A REVIEW ON ROLE OF COCONUT IN BREST CANCER

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ABSTRACT

This paper examined the risk factors of breast cancer among women using meta-analyses. A review Of past studies was made to determine the characteristics of researches on risk factors of breast cancer Among women where most victims came from the Philippines. Breast cancer incidence is rising worldwide due to urbanized lifestyles and changes in reproductive behavior. Advances in screening, therapies, surgical techniques, and radiotherapy have improved survival rates and cosmetic outcomes. Clinical trials are investigating new therapies, and gene-expression profiling offers better personalized treatment options. Despite declining mortality, breast cancer remains the second leading cause of cancer deaths in U.S. women. Male breast cancer is rare, and research on it is limited. Medical training on breast cancer is Insufficient, impacting early recognition and treatment. The article also reviews the pathology, diagnosis, and management of breast cancer, particularly in the UK.

*The traditional drug development process is hindered by high costs and lengthy timelines, making it difficult to rapidly develop affordable treatments. In response, natural products, particularly *Cocos nucifera* (coconut), have garnered attention for their therapeutic potential. Coconut water (CW), which is rich in bioactive cytokinins, has shown anti-aging, anti-proliferative, and apoptotic effects, suggesting its potential in cancer prevention and treatment. Lauric acid, a primary component of coconut oil, exhibits strong antimicrobial properties, which may contribute to the prevention of cancer and cardiovascular diseases associated with microbial infections. Additionally, virgin coconut oil (VCO) has demonstrated protective effects against methotrexate-induced oxidative stress and inflammation in preclinical studies, enhancing antioxidant enzyme activity and reducing inflammation markers. Bioinformatics analyses further support VCO's anti-cancer potential, identifying key cancer-related protein targets for its active components. Collectively, these findings underscore the promise of coconut-derived products in the development of affordable, natural therapeutics for cancer and other diseases.*

Key Words: *Coconut oil, Anti-cancer agent, Virgin coconut oil(VCO), Methotrexate, Inflamation.*

INTRODUCTION

"Today we fight. Tomorrow we fight. The day after, we fight. And if this disease plans on whipping us, it better bring a lunch, 'cause it's gonna have a day doing it" – Jim Beaver, Life's That Way : A Memoir

Between 460 and 370 BC, the renowned Greek physician Hippocrates introduced the term cancer. He employed words like "carcinos" and "carcinoma" to refer to both non-ulcerative and ulcerative tumors. In the Greek language, these terms signify a crab, as the disease spreads in a manner resembling a crab's shape. Later, the Roman doctor Celsus (50 BC to 28 BC) translated these terms into the Latin word "cancer." Around 130 to 200 AD, the Greek physician Galen used the term "oncos" to describe tumors. The crab analogy is

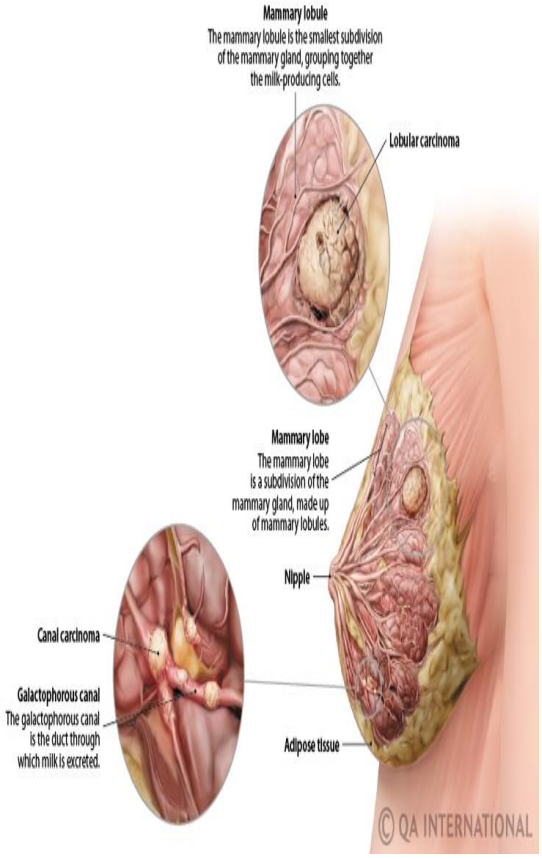
generally used for malignant tumors, while "oncos" describes a specific category of cancer, leading to the modern term "oncologists."

