EORTC Clinical Screening Group (CSG) phase II study using Taxotere at 100 mg/m2, 1 hour infusion without the usual premedication for hypersensitivity reactions, shown considerable anti-tumor activity: There were 5 complete and 18 partial responses out of the 32 patients that could be tested for response (72% overall response rate; 95% confidence range (53%-86%)). Additional trials in this programme assist individuals receiving first- and second-line chemotherapy for advanced disease, as well as those who are resistant to anthracycline-containing regimens. Neutropenia in grades III and IV without severe infection and Grades I and II skin toxicity were the most frequent adverse effects. Patients on Taxotere have experienced fluid retention syndrome, a chronic cumulative and non-life-threatening toxic side effect. Current research focuses on methods to decrease fluid retention, such as commencing medication prior to the start of treatment or reducing the dosage to 75 mg/m.

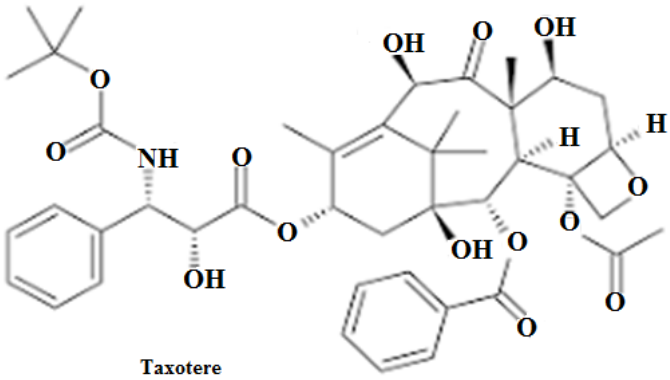


Fig:2 Structure of Taxotere

The antineoplastic medications Taxol and Taxotere belong to a new class known as the taxoids. These drugs work by promoting microtubule assembly and inhibiting microtubule depolymerization, which kills cancer cells both in vitro and in vivo.Hypersensitivity reactions initially prevented the clinical development of Taxol, while regular premedication and extended infusion times have helped to reduce these effects. As a result, there has been a lot of interest in similar medicines that could reduce hypersensitivity.[1]

Mechanism of Action:A chemotherapeutic medication from the second generation of the taxane family is docetaxel.The primary mechanism of action of docetaxel, a derivative of the

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original taxane paclitaxel, is binding to beta-tubulin to encourage its proliferation and maintain its conformation. This hinders the normal assembly of microtubules into the during G2/M. Docetaxel also inhibits the expression of the BCL2 gene, which cancer cells commonly overexpress in order to prolong their survival. This gene can be turned off to make cancer cells more susceptible to apoptosis. (Nicole G February 24, 2022.)

VINCRISTINE

392 patients with advanced cancer participated in a series of dose-level studies on vincristine. In a sizable percentage of individuals with advanced reticulum cell sarcoma, breast cancer, bladder cancer, Hodgkin's disease, and carcinomas of unclear source location, it caused tumour regressions. At 25 jug/kg/week, responses happened about as frequently as at larger dosages. In contrast to patients who experienced only mild or no toxic effects or those who experienced severe pharmacological effects on normal tissues, individuals who experienced moderate toxicity had the highest response rates. Central nervous system dysfunctions and dose-related sensory, motor, and anomie neuropathy were seen. Thrombocytopenia and leukopenia were noted. The patients' good- or poor-risk status affected the frequency of responses attained and the length of those responses. When prognostication and actual survival times were compared, it was found that the prediction of survival was rather accurate. Responders outlived non-responders by a longer margin. The survival extension in breast cancer patients beyond prognosis cannot be attributed simply to vincristine-induced remission period. In several other disorders, vincristine's therapeutic response was able to counteract a dismal prognosis and, it appears, increase survival above what was anticipated.. (Holland and Scharlau 1 June 1973)[2]

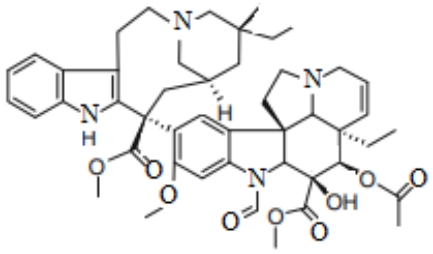

Fig:3 Structure of vincristine

Mechanism of Action : The tubulin-binding chemicals, like vincristine and other vinca alkaloids, which derive their biological features from impairing microtubule activity, are part of the class of mitotic poisons. Tubulin heterodimers make up the polymeric fibres known as microtubules. Tubulin's - and -subunits combine to form dimers, and vincristine's binding site is found on the -subunit at the intersection of two heterodimers (fig.). Thus, the only tubulin-binding substances identified to date that do not absolutely bind one tubulin heterodimer are vincristine and other vinca alkaloids. This crucial quality is essential to the distinctive mode of action of vinca alkaloids. Large doses of the chemicals have a specific ability to break the microtubule filaments. The vinca alkaloid then causes the fibres to unite and remain attached to one another. Such disordered, frequently spiralled fibres are unable to carry out the mitotic spindle's crucial function of separating the chromatids during mitosis. Vinca alkaloids, which

