ISSN (Online): 2456-5717

International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)
Vol.3, Issue.3, March 2017

Herbs and Spices Aids in Prevention and Treatment of Breast Cancer

Neha Vutakuri* and Sita Somara**
*Student: McLean High School, Virginia, USA
**Mentor: Wake Forest School of Medicine, Winston Salem, NC, USA

Abstract:-

Although there have been many scientific advances in the field of oncology, cancer mortality rates still have not significantly diminished in the past few decades. Current anticancer treatments, most notably chemotherapy, induce severe side effects as well as are expensive and even ineffective in some cases. Using common strategies to prevent from getting cancer is a better than the discomfort and costs of becoming sick. One promising approach is inclusion of herbs and spices in daily dietary intake which not only will to prevent breast cancer but also make the treatments in breast cancer patients more effective. Herbs and spices have been used for generations for their rich flavor in cooking as well as for their medicinal properties. Because herbs and spices have many beneficial chemical compounds such as flavonoids and anthocyanins, they have sparked a great interest in researchers. Unlike present anticancer treatments, herbal remedies are inexpensive and have minor side effects. However, there have been limited studies done on herbal medicine in prevention and treatments of cancer. Most of the herbal remedies have properties such as antioxidant, anti-inflammatory, anti-carcinogenic, anti-mutagenic, and radio-protective, which are useful in preventing or delaying the onset of breast cancer. This review discusses the antioxidant and antitumorigenic properties of certain herbs and spices with a focus on breast cancer prevention and cure.

I. INTRODUCTION

Cancer

The human body is composed of trillions of cells, which grow, divide to form tissue and when they die, the tissue is replenished with newly divided cells. Newly divided cells replace old cells in the body. The common aspect of all cancer types is that some of the body cells start dividing abnormally in an uncontrollable manner, which ultimately spread into the tissues ((Hammar, 2016 Cancer. In *AccessScience*. McGraw-Hill Education)). In the case of cancer, which can affect any part of human body, the orderly pattern of cell division deteriorates and cells start dividing in an abnormal way. The old cells in that part of the body, which are supposed to die, remain alive. Because old cells do not die, and new cells keep on dividing, the number of cells increases tremendously, and the mass of cells develop into tumors. Except blood cancer, many other cancers make solid tumor ((What is cancer? A guide for patients and families. (n.d.). Retrieved April 11, 2016, from http://www.cancer.org/cancer/cancerbasics/what-is-cancer)). Metastatic cancer

spreads to other body part, where cancer cells migrate through release into blood circulation by process known as metastasis ((Leber, M. F., & Efferth, T. (2009). Molecular principles of cancer invasion and metastasis (review). International journal of oncology, 34(4), 881-895)).

Cancer is reported to be a genetic disease caused by changes in genes controlling cell functions, particularly their growth patterns and replication ((Vogelstein, B., & Kinzler, K. W. (2004). Cancer genes and the pathways they control. Nature medicine, 10(8), 789-799)). Children can inherit these genetic changes from their parents ((Pizzo & Poplack, (2015). *Principles and practice of pediatric oncology*)). Exposure to unfavorable environmental conditions, which damages the DNA, can also cause genetic changes ((Esteller, (2007). Cancer epigenomics: DNA methylomes and histone-modification maps. *Nature Reviews Genetics*, *8*(4), 286-298)). Some of the basic unfavorable environmental exposures are tobacco smoke in the air, ultraviolet solar radiations and consumption of viral food ((Wogan, Hecht, Felton, Conney, Loeb, (2004, December). Environmental and chemical carcinogenesis. In *Seminars in cancer biology* (Vol. 14, No. 6, pp. 473-486)). Genetic changes leading to cancer mainly affect three types of genes; proto-oncogenes, DNA repair genes, and tumor suppressor genes; these are drivers of cancer ((Sotiriou, Neo, McShane, Korn, Long, Jazaeri, Liu, (2003). Breast cancer classification and prognosis based on gene expression profiles from a population-based study. *Proceedings of the National Academy of Sciences*, *100*(18), 10393)).

Scientists have identified nearly 100 different types of cancer, classified according to the affected organs and tissue ((Lawrence, Stojanov, Mermel, Robinson, Garraway, Golub, Getz, (2014). Discovery and saturation analysis of cancer genes across 21 tumour types. *Nature, 505*(7484), 495-501.)). Each cancer type is further classified into different stages to define the treatment approach and plan.

II. Stages of Cancer

Scientists classify stages of cancer according to the level and size of cancer cells ((Sherr, . (1996). Cancer cell cycles. *Science*, *274*(5293), 1672-1677)). Medical practitioners consider cancer staging as an important aspect in cancer treatment because this helps them in defining the type of treatment a patient needs ((Goroll & Mulley, (2012). *Primary care medicine: Office evaluation and management of the adult patient*.)). There are two systems that are used to name the cancer stages: (i) TNM System and (ii) Number system ((Greene, Balch, Fleming, Fritz, Haller, Morrow, Page, (2002). *AJCC cancer staging handbook: TNM classification of malignant tumors)*).

In TNM System, T describes the size of cancer that ranges from 0 to 4 where zero indicate absence of tumor and four indicate larger unit of cancer. N describes the probability of its spread to lymph nodes where zero shows that no lymph node has gotten cancer cells while three indicate greater effects on lymph node. M shows if cancer has transported to any other part of the body

where zero indicates no spreading and one indicates the spread of cancer ((Sobin & Fleming, (2002). *AJCC cancer staging handbook: TNM classification of malignant tumors*)).