Cancer is a life-threatening illness due to its rapid cell proliferation. The effect of cancer poses a heavy burden on both the patient and society, which is why the price of anti-cancer medications has been rising. Research into discovering affordable but equally effective alternative therapies would be a significant breakthrough. According to a Department of Health (DOH) representative, heart attacks, strokes, and cancer remain the top causes of mortality among Filipinos. Based on DOH statistics from 2009, data from the Philippines Cancer Society (2010), and the World Health Organization, every hour, nine individuals are diagnosed with cancer. Cancer is a dreadful condition that can develop at any stage of life. As Freeman (2015) noted, 75% of cancer sufferers in the Philippines are aged 50 and above, while 3.2% are children aged 0 to 14. Breast cancer is more prevalent in women than men and is the leading cause of death among women aged 35 to 54. Over a million women develop the disease without being aware of it, and almost 500,000 women die from it each year.

Coconut:

The coconut tree, Cocos nucifera, is part of the palm family, Arecaceae. There are several types, mainly categorized by the color of their fruit (yellow, orange, brown, red, or green) or the tree's size (tall, dwarf, or hybrid) (Debmandal and Mandal, 2011; Prades et al., 2012). The coconut tree is considered essential in many regions around the globe. Coconut water, the c'ear liquid inside young coconuts, is highly regarded for its nutritional and medicinal qualities. It has been effectively used for oral rehydration, treating childhood diarrhea, intestinal infections, and cholera in various parts of the world.

Coconut water is primarily made up of water (94%), sugars (glucose, fructose, and sucrose) (5%), proteins (0.02%), and fats (0.01%). It is rich in minerals such as calcium, potassium, and manganese, though it contains little sodium. Due to its short shelf life, coconut water is mostly consumed fresh in tropical coastal regions. Once exposed to air, it deteriorates and loses much of its sensory and nutritional properties. Coconut water is a nutritious, fat-free, low-calorie drink with significant health benefits. It contains both organic and inorganic compounds that support the body's antioxidant system and replenish electrolytes like sodium, potassium, magnesium, and calcium. Coconut water also provides vital nutrients such as amino acids, vitamins (B complex and C), and minerals, making it an excellent natural hydration beverage. Enzymes like peroxidase and polyphenol oxidase in coconut water cause nutrient degradation after the coconut is opened.



Breast Cancer:

Fig: Overview Of Breast Cancer

Approximately 70% of breast cancers occur in women with no identifiable risk factors, while about five percent are hereditary. In the past, the likelihood of developing breast cancer was 1 in 22. In Malaysia, breast cancer is the most prevalent cancer among women and is considered the leading cause of death from cancer. According to the third publication of the National Cancer Registry (2003–2005), the occurrence of breast cancer among women in Malaysia is 31.3%. The high death rate from breast cancer also accounted for 15.2% of medically confirmed cancer-related deaths. Chemotherapy and radiotherapy are frequently employed following primary breast cancer treatment to prevent the spread of the disease and improve long-term survival rates. However, chemotherapy is often linked to numerous adverse effects such as nausea and vomiting, hair thinning, exhaustion, pain, anxiety, depression, and more. Most of these side effects are experienced as distressing by patients, who often feel anxious during the treatment process. Both the illness and its treatment can severely impact a woman's life, negatively influencing all aspects of her daily living and thus altering her quality of life (QOL).

Nowadays, the risk is 1 in 8 cases, which is alarming. This is why government and private organizations have committed to fighting the disease. Breast cancer occurs when abnormal cells in the breast start to grow and divide uncontrollably, eventually forming a mass (tumor). Breast cancer typically originates in the cells lining the milk ducts of the breast. It is the most frequent cancer in the UK, mainly affecting women, although men can also develop it.