ISSN: 0975-3583,09 76-2833 VOL14, ISSUE 07, 2023

stabilise microtubule dynamics by binding to the terminals of microtubule filaments, also slightly impair this function.

Vincristine can also with combination of other drugs like:

- Vincristine in combination with cyclophosphamide, doxorubicin, and prednison
- Combination of Vincristine with Methotrexate
- Vincristine combined with dacarbazine or procarbazine (Škubník J 2021 Aug 31.)[3]

NAVELBINE(VINORELBINE)

A semi-synthetic vinca alkaloid called vinorelbine tartrate prevents microtubule assembly. The catharanthine and vindoline-containing dimeric molecules that make up the vinca alkaloids are catharanthine and vindoline. The catharanthine nucleus is where vinorelbine undergoes structural change. By interacting with tubulin, vinca alkaloids appear to exert their anticancer effect, which stops mitosis at metaphase. Thevinca alkaloids interact with tubulin in qualitatively distinct ways, according to in vitro research.As a result, vinorelbine depolymerizes mitotic microtubules more effectively than axonal microtubules.6 Clinically, axonal microtubule activity is linked to neurotoxicity, whereas mitotic microtubule activity is connected with anticancer activity. As a result, vinorelbine has an advantage over the other vinca alkaloids, especially in terms of neurotoxicity. Vinorelbine is eliminated in three steps, with a terminal phase half-life of between 28 and 44 hours.2 Vinorelbine is mostly eliminated through the liver, while urine elimination rates as high as 18% have been seen.2 Although it has not been determined how renal or hepatic impairment affect vinorelbine distribution, dose reductions are necessary in patients with hepatic impairment.For a total bilirubin of 2.1-3.0 mg/dL, a dose reduction of 50% is advised, and a dose reduction of 75% is advised for a total bilirubin of 3.0 mg/dL or above. Renal insufficiency does not need changing the dosage. For both intravenous and oral vinorelbine, Variol et al. showed equivalent pharmacokinetic and pharmacodynamic correlations. Vinorelbine has been linked to a number of different medication interactions. First, when coupled with mitomycin, vinorelbine and other vinca alkaloids have been linked to acute pulmonary responses. Secondly, granulocytopenia is more common when vinorelbine and cisplatin are used together than when vinorelbine is used alone. Finally, individuals receiving vinorelbine and paclitaxel sequentially or in combination should be watched for neuropathy symptoms and signs. When docetaxel was given before vinorelbine, Airoldi et al. reported a pharmacokinetic interaction and asubstantial change in neutrophil nadir count.

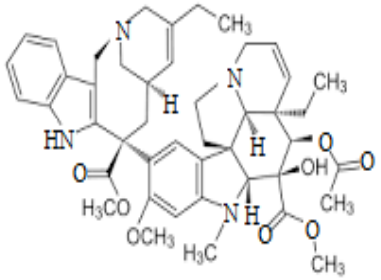

Fig:4 Structure of Navelbine

ISSN: 0975-3583,09 76-2833 VOL14, ISSUE 07, 2023

Vinorelbine, a Single-Agent First-Line Therapy for Metastatic Breast Cancer, In phase II investigations of first-line, single-agent vinorelbine at 30 mg/m2/week, conducted in the late 1980s and early 1990s, response rates varied from 35% to 52%. Which included 157 patients with metastatic breast cancer, Fumoleau et al[20].

ETOPOSIDE

High-dose etoposide (1,500-2,500 mg/nr) was administered to 23 patients with advanced breast cancer who had already had treatment. With a median response time of 5 months, objective regression was seen in six out of 23 patients (or 26% of the total). Except for the bone, every location exhibited responses. Response was dose-dependent, with 2/23 responses at 1,500 mg/m2 compared to 11/23 measurable lesion responses at 2,000 mg/nr. The treatment plan could be carried out on an outpatient basis with just normal supportive measures. Patients with advanced breast cancer may eventually get high-dose etoposide as part of combination chemotherapy therapies.Early in the 1970s, etoposide (VP 16, 4'-dimethyl-epipodophyllotoxin BD-ethylidene glucoside), one of the derivatives of podophyllotoxin, was used for the first time in cancer clinical trials. Etoposide has been shown to be both a powerful single agent and an essential component of combination therapy for a number of human malignancies. Despite the fact that certain early studies in breast cancer were not encouraging, we reconsidered the use of high-dose etoposide as a single drug in patients with advanced refractory breast cancer[21]. Now, etoposide is frequently used in high-dose chemotherapy regimens.