The numbering system divides cancer into four different stages. Stage 1 indicates that cancer is relatively small and has not spread to other organs or parts of the body from where it started ((Chua, Sham, Wei, Ho, Au, (2001). The predictive value of the 1997 American Joint Committee on Cancer stage classification in determining failure patterns in nasopharyngeal carcinoma. *Cancer*, *92*(11), 2845-2855)). Stage 2 is also an indication that cancer has not yet spread to any other part of the body; however, stage 2 indicates that the tumor has expanded in size as compared to the first stage tumor. Stage 2 is the critical point, where cancer cells almost affect lymph nodes ((Ellis, Suman, Hoog, Lin, Snider, Prat, Esserman, (2011). Randomized phase II neoadjuvant comparison between letrozole, anastrozole, and exemestane for postmenopausal women with estrogen receptor–rich stage 2 to 3 breast cancer: clinical and biomarker outcomes and predictive value of the baseline PAM50-based intrinsic subtype—ACOSOG Z1031. *Journal of clinical oncology*, *29*(17), 2342-2349)). In stage 3, cancer cells have increased tremendously forming a large tumor. The cancer cells have started encroaching surrounding tissues and organs. In stage 3, cancer cells affect lymph nodes ((Rosen & Jordan, (2009). The increasing complexity of the cancer stem cell paradigm. *science*, *324*(5935), 1670-1673)). Stage 4 is the critical stage of cancer, where cancer cells have spread to other parts of the body. This stage is also known as metastatic or secondary cancer ((Gupta & Massagué, (2006). Cancer metastasis: building a framework. *Cell*, *127*(4), 679-695.)).

III. Breast Cancer

Breast cancer refers to the malignant tumor within breast cells; hence, it is a kind of cancer that starts in breast cells ((Stephens, Tarpey, Davies, Van Loo, Greenman, Wedge, Yates, (2012). The landscape of cancer genes and mutational processes in breast cancer. *Nature*, *486*(7403), 400-404)). The uncontrolled growth of breast cells results in breast cancer. Cancer cells in breast usually arose in milk-producing lobules or milk ducts through which milk travels to nipples ((Braddock, Kercher, Edney, (2014). *Straight Talk about Breast Cancer: From Diagnosis to Recovery*. Addicus Books)). Sometimes, it can start in the breast's fibrous connective tissues ((Wells, Howlett, Cole, Kees, (2015). Deregulated expression of connective tissue growth factor (CTGF/CCN2) is linked to poor outcome in human cancer. *International Journal of Cancer*, *137*(3), 504-511)). Breast cancer is reported to be a genetic disorder as most of the patients inherit it from their parents ((Apostolou & Fostira, (2013). Hereditary breast cancer: the era of new susceptibility genes. *BioMed research international*, *2013*)).

Stages of Breast Cancer

Similar to stages of general cancer, scientists base breast cancer stages on the following things. First, the tumor size inside the breast, seconds the lymph nodes affected, third the presence

of lymph nodes near the axillary area, and finally the fact that breast cancer cell had invaded the rest of body organs or not ((Tavassoli & Devilee, (2003). *Pathology and genetics of tumours of the breast and female genital organs*. Iarc)).

Breast cancer has following stages: Stage 0 and 1 is the initial stage representing early signs of breast cancer. At this stage, cancer cells stay at one particular part of the breast area ((Sears, Stanton Danoff-Burg, (2003). The yellow brick road and the emerald city: benefit finding, positive reappraisal coping and posttraumatic growth in women with early-stage breast cancer. *Health Psychology*, *22*(5), 487)). Stage 2 is also an early stage of breast cancer, but the cancer tumor are enlarged and ready to spread. Breast cancer is still effectively treatable at this stage ((Litière, Werutsky, Fentiman, Rutgers, Christiaens, Van Limbergen, Bartelink, (2012). Breast conserving therapy versus mastectomy for stage I–II breast cancer: 20 year follow-up of the EORTC 10801 phase 3 randomised trial. *The lancet oncology*, *13*(4), 412-419)). Stage 3 is an advanced stage of breast cancer, where cancer cells invade areas surrounding the breast ((Koolen, Peeters, Aukema, Vogel, Oldenburg, van der Hage Emiel, (2012). 18F-FDG PET/CT as a staging procedure in primary stage II and III breast cancer: comparison with conventional imaging techniques. *Breast cancer research and treatment*, *131*(1), 117-126)). Finally, stage 4 is when cancer cells spread to nearby organs of the body. Stage 4 is considered incurable, but the life of patient can be sustained for a longer period through adequate treatment ((BSW, D. S. T., Drory, M., Ginzburg, K., & Stadler, J. (2008).Stages of Breast Cancer. Journal of Psychosocial Oncology.)). Sometimes, mastectomy, surgical removal of breast is the best choice based on the stage of cancer and other factors.

IV. Prevention of Breast Cancer

While there are many radiation and chemotherapies available for treating cancer but all these treatments are associated with side effects. Scientist are exploring the use of natural plants that are tested for killing carcinogenic cells ((Zhuang, Chiu, Chen, Tsai, Lee, Lee, Wang, (2012). Effects of a Chinese medical herbs complex on cellular immunity and toxicity-related conditions of breast cancer patients. *British Journal of Nutrition*, *107*(05), 712-718)) to use for cancer treatments. Using herbs and spices to kill carcinogenic cells as an alternative to the chemotherapy ((Reverter, Bontemps, Lecchini, Banaigs, Sasal, (2014). Use of plant extracts in fish aquaculture as an alternative to chemotherapy: current status and future perspectives. *Aquaculture*, *433*, 50-61)) is being greatly researched as herbal treatment has no negative impacts ((Yarney, Donkor, Opoku, Yarney, Agyeman-Duah, Abakah, Asampong, (2013). Characteristics of users and implications for the use of complementary and alternative medicine in Ghanaian cancer patients undergoing radiotherapy and chemotherapy: a cross-sectional study. *BMC complementary and alternative medicine*, *13*(1), 1)). There are numerous anticancer herbs, which have been used throughout the history by different nations to treat their patients ((Sawadogo, Schumacher, Teiten, Cerella, Dicato, Diederich, (2013). A survey of marine natural compounds and their derivatives

with anti-cancer activity reported in 2011. *Molecules*, *18*(4), 3641-3673)). Some of the commonly used herbs and spices around the world reported to treat breast cancer in particular are as following.