Breast cancer is a condition where abnormal breast cells multiply uncontrollably, creating tumors. If untreated, these tumors can spread throughout the body and become deadly. Breast cancer occurs when cells in the breast grow without restraint. It is one of the most widespread cancers globally, predominantly affecting women, though men can also get it. The abnormal growth usually begins in either the milk-producing glands (lobules) or the ducts that carry milk to the nipple. Over time, these cancerous cells may invade nearby tissue and, in more advanced cases, spread to other parts of the body via the lymphatic system or bloodstream. The earliest form (in situ) is not life-threatening and can be identified in the initial stages. Cancer cells can spread into surrounding breast tissue (invasion),

forming tumors that cause lumps or thickening. Invasive cancers can metastasize, reaching nearby lymph nodes or distant organs. Metastasis can be life-threatening and fatal.

History Of Cancer:

Hippocrates coined the term "carcinoma" (from the Greek word "karkinoma") because tumors reminded him of a crab, with the main body of the tumor and its spreading growths resembling a crab's legs.

In the modern era, advancements in science allowed researchers to observe the human body more closely. In the 16th and 17th centuries, researchers such as Gaspare Aselli began to understand the human body's vascular system and the abnormal behavior of cells that might cause cancer. Later, French physician Claude Gendron rejected earlier ideas and proposed that cancer was a mass of abnormal growths that couldn't be treated with conventional medicine.

In the 18th century, two French scientists, Jean Astruc and Bernard Peyrilhe, conducted experiments to better understand cancer and worked toward developing treatments. By the 19th century, advancements in microscopes allowed scientists to study cells in greater detail, In helping them differentiate cancer cells from normal cells.

The early 20th century, cancer research advanced rapidly. In 1911, the first documented case of cancer in chickens was reported, showing that cancer could affect other species too. Chromosomal abnormalities were identified as a primary cause of cancer. By 1937, the United States Congress passed the National Cancer Institute Act to support cancer research and treatments. In 1971, President Nixon signed an act launching a national cancer program to further research and improve treatment options through the National Cancer Institute. Since then, the study of cancer has grown, with researchers focusing on understanding how cancer cells develop and spread, and finding better ways to diagnose, treat, and possibly cure the disease.

PATHOPHYSIOLOGY:

The pathophysiology of breast cancer is multidimensional and still poorly understood, but certain risk factors are known. Advancing age and female sex are the most common risk factors. Genetic mutations, specifically BRCA 1 and 2, account for about 10% of breast cancers.2 Other known risk factors include a history of ductal carcinoma in situ, high body mass index (BMI), first birth at age greater than 30 years or nulliparity, early menarche (before age 13 years), family history of breast or ovarian cancer, late menopause, and postmenopausal hormone therapy use. Among women who use postmenopausal hormone therapy, white women and women with a normal BMI and dense breasts are at greatest risk.3 women with a history of previous chest radiation also are at an increased risk. normal BMI and dense breasts are at greatest risk.

Breast cancer is a malignant tumor that starts in the cells of the breast. Like other cancers, there are several factors that can raise the risk of getting breast cancer. Damage to the DNA and genetic mutations can lead to breast cancer have been experimentally linked to estrogen exposure.

Most breast cancer is sporadic (90%-95%), with only 5% to 10% of patients having an

identifiable genetic mutation. BRCA 1 and 2 are the most common associated genetic conditions. Invasive ductal and invasive lobular carcinoma are the most common pathologic forms of invasive breast cancer. Carcinogenesis occurs due to a complex interplay of genetic and environmental risk factors, hormonal influences, and patient-related factors. The pathogenesis, treatment, and prognosis are closely associated with the following molecular subtypes of breast cancer:

Luminal A: Hormone receptor-positive, human epidermal growth factor receptor (HER)-2 negative

Luminal B: Hormone receptor-positive, HER-2 positive

Basal-like: Hormone receptor and HER-2 negative

HER-enriched: HER-2 positive, hormone receptor-negative

Hormone receptor-positive tumors (i.e, luminal A and B) tend to be less aggressive, with improved survival rates. HER-2 enriched tumors are more aggressive, with a poor prognosis without targeted therapy. In the era of targeted anti-HER therapy (eg, trastuzumab), the paradigm has shifted. Basal-like tumors are negative for the molecular markers and tend to have a worse prognosis with poor survival rates.