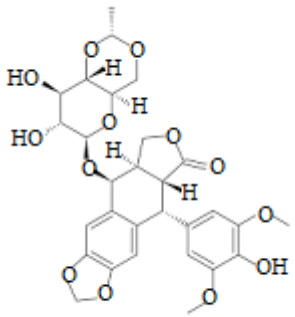

Fig:5 Structure of Etoposide

A Derivative with a Novel Mechanism of Action: Etoposide

Different from Podophyllotoxin's mechanism: Etoposide stops cells from entering during mitosis, in contrast to podophyllotoxin, which blocks cell replication in metaphase at mitosis. Because of this, it prevents cell development in the early G2 phase, which serves as an arrest point, and the late S phase, which is when DNA replication takes place. Therefore, VP-16 and VM-26 are phase-specific cytotoxic drugs. An increase of cells in the G2 phase has also been observed during in vivo investigations. The fact that VP-16 can cause a cycle stoppage in metaphase at mitosis, but only at extremely high concentrations that are incompatible with those encountered in vivo, is interesting to note. Therefore, despite having comparable behaviours, etoposide and teniposide work through different mechanisms than podophyllotoxin. Etoposide has also been shown to impede the assembly of microtubules and

ISSN: 0975-3583,09 76-2833 VOL14, ISSUE 07, 2023

to not bind to tubulin. Teniposide and Etoposide inhibit nucleoside transport, metabolism, and incorporation into DNA, similarly to podophyllotoxin.

Etoposide Acts on DNA

We made substantial progress in our knowledge of the mechanism of action of etoposide when Like and Horwitz found DNA breakage in HeLa cells after exposure to VP-16 and VM-26 at low concentrations (1 M). The cause of this was later shown to be dose-dependent single-stranded DNA breakage. The study also showed that a C-4 structure promoted DNA breakdown and that it required a free 4'-phenol. When the medicine was stopped, the cell then repaired these DNA damage.

Involvement of an Enzyme in the Mechanism of Action

The effects of VP-16 and VM-26 on DNA protein crosslinks, single-stranded DNA breaks, and double-stranded DNA breaks were shown by Wozniak and Ross in 1983. They also discovered that while DNA breaking could be seen in isolated nuclei, it could not be generated on purified DNA. Therefore, it was believed that a nuclear enzyme was responsible for creating these double-stranded DNA breaks. Their findings made it possible to link DNA breaks to medication cytotoxicity. Finally, etoposide and teniposide's targets for action were discovered by Long and Minocha and Ross et al. virtually simultaneously as a result of all these observations.Topoisomerase II has already been linked to the mechanism of action of intercalative medications such anthracyclines and acridines, which stabilise the cleavage complex between topoisomerase II and its DNA substrate. Etoposide, despite not being a DNA intercalating agent, functions similarly to DNA and topoisomerase. (Philippe Meresse Number 18, 2004)[4]

TENIPOSIDE

A semi-synthetic podophyllotoxin derivative known as teniposide (VM-26) has significant antitumor effect against cancers of the testicles, small cell lung cancer, acute leukaemia, and malignant lymphomas. The efficacy in the majority of other solid tumours is either modest or has not yet undergone enough testing. We present results of a phase II teniposide study in individuals with advanced breast cancer who had not had any prior treatment. Previous studies utilising daily or weekly schedules of teniposide demonstrated minimal activity in individuals with metastatic breast cancer who had undergone extensive pretreatment. In more recent investigations, 52 patients who had previously had chemotherapy showed an overall response rate of 8% PRs using a regimen of days 1 through 5 every three weeks. Accordingly, 383 patients who had received a lot of pretreatment had a 7% response rate to etoposide (VP-16). The two epipodophyllotoxins' limited activity has been seen at doses that cause moderate to severe hematologic damage. However, when teniposide was employed as a second-line or later treatment for lung cancer, important therapeutic effects were missed. There has only been one phase II trial of epipodophyllotoxin derivatives in breast cancer patients who had not previously received treatment [10]. Etoposide 230 mg/m2 day 1-3 every four weeks was utilised as a treatment. A 15% response rate was seen (3 PRs out of 20 patients), however the toxic side effects, particularly hematologic ones, were minimal because no dose reductions were required. In our study, the median response time was 9 months, and the response rate was 37% (95%