a) Andrographis

Andrographis is another important herbal medicine, used from ancient times to treat cancer and all other bacterial diseases ((Gunn, Williams, Huynh, Iannotti, Han, Barrios, Kirshner, (2011). The natural products parthenolide and andrographolide exhibit anti-cancer stem cell activity in multiple myeloma. *Leukemia & lymphoma*, *52*(6), 1085-1097)). Research in Japan, reveals that leaves of Andrographis have the ability to kill cancer cells ((Harjotaruno, Widyawaruyanti Zaini, (2008). Apoptosis Inducing Effect of Andrographolide On TF-47 Human Breast Cancer Cell Line. *African Journal of Traditional, Complementary and Alternative Medicines*, *4*(3), 345-351)). They have been reported to be very effective in curing breast cancer patients ((Kim, Mehta, Yu, Neeman, Livney, Amichay, Mansel, (2002). Chemopreventive and adjuvant therapeutic potential of pomegranate (Punicagranatum) for human breast cancer. *Breast cancer research and treatment*, *71*(3), 203-217)).

b) Bell pepper

Bell pepper (scientific name is *Capsicum annum)* is best known for their rich ingredients, like vitamin C, A, and foliate. Some of the characteristics of bell pepper are antioxidant, antimutagenic and radioprotective ((Asif, (2015). Chemistry and antioxidant activity of plants containing some phenolic compounds. *Chemistry International*, *1*(1), 35-52)). Studies revealed that the micronutrients of bell pepper include apigenin, luteolin, lupeol, carotenoids, quercetin and campsite; which are the best anti-breast cancer ingredients ((Ramírez-Gómez, Moguel-Ordoñez, Segura-Campos, Ruiz-Ruiz, Chel-Guerrero, Betancur-Ancona, (2016). Antioxidant Capacity of Capsicum chinense Genotypes. In *Functional Properties of Traditional Foods* (pp. 241-249)). Among all these components of bell pepper, apigenin has been known to stop cancer cells growth, specifically in the breast cells ((Tseng, Chien, Lin, Wen, Chow, Chen, Lee, . (2016). Inhibition of MDA-MB-231 breast cancer cell proliferation and tumor growth by apigenin through induction of G2/M arrest and histone H3 acetylation-mediated p21WAF1/CIP1 expression. *Environmental toxicology)*). Bell pepper are available in different colors; however, according to existing studies red color bell pepper are known to be more effective against breast cancer than any other color ((Guruvayoorappan, Sakthivel, Padmavathi, Bakliwal, Monisha, Kunnumakkara, (2015). Cancer Preventive and Therapeutic Properties of Fruits and Vegetables: An Overview. In *ANTICANCER PROPERTIES OF FRUITS AND VEGETABLES: A Scientific Review* (pp. 1-52)).

c) Garlic (Allium sativum)

Several cancer research institutions recognize that garlic has the potential to cure cancer, due to its anticancer properties ((Schafer & Kaschula, (2014). The immunomodulation and anti-inflammatory effects of garlic organosulfur compounds in cancer chemoprevention. *Anti-Cancer*

Agents in Medicinal Chemistry (Formerly Current Medicinal Chemistry-Anti-Cancer Agents), *14*(2), 233-240)). Garlic has sulfhydryl compounds, which can block cancer-forming substances ((Shukla & Kalra, (2007). Cancer chemoprevention with garlic and its constituents. *Cancer letters*, *247*(2), 167-181)). The significant characteristic of garlic comes from the presence of sulfur in its overall constituents ((Milner, (2001). Mechanisms by which garlic and allyl sulfur compounds suppress carcinogen bioactivation. In *Nutrition and Cancer Prevention* (pp. 69-81)). Some of the preclinical studies on garlic provide evidence that it reduces breast cancer through the nitrosamine formation ((Nicastro, Ross, Milner, (2015). Garlic and onions: Their cancer prevention properties. *Cancer Prevention Research*, *8*(3), 181-189)). Garlic can inhibit tumors by activating metabolism of carcinogens, which alter enzymes in phase I or II of what ((Richard, Kamdje, Mukhtar, (2015). Medicinal plants in breast cancer therapy. *J Dis Med Plants*, *1*, 19-23)). Maximum tumor inhibition is achieved when sulfur compounds suppress neoplastic cell over the non-neoplastic cells, which results in the breakdown of allicin ({An, Zhang, Yao, Li, & Ren, (2015). Effects of Diallyl Disulfide in Elephant Garlic Extract on Breast Cancer Cell Apoptosis in Mitochondrial Pathway. *Journal of Food and Nutrition Research*, *3*(3), 196-201)).

d) Cumin

Cumin (*Cuminum cyminum*) is a very effective Indian flowing spice, known for its anticancer properties ((Darvesh, Aggarwal, Bishayee, (2012). Curcumin and liver cancer: a review. *Current pharmaceutical biotechnology*, *13*(1), 218-228)). Cumin exhibits antioxidant and chemopreventive properties ((López- Lázaro, (2008). Anticancer and carcinogenic properties of curcumin: considerations for its clinical development as a cancer chemopreventive and chemotherapeutic agent. *Molecular nutrition & food research*, *52*(S1), S103-S127)). A study conducted verified the effectiveness of cumin in the prevention of cancer cells ((Allahghadri, Rasooli, Owlia, Nadooshan, Ghazanfari, Taghizadeh, Astaneh, (2010). Antimicrobial property, antioxidant capacity and cytotoxicity of essential oil from cumin produced in Iran. *Journal of food science*, *75*(2), H54-H61)). Other clinical studies also reported that Cumin contains ingredients that suppress the proliferation of tumor cells and breast adenocarcinoma ((Gali-Muhtasib, El-Najjar and Schneider-Stock, (2006). The medicinal potential of black seed (Nigella sativa) and its components. *Advances in Phytomedicine*, *2*, 133-153, Khan, Chen, Tania, Zhang, (2011). Anticancer activities of Nigella sativa (black cumin). *African Journal of Traditional, Complementary and Alternative Medicines*, *8*(5S).)).