Cancer includes the physical and hormonal changes associated with cancer and paraneoplastic syndrome. In general, cancer occurs in four main stages. The pathological stage of cancer is determined through biopsy (removal of small body tissue for laboratory examination) where the cancerous cells are compared to normal cells. The four main stages of cancer are:

Stage 1 — Cancer is normally localized in a small area

Stage 2 — The size of the cancer increases

Stage 3 — The size of cancer becomes larger and starts spreading to some parts of the body including lymph node.

Stage 4 — Cancer has grown and has spread to most parts of the body.

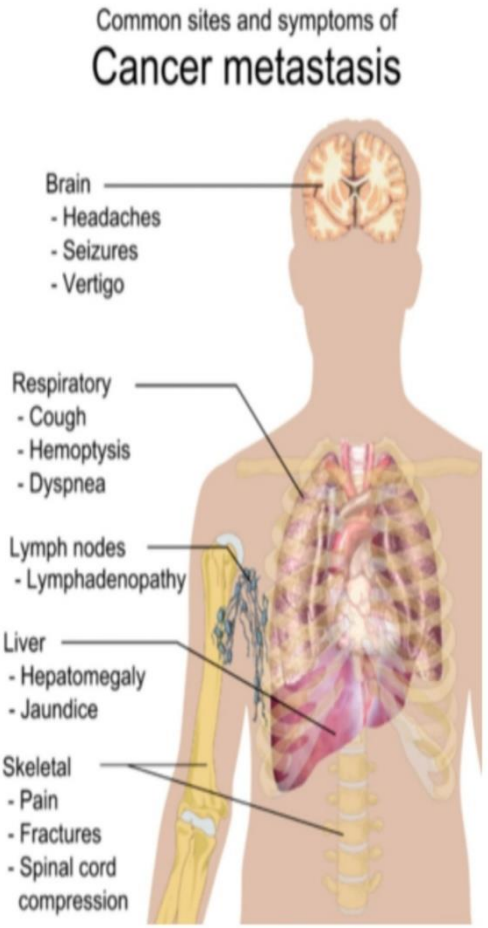


Fig. Metastasis Of Cancer Cells In Various Body Parts

Breast cancer is a globally pervasive disease that significantly impacts all races and affects both sexes. Cancerous abnormalities of the breast occur in two types of tissue –

1) Ductal epithelium
2) Lobular epithelium.

Although most breast cancers arise from within the ductal epithelium, malignant cells can also originate within lobular (milk-producing) glands. Aberrations of other breast structures, such as sarcomas and lymphomas, are not typically associated with breast cancer, although some proliferative and non-proliferative benign breast conditions can carry a higher risk of breast cancer development.

TYPES OF BREAST CANCER:

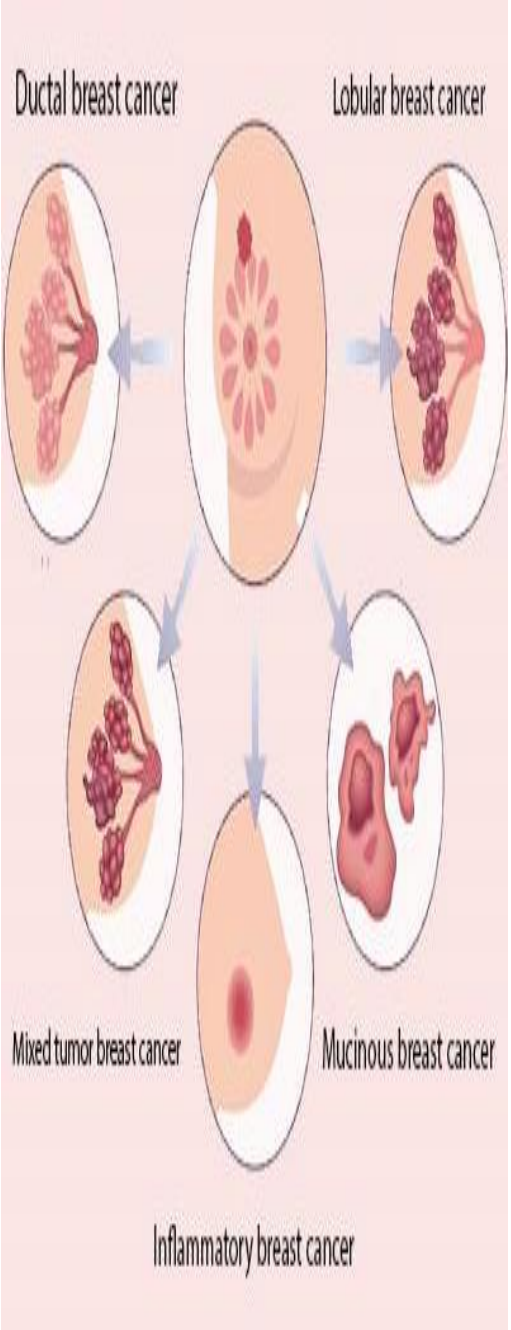


Fig. Types Of Breast Cancer

1.Ductal Breast Cancer:- Ductal carcinoma in situ is a very early form of breast cancer. In ductal carcinoma in situ, the cancer cells are confined inside a milk duct in the breast. The cancer cells haven't spread into the breast tissue. Ductal carcinoma in situ is often shortened to DCIS. It's sometimes called noninvasive, pre-invasive or stage 0 breast cancer.

2.Mixed Tumor **Breast** Cancer:- Mixed invasive ductal and lobular carcinoma (Mixed IDC/L) is a rare subtype (3-5%) of invasive breast cancer with elusive pathophysiology. This entity is characterized by a mixed population of both ductal and lobular components within an individual tumor.

3.Inflammatory Breast Cancer:- Inflammatory breast cancer is a rare and very aggressive disease in which cancer cells block lymph vessels in the skin of the breast. This type of breast cancer is called "inflammatory" because the breast often looks swollen and red, or inflamed. Inflammatory breast cancer progresses rapidly, often in a matter of weeks or months.

4.Mucinous Breast Cancer:- Mucinous breast cancer is a rare type of cancer that makes up less than 2% of all breast cancer cases. It is an invasive ductal breast cancer. Mucinous or colloid breast cancer works in a similar way to other invasive ductal breast cancers. It begins in the milk duct of the breast and then spreads to the other tissues. The tumor comprises abnormal cells, and in this type of breast cancer, these cells float in mucin, which is a primary component of a slimy substance called mucus.

5.Lobular Breast Cancer:- Lobular breast cancer (also called invasive lobular carcinoma, or ILC) is breast cancer that starts in the milk-producing gland, or lobules, of your breast and has spread into surrounding breast tissue. It accounts for about 10% to 15% of all breast cancers and is the second most common type of breast cancer. Left untreated, lobular breast cancer spreads to nearby lymph nodes, and then to other areas of your body.

Sign & Symptoms

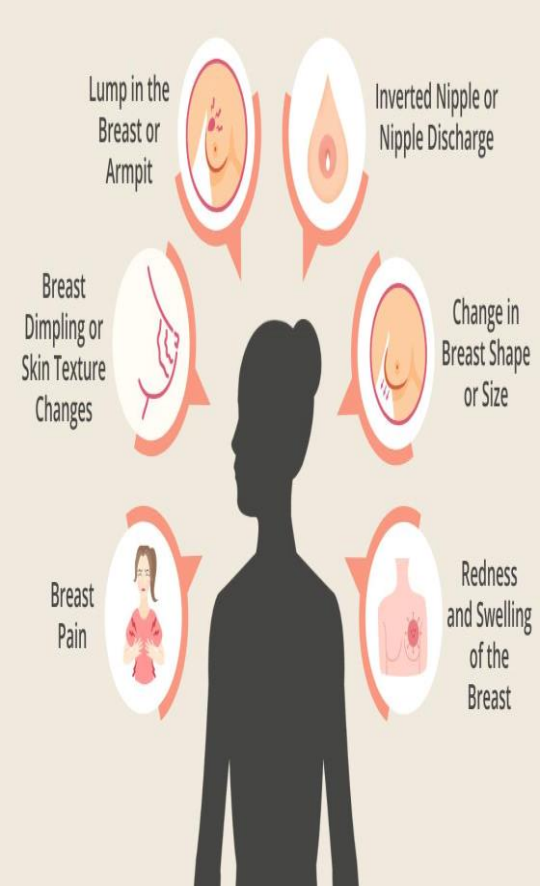


Fig. Sign & Symptoms

Causes & Risk Factors:

1) Sex
2) Age
3) Sex
4) Family History
5) Genetics
6) Smoking
7) Drinking Beverages Containing Alcohol
8) Having Obesity
9) Radiation Exposure
10) Hormone Replacement Therapy.