4

ISSN: 0975-3583,09 76-2833 VOL14, ISSUE 07, 2023

confidence limits 19%-58%). However, we were willing to accept a proportionally greater hematopoietic toxicity. The WBC and platelet nadirs showed a wide range of variance. Similar toxicity has been found by other writers [11]. Age, tumour load, or performance status were the only variables we could not identify that predicted the haematological damage. These findings imply that teniposide has at least modest effect in elderly patients with advanced breast cancer who have received prior endocrine therapy, despite the fact that the patient population in this trial was carefully chosen based on age and sites of metastatic illness (soft tissue being predominate).. (D. Nielsen n.d.)[5]

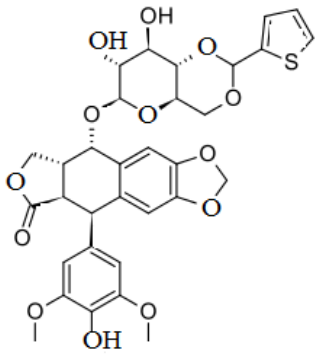

Fig:6 Structure of Teniposide

MECHANISM OF ACTION: Epipodophyllotoxin teniposide is linked to etoposide both structurally and pharmacologically.2 DNA strands can break into single and double strands as a result of teniposide's inhibition of type II topoisomerase. It doesn't strongly attach to DNA or intercalate into it. Teniposide prevents cells from going through mitosis by stopping cell growth in the late S2 or early G2 phases of the cell cycle. (St. Laurent 1 July 2014).

MICROBIAL ORIGINS

DOXORUBICIN

The most effective chemotherapeutic agent now used to treat breast cancer is doxorubicin (DXR), a member of the anthracycline class. However, it has been demonstrated that DXR can cause medication resistance and even cancer growth, which results in a poor prognosis and survival rate for patients. (Claudia Christowitz 1 August 2019)

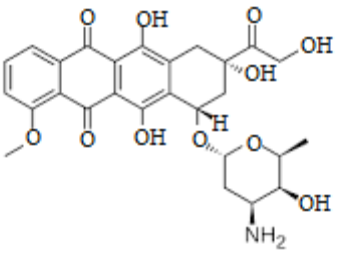

Fig:7 Structure of DOXORUBICIN

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ISSN: 0975-3583,09 76-2833 VOL14, ISSUE 07, 2023

MACHANISM OF ACTION:In cancer cells, doxorubicin is hypothesised to function by two separate mechanisms: (i) intercalation into DNA and disruption of topoisomerase-II-mediated DNA repair; and (ii) generation of free radicals and damage to cellular membranes, DNA, and proteins. When doxorubicin is oxidised to semiquinone, an unstable metabolite that is then converted back into doxorubicin, reactive oxygen species are created. In addition to initiating the apoptotic pathways that lead to cell death, reactive oxygen species can damage membranes, lipids, DNA, and cause oxidative stress, lipid peroxidation, and oxidative stress. Among the possible genes that may have an impact on this pathway are the free radical-deactivating genes (glutathione peroxidase, catalase, and superoxide dismutase) and the oxidation reaction-capable genes (NADH dehydrogenases, nitric oxide synthases, and xanthine oxidase). Alternatively, doxorubicin, which likewise damages DNA and kills cells, can poison topoisomerase-II as it enters the nucleus. Potential pharmacogenes for this region of the system include the enzymes TOP2A, MLH1, MSH2, TP53, and ERCC2 that are involved in DNA repair pathways and cell cycle control. Others are included based on results from model systems, although even though the evidence for some of them (TOP2A) is undisputed, the polymorphic nature of these candidate genes may be worthwhile to examine in PGx research. (Caroline F. Thorn 2012 Jul 1.)

Dactinomycin: Dactinomycin is an injectable antineoplastic antibiotic used to treat choriocarcinoma in adult women as well as solid tumours in children. Dactinomycin can cause serious liver damage in large dosages, including sinusoidal obstruction syndrome.

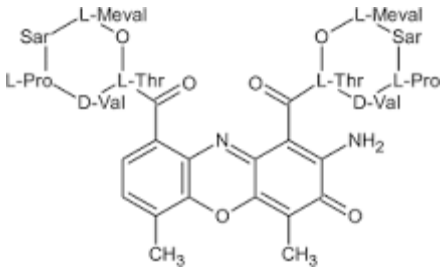

Fig:8 Structure of Dactinomycin

Mechanism of Action: The Actinomycin Dactinomycin is one. Dactinomycin functions as a protein synthesis inhibitor as well as a nucleic acid synthesis inhibitor.