e) Cardamom

Cardamom is a famous Indian herb, commonly used in Indian foods. Its scientific name is *Elettaria* Amomum and belongs to the ginger family of plants ((Sengupta & Bhattachanjee, (2009). *Cardamom (Elettaria cardamomum) and its active constituent, 1, 8-cineole* (pp. 65-86). B. B. Aggarwal, & A. B. Kunnumakkara (Eds.). World Scientific Publishing, Singapore)). Kikuzaki et al conducted a study in 2001 to explore the characteristic of Cardamom. They found that it carries

antioxidant properties and is an effective anti-breast cancer remedy ((Kikuzaki, Kawai, Nakatani, (2001). 1, 1-Diphenyl-2-picrylhydrazyl radical-scavenging active compounds from greater cardamom (Amomum subulatum Roxb.). *Journal of nutritional science and vitaminology*, *47*(2), 167-171)). Earlier in 1994, Banerjee et al. had successful reported that cardamom can inhibit chemical carcinogenesis ((Banerjee, Sharma, Kale, Rao, (1994). Influence of certain essential oils on carcinogen- metabolizing enzymes and acid- soluble sulfhydryls in mouse liver.)). It enhances the metabolic processes and hence proved deterrent to cancer. It has anti-inflammatory and antiproliferative properties, which reduces azoxymethane, a carcinogenic compound used to induce cancer with in-vivo research studies ((Acharya, Das, Singh, Saha, (2010). Chemopreventive properties of indole-3-carbinol, diindolylmethane and other constituents of cardamom against carcinogenesis. *Recent patents on food, nutrition & agriculture*, *2*(2), 166-177)).

f) Ginger

Ginger (*Zingiber officinale)* is an underground stem or rhizome ((Shukla & Singh, (2007). Cancer preventive properties of ginger: a brief review. *Food and chemical toxicology*, *45*(5), 683-6907)). Cancer chemoprevention with garlic and its constituents. *Cancer letters*, *247*(2), 167-181)). This important spice gives a refreshing taste to foods, due to the presence of different vitamins as ingredients ((Budhwaar, (2013). *The secret benefits of ginger and turmeric*. Sterling Publishers Pvt. Ltd)). This also enhances the immune system ((Tan & Vanitha, (2004). Immunomodulatory and antimicrobial effects of some traditional Chinese medicinal herbs: a review. *Current Medicinal Chemistry*, *11*(11), 1423-1430)). The extracts of ginger inhibit abnormal cell production within breast cells without disturbing the healthy cell proliferation ((Lee, Seo, Kang, Kim, (2008). [6]-Gingerol inhibits metastasis of MDA-MB-231 human breast cancer cells. *The Journal of nutritional biochemistry*, *19*(5), 313-319)). Researchers reported that extracts of ginger is able to reduce the tumor size in mice carrying prostate cancer ((Habib, Makpol, Hamid, Das, Ngah, Yusof, (2008). Ginger extract (Zingiber officinale) has anti-cancer and anti-inflammatory effects on ethionine-induced hepatoma rats. *Clinics*, *63*(6), 807-813)). Experiments show that the phytochemicals within ginger enhance apoptosis of the cancer cells, which have an effective preventive role against metastasis ((Surh, (2003). Cancer chemoprevention with dietary phytochemicals. *Nature Reviews Cancer*, *3*(10), 768-780)). Traditionally, people have used ginger in tea and its extract to treat nausea and vomiting as a chemotherapy ((Dibble, Luce, Cooper, Israel, Cohen, Nussey, Rugo, (2007, July). Acupressure for chemotherapy-induced nausea and vomiting: a randomized clinical trial. In *Oncology nursing forum* (Vol. 34, No. 4, p. 813)). Hsu et al. suggests that ginger should be further explored as it could prove to be an excellent medicine for the treatment of breast cancer ((Hsu, Hung, Tsai, Tsai, Huang, Hou, Kuo, (2015). 6-shogaol, an active constituent of dietary ginger, impairs cancer development and lung metastasis by inhibiting the secretion of CC-chemokine ligand 2 (CCL2) in tumor-associated dendritic cells. *Journal of agricultural and food chemistry*, *63*(6), 1730-1738)).

g) Black pepper

The dried fruit of vine *Piper nigrum* known as black pepper ((Nirmal Babu, Divakaran, Yamuna, Ravindran, Peter, (2016). Protocols for Improvement of Black Pepper (Piper nigrum L.) Utilizing Biotechnological Tools. *Protocols for In Vitro Cultures and Secondary Metabolite Analysis of Aromatic and Medicinal Plants, Second Edition*, 367-385)). It was also called black gold, and it is very interesting to note that this black pepper spice was so important in ancient times that nations fought wars for it. ((Ravindran, (2003). *Black pepper: Piper nigrum*. CRC Press)). Ancient herbal experts have discovered the anti-inflammatory character of black pepper and piperine, an ingredient extracted from it, has an important antioxidant and anti-breast cancer effect ((Majdalawieh & Carr, (2010).In vitro investigation of the potential immunomodulatory and anti-cancer activities of black pepper (Piper nigrum) and cardamom (Elettariacardamomum). *Journal of Medicinal Food*, *13*(2), 371-381)). Piperine is effective in breast cancer treatment because it can inhibit abnormal breast cancer cells ((Kakarala, Brenner, Korkaya, Cheng, Tazi, Ginestier, Wicha, (2010). Targeting breast stem cells with the cancer preventive compounds curcumin and piperine. *Breast cancer research and treatment*, *122*(3), 777-785)). It can even inhibit those aggressive cells that are unresponsive against other preventive drugs like raloxifene and tamoxifen ((Lai, Fu, Liu, Jiang, Guo, Chen, Shen, (2012). Piperine suppresses tumor growth and metastasis in vitro and in vivo in a 4T1 murine breast cancer model. *Acta Pharmacologica Sinica*, *33*(4), 523-530)). The positive aspect of piperine is that it does not carry any adverse effects, and attacks affected cancer cells without harming normal breast cells ((Do, Kim, Choi, Khanal, Park, Tran, Jeong, (2013). Antitumor efficacy of piperine in the treatment of human HER2-overexpressing breast cancer cells. *Food chemistry*, *141*(3), 2591-2599)). Apart from the independent effectiveness, it also promotes the action of curcumin against cancer and enhances the biodiversity of the potent polyphenol compound in green tea ((Lambert, Hong, Kim, Mishin, Yang, (2004). Piperine enhances the bioavailability of the tea polyphenol (−)-epigallocatechin-3-gallate in mice. *The Journal of nutrition*, *134*(8), 1948-1952)).