Anticancer Activity Of Coconut:

In this review, we look back at the history of the anticancer potential of virgin coconut oil (VCO) and summarize recent findings to broaden our understanding of coconut

water's anticancer effects. This information will help explain how it works and encourage other research groups to carry out more studies in this area. There is still much to learn about using nutrition-based treatments. However, a careful look at existing studies shows that coconut products act like a double-edged sword – nutritionally, they can help prevent cancer and also provide powerful anticancer compounds. The anticancer properties of coconut oil were also reported by Lim-Sylianco in 1987, who reviewed 50 years of research, and by Cohen et al. in 1986. Coconut oil also has anti-carcinogenic (cancer-fighting) properties.

The anticancer properties of virgin coconut oil (VCO) come from its high content of medium-chain fatty acids. Coconut oil is made up of 92% saturated fatty acids, mostly in the form of medium-chain triglycerides (MCT), and 8% unsaturated fats, including oleic and linoleic acids. Because of its high fat and low carbohydrate content, VCO can be considered part of a ketogenic diet (KD). This diet causes the body to burn fat instead of carbohydrates. Ketogenic diets are known to reduce the frequency of epileptic seizures and are also used to treat several rare metabolic disorders.

Because cancer cells are not efficient at using ketone bodies for energy, a ketogenic diet can be effective for cancer treatment. Eating a ketogenic diet limits carbohydrates, which lowers blood sugar and insulin levels, leading to increased fat breakdown. Fatty acids activate the peroxisome proliferator-activated receptor α (PPARα). PPARα boosts the breakdown of fatty acids and the production of ketones, while also reducing the creation of new fatty acids and the process of glycolysis (sugar breakdown).

Chemical Components Of Coconut:

Coconut water contains important substances like phytohormones (such as auxin and cytokinins) and minerals that help maintain the body's electrolyte balance, including potassium, sodium, magnesium, phosphorus, and calcium. It also contains vitamins, sugars, and other nutrients that support overall health and well-being, as well as recovery from illness

Phytohormones are natural compounds that play a key role in regulating plant growth. Auxin, different types of cytokinins, and gibberellins are all found in coconut water. Other plant growth hormones, such as gibberellins (GAS), abscisic acid (ABA), ethylene, and cytokinins, were later grouped with auxins as the "classical five" plant hormones, though auxin was originally considered the only phytohormone.

Composition Of Coconut Oil:

Coconut oil (CNO) has become one of the most sought-after oils globally because of its high level of saturation and excellent stability. There are various forms of CNO derived from different parts of the coconut. Copra oil is obtained from the dried coconut kernel through mechanical processing. Virgin coconut oil (VCO) is produced from fresh coconut kernel without the use of intense heat or chemical processes. Coconut testa oil is extracted from the brown skin (testa) of the coconut using isopropyl alcohol.

CNO is primarily composed of saturated fatty acids (SFAs), making up about 90% of its total content. In addition to

triacylglycerols (TAGs), which are fats linked to different fatty acids, CNO also contains other minor compounds such as:

1) **Phospholipids**, which aid in fat digestion and are vital for cell structure.

2) **Sterols**, which contribute to cell membrane structure and may reduce cholesterol absorption.

3) **Tocopherols** (vitamin E), which act as antioxidants that protect cells from damage.

4) **Volatile compounds,** which give CNO its unique smell and taste.

These elements play a key role in influencing the physical and chemical behavior of coconut oil. For example, the way it quickly changes from solid to liquid in a narrow temperature range is due to its composition. Virgin coconut oil (VCO) is considered more beneficial than commercial copra oil because it contains higher amounts of medium-chain saturated fatty acids (which are easier to digest) and more polyphenols, which are antioxidants that help protect the body from cell damage.