Bleomycin

Bleomycin was initially extracted from culture broth of the fungus Streptomyces verticillus that was found in dirt at a Japanese coalmine and was discovered in 1966 by Umezawa and colleagues. It is a group of at least 13 tiny, 1500 Da molecular weight, water-soluble glycopeptidic antibiotics. The names of the glycopeptides are A1-6, A0-2, and B1-6. At least 80% of the clinical combination is composed of the fractions A2 and B2. The bleomycinic acid, a distinctive structural element shared by all bleomycins, is their single structurally distinct feature (61). Bleomycin's capacity to generate single- and double-strand DNA breaks in

ISSN: 0975-3583,09 76-2833 VOL14, ISSUE 07, 2023

mammalian cells is what makes it cytotoxic. Iron, copper, and cobalt are just a few of the metals that bleomycin is effective in chelating. The most active complex is the bleomycin-Fe2-complex. Complexes like Cu2, Co2, and Ru2 are only active under a relatively narrow range of circumstances. Bleomycin has the highest affinity for cobalt of all the metals, and their chelation is permanent[22].

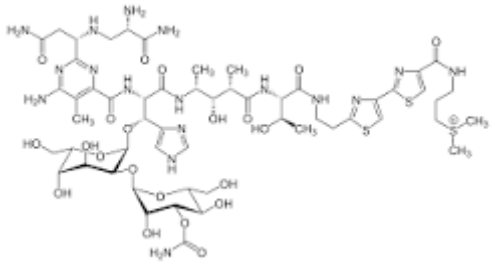

Fig:9 Structure of Bleomycin

Mechanism of action: Bleomycin's cytotoxicity is mostly caused by direct DNA damage. Chromosome gaps, deletions, and DNA fragmentation are all signs of single- and doublestrand DNA breaks caused by bleomycin. In order to damage DNA, bleomycin needs oxygen and metals as cofactors (67). Cu2 and bleomycin combine to produce a complex, which the cell then absorbs. The bleomycin-Cu2 combination is thought to be a prodrug that, once inside the cell, transforms into the physiologically active Fe2-bleomycin.When the Fe2-bleomycin-complex binds to O2 and then to DNA, the quaternary complex (Fe2-bleomycin-O2-DNA) induces DNA cleavage. Fe2-bleomycin attaches to O2 quite quickly, and DNA aids in maintaining the stability of the complex. The interaction with the DNA at the minor groove has a definite nucleotide selectivity, such as a predilection for GC base pairs. The chromatin is cut by bleomycin at the level of the DNA that connects nucleosomes. With roughly 6–10 single strand breaks to 1 double strand break, bleomycin causes both single and double strand DNA breaks. The initial cleavage is more sequence specific than the attack on the opposing strand. The first cleavage site is within one nucleotide of where it is cleaved. Bleomycin, also is considered to have an 8–10 piece DNA severing capacity per molecule, and 3 106 molecules of the medication can sever about 5 106 double strands of DNA in a single cell. It has been shown that 30 seconds after bleomycin enters the cell, DNA fragmentation takes place very swiftly. Bleomycin also produces free nucleic bases without strand breaking, degrades oxidised RNA, targets small chemical compounds, and induces lipid peroxidation, all of which could be detrimental to cells.One of two mechanisms by which bleomycin kills cells. If only a few bleomycin molecules are present, the cell is stopped in the G2-M phase, enlarges, and polynuclei and micronuclei can be detected. Bleomycin does this by causing the distinctive DNA fragmentation that short-circuits the apoptosis pathway. Cell shrinkage, membrane blebbing, and chromatin condensation follow this. (Anita Gothelf October 2003)[17].

CONCLUSION:

Breast cancer is treated and managed using natural substances with microbial and botanical origins. These organic compounds may be used alone or in combination with other chemotherapeutic agents to treat breast cancer. The bulk of natural products originating from plants and microorganisms are utilised all over the globe and have been for a very long time. Research initiatives that enhance these derivatives' capacity to treat patients with breast cancer

ISSN: 0975-3583,09 76-2833 VOL14, ISSUE 07, 2023

must be given more weight. They still work via pathways and don't have any particular negative consequences. The importance of natural derivatives with microbial and plant origins as well as their modes of action are covered in this study. Therefore, further in-depth investigation is needed to validate the proper functioning of these derivatives, which will allow us to better understand their therapeutic uses and address the problems associated with breast cancer.

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