h) Cinnamon

Cinnamon is another important anti-breast cancer Indian spice from the bark of Lauraceae family tree ((Herdwiani, (2016). A review of cinnamon as a potent anticancer. *Asian Journal of Pharmaceutical and Clinical Research*, 9-11)). Cinnamon constitutes cinnamaldehyde, terpinene, eugenol, pinene, linalool, carvacrol, coumarin, and benzyl benzoate ((Singh, Maurya, Catalan, (2007). A comparison of chemical, antioxidant and antimicrobial studies of cinnamon leaf and bark volatile oils, oleoresins and their constituents. *Food and chemical toxicology*, *45*(9), 1650-1661)). A regular use of cinnamon can help in the prevention of cancer; however, it is equally effective in reversing this disease ((Hamidpour, Hamidpour, Hamidpour, Shahlari, (2015). Cinnamon from the selection of traditional applications to its novel effects on the inhibition of angiogenesis in cancer cells and prevention of Alzheimer's disease, and a series of functions such as antioxidant, anticholesterol, antidiabetes, antibacterial, antifungal, nematicidal, acaracidal, and

repellent activities. *Journal of traditional and complementary medicine*, *5*(2), 66-70)). It reduces the growth of tumor cells and prohibits new tumor vessels formation in humans ((Shishodia, Chaturvedi, Aggarwal, (2007). Role of curcumin in cancer therapy. *Current problems in cancer*, *31*(4), 243-305)). Cinnamon can extract the H. pylori which is indeed very effective in the cure of breast cancer, as its extraction suppresses further growth of cancer cells ((Azmi, Ojha, Rao, (2015). CURCUMIN: BOON FOR HUMAN BEING)). Clinical tests on cinnamon showed an increase of antioxidant enzymes in liver and heart tissues ((Gruenwald, Freder, Armbruester, (2010). Cinnamon and health. *Critical reviews in food science and nutrition*, *50*(9), 822-834; Yang Su, Liu, Zhang, Yu, Xi, Zhai, (2013). Advances in clinical study of curcumin. *Current pharmaceutical design*, *19*(11), 1966-1973)).

i) Thyme

Thyme is a very important Indian herb, which has a wider medicinal usage ((Basch, Ulbricht, Hammerness, Bevins, Sollars, (2004). Thyme (Thymus vulgaris L.), thymol. *Journal of herbal pharmacotherapy*, *4*(1), 49-67)). Thyme ingredients include thymol, apigenin, tennis, carvacrol, luteolin, and terpinene ((Zarzuelo & Crespo, (2002). The medicinal and non-medicinal uses of thyme. *Thyme: The Genus Thymus*, 263-292)). These are the best agents in antibacterial, antioxidant and antiseptic actions ((Singletary, (2016). Thyme: History, Applications, and Overview of Potential Health Benefits. *Nutrition Today*, *51*(1), 40-49)). The oil, extracted from this herb is used in many products because it carries different positive characteristics ((Wu, Lin, Zhong, (2014). Physical and antimicrobial characteristics of thyme oil emulsified with soluble soybean polysaccharide. *Food Hydrocolloids*, *39*, 144-150)). One of the studies conducted by Kluth et al. (2007) says that thyme has effects on enzyme induction within human body cells. He observed in his study that thyme ingredients in the form of oil activate elements, which are helpful in the enzyme promotions that results in the prevention of breast cancer disease ((Kluth, Banning, Paur, Blomhoff, Brigelius-Flohé, (2007). Modulation of pregnane X receptor-and electrophile responsive element-mediated gene expression by dietary polyphenolic compounds. *Free Radical Biology and Medicine*, *42*(3), 315-325)).

j) Turmeric

Turmeric (*Curcuma longa)* belongs to ginger family plant, which is used in Indian regions as an herbal medicine for centuries ((Ravindran, Babu, Sivaraman, (2007). *Turmeric: the genus Curcuma*. CRC Press)). The ingredients of turmeric have the ability to inhibit inflammatory reactions ((Lantz, Chen, Solyom, Jolad, Timmermann, (2005). The effect of turmeric extracts on inflammatory mediator production. *Phytomedicine*, *12*(6), 445-452)). Apart from its use in breast cancer treatment, turmeric is also an antidiabetic and used for controlling cholesterol level in the body ((Liu, Yadev, Aggarwal, Nair, (2010). Inhibitory effects of black pepper (Piper nigrum) extracts and compounds on human tumor cell proliferation, cyclooxygenase enzymes, lipid peroxidation and nuclear transcription factor-kappa-B. *Natural product communications*, *5*(8),

1253-1257)). Turmeric has attracted many scientists to conduct clinical studies of its effectiveness in diseases. Turmeric has been a part of approximately 700 different studies to know its usefulness in the prevention or treatment of breast cancer ((Bhat, Jakribettu, Boloor, Fayad, Baliga, (2015). Use of Ayurvedic Medicinal Plants as Immunomodulators in Geriatrics: Preclinical Studies. *Foods and Dietary Supplements in the Prevention and Treatment of Disease in Older Adults*, 143)). Studies prove that it contains strong polyphenol curcumin which prohibits and reverse the growth of cancer cells ((Kocaadam & Şanlier, (2015). Curcumin, an Active Component of Turmeric (Curcuma longa), and Its Effects on Health. *Critical reviews in food science and nutrition*, (just-accepted)). It also enhances apoptosis, which is a helpful process to stop cells from abnormal-growth or disorderly growth ((Mock, Jordan & Selvam, (2015). Recent advances of curcumin and its analogues in breast cancer prevention and treatment. *RSC Advances*, *5*(92), 75575-75588)).