Mechanism Of Action:

The mechanisms through which coconut oil exerts these protective effects are varied and still under investigation. However, some key pathways include:

Inducing Apoptosis: Lauric acid triggers programmed cell death in cancer cells by increasing the production of reactive oxygen species (ROS), leading to oxidative stress that the cancer cells cannot survive.

Anti-Inflammatory Effects: Coconut oil has strong anti-inflammatory properties, which are important in reducing chronic inflammation, a known risk factor for cancer development.

Improved Intestinal Health: In colon cancer models, coconut oil has been shown to increase the levels of mucin 2, a protein essential for maintaining the integrity of the intestinal barrier. A healthy intestinal barrier is crucial in preventing the onset and progression of gastrointestinal cancers.

Coconut Oil and Cancer :

Coconut oil, particularly virgin coconut oil (VCO), has been increasingly studied for its health benefits, especially in relation to its anti-cancer and chemoprotective properties. The unique composition of coconut oil, which is rich in medium-chain fatty acids (MCFAs), primarily lauric acid, plays a central role in its health-promoting effects.

In 1987, Lim Sylianco reviewed 50 years of research highlighting the anti-carcinogenic (cancer-preventing) effects of dietary coconut oil. These animal studies showed that feeding coconut oil did not encourage the development of cancer, a finding that supports its protective role in health.

A significant study conducted in 1984 by Reddy demonstrated that pure coconut oil was more effective than medium-chain triglyceride (MCT) oil at inhibiting colon tumors caused by azoxymethane, a chemical known to induce cancer. In the study, the incidence of colon cancer in animals fed corn oil was 10 times higher (32%) compared to those fed coconut oil (3%). Furthermore, both olive oil and coconut oil produced similarly low rates of colon cancer, approximately 3%. However, coconut oil had a unique protective effect in the small intestine, where no tumors were found in the animals fed coconut oil, whereas 7% of those fed olive oil

developed tumors. This suggests that coconut oil may offer specific protection against tumor development in the digestive tract.

In 1986, a study by Cohen found that the protective, non-promotional effects of coconut oil extended to breast cancer. In this research, it was observed that animals fed coconut oil had slightly elevated cholesterol levels, but this seemed to be beneficial, as they developed fewer tumors. In contrast, animals fed polyunsaturated oils had lower cholesterol but a higher incidence of tumors. This finding suggests an inverse relationship between total cholesterol levels and cancer risk: higher cholesterol was linked to fewer tumors. This is consistent with other studies that highlight coconut oil's stability under heat and its resistance to oxidation, which may prevent the formation of harmful free radicals that can promote cancer.

Additionally, coconut oil contains high levels of lauric acid, a medium-chain fatty acid known for its antimicrobial properties. Lauric acid can kill harmful pathogens, such as bacteria, viruses, and fungi, which may contribute to overall health and possibly reduce cancer risk by lowering inflammation and oxidative stress in the body.

Anticancer Property and Chemotherapy Protective Effect:

Several studies have reported the anti-cancer effects of coconut oil (CNO) against different types of cancer cells, including breast, colon, liver, lung, and oral cancer. For instance, a study by Salerno and Smith found that coconut oil, which is high in lauric and palmitic acids, had a stronger inhibitory effect on HT-29 human colon cancer cells than linoleic acid. Another study by Enos and colleagues showed that a coconut oil-rich diet significantly reduced the incidence of ulcerative colitis and colon cancer in a model where colon cancer was chemically induced. It was also discovered that coconut oil Increases the levels of mucin 2, a protein that helps maintain the health of the intestinal lining.

In lab studies, lauric acid, the main fatty acid in virgin coconut oil (VCO), has been shown to trigger apoptosis (programmed cell death) in various types of cancer cells, including colorectal, breast, and endometrial cancer cells. This effect is believed to be driven by reactive oxygen species, which are molecules that can cause damage to cancer cells. Lauric acid has also demonstrated toxicity towards human colon cancer cells (HCT-15), liver cancer cells (HepG2), and certain immune cells in both computer models (in silico) and lab studies (in vitro). Moreover, coconut oil has shown the ability to inhibit the growth of breast tumors in animal studies.