k) Oregano

Oregano's common name is wild marjoram while the scientific name is *Origanum vulgare* ((Skoula & Harborne, (2002). 3 The taxonomy and chemistry of Origanum. *Oregano: the genera Origanum and Lippia*, 67)). This herb has proven positive in protection from cancer ((Bakkali, Averbeck, Averbeck, Idaomar, (2008). Biological effects of essential oils–a review. *Food and chemical toxicology*, *46*(2), 446-475)). Because it prevents cancer, it is important intake in daily life, even if cancer is not diagnosed ((Sankar, Karthik, Prabu, Karthik, Shivashangari, Ravikumar, (2013). Origanum vulgare mediated biosynthesis of silver nanoparticles for its antibacterial and anticancer activity. *Colloids and Surfaces B: Biointerfaces*, *108*, 80-84)). This is also an effective herb in the first stage of cancer, because monoterpenoid phenolic compound carvacrol present in it helps to stop the spread of cancer from an affected organ to other parts of the body ((Lesjak, Simin, Orcic, Franciskovic, Knezevic, Beara, Mimica- Dukic, (2015). Binary and Tertiary Mixtures of Satureja hortensis and Origanum vulgare Essential Oils as Potent Antimicrobial Agents Against Helicobacter pylori. *Phytotherapy Research*)). One another way, in which oregano helps as anticancer is through the reduction of the formation of carcinogenic heterocyclic amines ((Damašius, Venskutonis, Ferracane, Fogliano, (2011). Assessment of the influence of some spice extracts on the formation of heterocyclic amines in meat. *Food Chemistry*, *126*(1), 149-156)). These amines form because of cooking of animal proteins at very high temperature ((Puangsombat, Gadgil, Houser, Hunt, Smith, (2012). Occurrence of heterocyclic amines in cooked meat products. *Meat Science, 90*(3), 739-746)).

V. CONCLUSION

Breast cancer is one of the most common types of cancer that affects females on a large scale. It is a tumor that is highly malignant and develops by the abnormal division of cells in the breast. Every eighth woman is expected to have breast cancer in the world, and many die as a consequence. Such terrible facts about cancer urge humanity to start utilizing all available research tools over natural herbs and spices, to bring up with some 100% output treatment of cancer.

The human body constantly fights cancer all the time, even before diagnosis. There are many bioactive elements in dietary intake that helps the body to fight cancer, by strengthening the immune system. Natural herbs and spices are not only the direct source of treatment of breast cancer but they are also the basic ingredient part of medicines.

With the innovation in science and technology, a number of individuals are opting for mastectomies as a means of preventing breast cancer. Among many approaches utilized for the successful prevention and treatment of breast cancer, herbs and spices can prove to be best therapeutic agents. Herbs and Spices are also used to treat different types of ailments like arthritis, high blood pressure, and headaches. Broccoli, wheatgrass, thyme, ginger are all known to provide therapeutic benefits for the treatment of a number of lethal diseases including breast cancer. The main aim of this review is to analyze the therapeutic miracles and effects of herbs and spices in preventing as well as effectively aiding the treatment of breast cancer. The review discussed exclusively various herbs and spices that have been experimentally proven to demonstrate therapeutic benefits against breast cancer. The existing research and facts about the use of herbs and spices against cancer are very encouraging for the future biological researchers.

REFERENCES

[1] Acharya, A., Das, I., Singh, S., & Saha, T. (2010). Chemopreventive properties of indole-3-carbinol, diindolylmethane and other constituents of cardamom against carcinogenesis. *Recent patents on food, nutrition & agriculture*, *2*(2), 166-177. http://www.ingentaconnect.com/content/ben/pfna/2010/00000002/00000002/art00009

[2] Allahghadri, T., Rasooli, I., Owlia, P., Nadooshan, M. J., Ghazanfari, T., Taghizadeh, M., & Astaneh, S. D. A. (2010). Antimicrobial property, antioxidant capacity and cytotoxicity of essential oil from cumin produced in Iran. *Journal of food science*, *75*(2), H54-H61. http://onlinelibrary.wiley.com/doi/10.1111/j.1750-3841.2009.01467.x/abstract;jsessionid=65EF089524BDD7389F49AE6ACAFED00C.f01t02?userIsAuthenticated=false&deniedAccessCustomisedMessage=

[3] An, X., Zhang, X., Yao, H., Li, H., & Ren, J. (2015). Effects of Diallyl Disulfide in Elephant Garlic Extract on Breast Cancer Cell Apoptosis in Mitochondrial Pathway. *Journal of Food and Nutrition Research*, *3*(3), 196-201.

[4] Apostolou, P., & Fostira, F. (2013). Hereditary breast cancer: the era of new susceptibility genes. *BioMed research international*, *2013*.

[5] Asif, M. (2015). Chemistry and antioxidant activity of plants containing some phenolic compounds. *Chemistry International*, *1*(1), 35-52. https://www.researchgate.net/profile/Chemistry_International/publication/270645859_Chemistry_and_antioxidant_activity_of_plants_containing_some_phenolic_compounds/links/54b13a340cf2318f0f9253bc.pdf

[6] Azmi, L., Ojha, S. K., & Rao, C. V. (2015). CURCUMIN: BOON FOR HUMAN BEING. http://journal.waocp.org/article_16296_a362663663e67cc5480e6df239532cf7.pdf

[7] Bakkali, F., Averbeck, S., Averbeck, D., & Idaomar, M. (2008). Biological effects of essential oils–a review. *Food and chemical toxicology*, *46*(2), 446-475. http://www.sciencedirect.com/science/article/pii/S0278691507004541

[8] Banerjee, S., Sharma, R., Kale, R. K., & Rao, A. R. (1994). Influence of certain essential oils on carcinogen-metabolizing enzymes and acid-soluble sulfhydryls in mouse liver.

[9] Basch, E., Ulbricht, C., Hammerness, P., Bevins, A., & Sollars, D. (2004). Thyme (Thymus vulgaris L.), thymol. *Journal of herbal pharmacotherapy*, *4*(1), 49-67.

[10] Bhat, H. P., Jakribettu, R. P., Boloor, R., Fayad, R., & Baliga, M. S. (2015). Use of Ayurvedic Medicinal Plants as Immunomodulators in Geriatrics: Preclinical Studies. *Foods and Dietary Supplements in the Prevention and Treatment of Disease in Older Adults*, 143.

[11] Braddock, S., Kercher, J., & Edney, J. (2014). *Straight Talk about Breast Cancer: From Diagnosis to Recovery*. Addicus Books.
[12] Breast Cancer Clinical Practice Guidelines in Oncology. (2003). *Journal of The National Comprehensive Cancer Network*, *1*(2), 148-148. Retrieved from http://www.jnccn.org/content/1/2/148.long
[13] BSW, D. S. T., Drory, M., Ginzburg, K., & Stadler, J. (2008). Stages of Breast Cancer. *Journal of Psychosocial Oncology*. http://www.tandfonline.com/doi/abs/10.1300/J077v17n03_04
[14] Budhwaar, V. (2013). *The secret benefits of ginger and turmeric*. Sterling Publishers Pvt. Ltd.
[15] Chattopadhyay, I., Biswas, K., Bandyopadhyay, U., & Banerjee, R. K. (2004). Turmeric and curcumin: Biological actions and medicinal applications. *CURRENT SCIENCE-BANGALORE-*, *87*, 44-53. http://repository.ias.ac.in/5196/1/306.pdf
[16] Choumessi, A. T., Loureiro, R., Silva, A. M., Moreira, A. C., Pieme, A. C., Tazoacha, A., &Penlap, V. B. (2012). Toxicity evaluation of some traditional African spices on breast cancer cells and isolated rat hepatic mitochondria. *Food and chemical toxicology*, *50*(11), 4199-4208.http://www.sciencedirect.com/science/article/pii/S0278691512005662
[17] Chua, D. T., Sham, J. S., Wei, W. I., Ho, W. K., & Au, G. K. (2001). The predictive value of the 1997 American Joint Committee on Cancer stage classification in determining failure patterns in nasopharyngeal carcinoma. *Cancer*, *92*(11), 2845-2855.
[18] Damašius, J., Venskutonis, P. R., Ferracane, R., & Fogliano, V. (2011). Assessment of the influence of some spice extracts on the formation of heterocyclic amines in meat. *Food Chemistry*, *126*(1), 149-156.
[19] Darvesh, A., B Aggarwal, B., & Bishayee, A. (2012). Curcumin and liver cancer: a review. *Current pharmaceutical biotechnology*, *13*(1), 218-228.
[20] Dibble, S. L., Luce, J., Cooper, B. A., Israel, J., Cohen, M., Nussey, B., & Rugo, H. (2007, July). Acupressure for chemotherapy-induced nausea and vomiting: a randomized clinical trial. In *Oncology nursing forum* (Vol. 34, No. 4, p. 813). ONCOLOGY NURSING SOCIETY.
[21] Do, M. T., Kim, H. G., Choi, J. H., Khanal, T., Park, B. H., Tran, T. P., & Jeong, H. G. (2013). Antitumor efficacy of piperine in the treatment of human HER2-overexpressing breast cancer cells. *Food chemistry*, *141*(3), 2591-2599.
[22] Ellis, M. J., Suman, V. J., Hoog, J., Lin, L., Snider, J., Prat, A., & Esserman, L. J. (2011). Randomized phase II neoadjuvant comparison between letrozole, anastrozole, and exemestane for postmenopausal women with estrogen receptor–rich stage 2 to 3 breast cancer: clinical and biomarker outcomes and predictive value of the baseline PAM50-based intrinsic subtype—ACOSOG Z1031. *Journal of clinical oncology*, *29*(17), 2342-2349. http://jco.ascopubs.org/content/29/17/2342.short
[23] Esteller, M. (2007). Cancer epigenomics: DNA methylomes and histone-modification maps. *Nature Reviews Genetics*, *8*(4), 286-298.http://www.nature.com/nrg/journal/v8/n4/abs/nrg2005.html
[24] Gali-Muhtasib, H., El-Najjar, N., & Schneider-Stock, R. (2006). The medicinal potential of black seed (Nigella sativa) and its components. *Advances in Phytomedicine*, *2*, 133-153.
[25] Goroll, A. H., & Mulley, A. G. (2012). *Primary care medicine: Office evaluation and management of the adult patient*. Philadelphia: Lippincott Williams & Wilkins.
[26] Greene, F. L., Balch, C. M., Fleming, I. D., Fritz, A., Haller, D. G., Morrow, M., & Page, D. L. (Eds.). (2002). *AJCC cancer staging handbook: TNM classification of malignant tumors*. Springer Science & Business Media.
[27] Gruenwald, J., Freder, J., & Armbruester, N. (2010). Cinnamon and health. *Critical reviews in food science and nutrition*, *50*(9), 822-834. http://www.tandfonline.com/doi/abs/10.1080/10408390902773052
[28] Gunn, E. J., Williams, J. T., Huynh, D. T., Iannotti, M. J., Han, C., Barrios, F. J., & Kirshner, J. (2011). The natural products parthenolide and andrographolide exhibit anti-cancer stem cell activity in multiple myeloma. *Leukemia & lymphoma*, *52*(6), 1085-1097.
[29] Gupta, G. P., & Massagué, J. (2006). Cancer metastasis: building a framework. *Cell*, *127*(4), 679-695.
[30] Guruvayoorappan, C., Sakthivel, K. M., Padmavathi, G., Bakliwal, V., Monisha, J., & Kunnumakkara, A. B. (2015). Cancer Preventive and Therapeutic Properties of Fruits and Vegetables: An Overview. In *ANTICANCER PROPERTIES OF FRUITS AND VEGETABLES: A Scientific Review* (pp. 1-52).
[31] Habib, S. H. M., Makpol, S., Hamid, N. A. A., Das, S., Ngah, W. Z. W., & Yusof, Y. A. M. (2008). Ginger extract (Zingiber officinale) has anti-cancer and anti-inflammatory effects on ethionine-induced hepatoma rats. *Clinics*, *63*(6), 807-813.
[32] Hamidpour, R., Hamidpour, M., Hamidpour, S., & Shahlari, M. (2015). Cinnamon from the selection of traditional applications to its novel effects on the inhibition of angiogenesis in cancer cells and prevention of

Alzheimer's disease, and a series of functions such as antioxidant, anticholesterol, antidiabetes, antibacterial, antifungal, nematicidal, acaracidal, and repellent activities. *Journal of traditional and complementary medicine*, *5*(2), 66-70.