Additionally, virgin coconut oil (VCO), processed CNO, and fractionated CNO have shown anti-cancer effects on liver and oral cancer cells. A separate study by Kamalaldin et al. found that VCO induced cell death in two lung cancer cell lines (NCI-H1299 and A549), and it was deemed safe for consumption. The cancer cells treated with VCO displayed distinct changes, such as large vacuoles in the cytoplasm and changes in the cell membrane.

Beyond its anti-cancer properties, VCO is emerging as a functional oil that helps reduce the harmful side effects of chemotherapy. For example, an animal study showed that fermented virgin coconut

oil (F-VCO) reduced bone marrow suppression and improved antioxidant levels in animals treated with the chemotherapy drug cyclophosphamide. Similarly, F-VCO helped prevent liver damage and oxidative stress caused by the chemotherapy drug methotrexate in rats. Another study found that the kidney damage caused by methotrexate was reduced by the antioxidant and anti-inflammatory effects of VCO. Breast cancer patients undergoing chemotherapy also experienced fewer side effects when they consumed VCO. Furthermore, VCO-based mouthwash has been shown to reduce oral mucositis (painful inflammation in the mouth) caused by radiation in patients with nasopharyngeal cancer.

Colon Cancer: Research has demonstrated that coconut oil, especially rich in lauric and palmitic acids, is effective against human colon cancer cells, such as HT-29 and HCT-15 cells. Additionally, diets rich in coconut oil have been shown to reduce colon cancer incidence in animal models of ulcerative colitis, a condition that increases colon cancer risk.

Breast and Endometrial Cancer: Lauric acid has also shown promising results in studies targeting breast and endometrial cancer cells. Its ability to induce oxidative stress in cancer cells leads to their death, offering a potential therapeutic strategy.

Liver and Oral Cancer: Both virgin coconut oil and processed coconut oil have been studied for their effects on liver and oral cancer cells, showing inhibitory effects in lab settings. These findings are supported by animal studies where coconut oil supplementation reduced tumor formation and growth.

Lung Cancer: VCO has been shown to induce apoptosis in lung cancer cell lines (NCI-H1299 and A549), demonstrating that it could potentially be used as an adjunct therapy in treating lung cancer.

Chemoprotective Effects:

Antioxidant Support:

Studies have indicated that VCO helps improve antioxidant levels in the body, which is critical for mitigating the oxidative damage caused by chemotherapy. By enhancing the body's natural defense system, VCO can help protect vital organs like the liver, kidneys, and bone marrow.

Reducing Chemotherapy Side Effects:

Animal studies have shown that F-VCO can reduce myelosuppression (suppression of bone marrow activity) and improve antioxidant status after exposure to chemotherapy drugs. This is particularly important for patients receiving drugs like cyclophosphamide, which can significantly lower immune function.

Protection Against Organ Damage:

VCO has also been found to protect against liver toxicity and kidney damage caused by chemotherapy drugs like methotrexate. Its anti-inflammatory and antioxidative effects help preserve organ function during cancer treatment.

Mouthwash for Radiation-Induced Mucositis:

Radiation therapy can cause mucositis, an inflammation of the mucous membranes in the mouth, especially in patients with nasopharyngeal cancer. A VCO-based mouthwash has been shown to reduce the severity of this painful condition, offering a

natural, non-invasive way to manage treatment side effects.

Conclusion:

This manuscript highlights the role of lauric acid (LA) in regulating cytokines and inflammatory pathways, emphasizing the interaction between Nrf2 and NF-κB in controlling cellular redox states, inflammation, and cell fate.

It suggests further research on LA's epigenetic regulation of inflammatory genes and RNA processing.

Additionally, virgin coconut oil (VCO) shows promise in improving the quality of life (QOL) of breast cancer patients during chemotherapy, with potential benefits for symptoms and functional status.

Coconut oil (CNO), rich in medium-chain triglycerides (MCTs), demonstrates health benefits such as anti-inflammatory and antimicrobial effects, though its cardioprotective effects remain inconclusive.

Lastly, coconut water and its cytokinins have potential anti-cancer properties, and lauric acid in coconut oil shows protective effects against cancer and heart disease.

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