[33] Hammar, Samuel P. (2016). Cancer. In *AccessScience*. McGraw-Hill Education. http://dx.doi.org/10.1036/1097-8542.105800

[34] Harjotaruno, S., Widyawaruyanti, A., & Zaini, N. C. (2008). Apoptosis Inducing Effect of Andrographolide On TF-47 Human Breast Cancer Cell Line. *African Journal of Traditional, Complementary and Alternative Medicines*, *4*(3), 345-351.

[35] Herdwiani, W. (2016). A review of cinnamon as a potent anticancer. *Asian Journal of Pharmaceutical and Clinical Research*, 9-11.

[36] Hsu, Y. L., Hung, J. Y., Tsai, Y. M., Tsai, E. M., Huang, M. S., Hou, M. F., & Kuo, P. L. (2015). 6-shogaol, an active constituent of dietary ginger, impairs cancer development and lung metastasis by inhibiting the secretion of CC-chemokine ligand 2 (CCL2) in tumor-associated dendritic cells. *Journal of agricultural and food chemistry*, *63*(6), 1730-1738.

[37] Kakarala, M., Brenner, D. E., Korkaya, H., Cheng, C., Tazi, K., Ginestier, C., & Wicha, M. S. (2010). Targeting breast stem cells with the cancer preventive compounds curcumin and piperine. *Breast cancer research and treatment*, *122*(3), 777-785.

[38] Khan, A., Chen, H. C., Tania, M., & Zhang, D. Z. (2011). Anticancer activities of Nigella sativa (black cumin). *African Journal of Traditional, Complementary and Alternative Medicines*, *8*(5S). http://www.ajol.info/index.php/ajtcam/article/view/67964

[39] Kikuzaki, H., Kawai, Y., & Nakatani, N. (2001). 1, 1-Diphenyl-2-picrylhydrazyl radical-scavenging active compounds from greater cardamom (Amomum subulatum Roxb.). *Journal of nutritional science and vitaminology*, *47*(2), 167-171.

[40] Kim, N. D., Mehta, R., Yu, W., Neeman, I., Livney, T., Amichay, A., & Mansel, R. (2002). Chemopreventive and adjuvant therapeutic potential of pomegranate (Punicagranatum) for human breast cancer. *Breast cancer research and treatment*, *71*(3), 203-217.http://link.springer.com/article/10.1023/A:1014405730585#page-1

[41] Kluth, D., Banning, A., Paur, I., Blomhoff, R., & Brigelius-Flohé, R. (2007). Modulation of pregnane X receptor-and electrophile responsive element-mediated gene expression by dietary polyphenolic compounds. *Free Radical Biology and Medicine*, *42*(3), 315-325. http://www.sciencedirect.com/science/article/pii/S0891584906006630

[42] Kocaadam, B., & Şanlier, N. (2015). Curcumin, an Active Component of Turmeric (Curcuma longa), and Its Effects on Health. *Critical reviews in food science and nutrition*, (just-accepted), 00-00.

[43] Koolen, B. B., Peeters, M. J. T. V., Aukema, T. S., Vogel, W. V., Oldenburg, H. S., van der Hage, J. A., & Emiel, J. T. (2012). 18F-FDG PET/CT as a staging procedure in primary stage II and III breast cancer: comparison with conventional imaging techniques. *Breast cancer research and treatment*, *131*(1), 117-126.

[44] Lai, L. H., Fu, Q. H., Liu, Y., Jiang, K., Guo, Q. M., Chen, Q. Y., & Shen, J. G. (2012). Piperine suppresses tumor growth and metastasis in vitro and in vivo in a 4T1 murine breast cancer model. *Acta Pharmacologica Sinica*, *33*(4), 523-530.

[45] Lambert, J. D., Hong, J., Kim, D. H., Mishin, V. M., & Yang, C. S. (2004). Piperine enhances the bioavailability of the tea polyphenol (−)-epigallocatechin-3-gallate in mice. *The Journal of nutrition*, *134*(8), 1948-1952.

[46] Lantz, R. C., Chen, G. J., Solyom, A. M., Jolad, S. D., & Timmermann, B. N. (2005). The effect of turmeric extracts on inflammatory mediator production. *Phytomedicine*, *12*(6), 445-452.

[47] Lawrence, M. S., Stojanov, P., Mermel, C. H., Robinson, J. T., Garraway, L. A., Golub, T. R., Getz, G. (2014). Discovery and saturation analysis of cancer genes across 21 tumour types. *Nature, 505*(7484), 495-501. doi:10.1038/nature12912

[48] Leber, M. F., & Efferth, T. (2009). Molecular principles of cancer invasion and metastasis (review). *International journal of oncology*, *34*(4), 881-895.

[49] Lee, H. S., Seo, E. Y., Kang, N. E., & Kim, W. K. (2008). [6]-Gingerol inhibits metastasis of MDA-MB-231 human breast cancer cells. *The Journal of nutritional biochemistry*, *19*(5), 313-319.

[50] Lesjak, M., Simin, N., Orcic, D., Franciskovic, M., Knezevic, P., Beara, I., & Mimica-Dukic, N. (2015). Binary and Tertiary Mixtures of Satureja hortensis and Origanum vulgare Essential Oils as Potent Antimicrobial Agents Against Helicobacter pylori. *Phytotherapy Research*.

[51] Litière, S., Werutsky, G., Fentiman, I. S., Rutgers, E., Christiaens, M. R., Van Limbergen, E., & Bartelink, H. (2012). Breast conserving therapy versus mastectomy for stage I–II breast cancer: 20 year follow-up of the EORTC 10801 phase 3 randomised trial. *The lancet oncology*, *13*(4), 412-419.

[52] Liu, Y., Yadev, V. R., Aggarwal, B. B., & Nair, M. G. (2010). Inhibitory effects of black pepper (Piper nigrum) extracts and compounds on human tumor cell proliferation, cyclooxygenase enzymes, lipid peroxidation and nuclear transcription factor-kappa-B. *Natural product communications*, *5*(8), 1253-1257.http://europepmc.org/abstract/med/20839630

[53] López-Lázaro, M. (2008). Anticancer and carcinogenic properties of curcumin: considerations for its clinical development as a cancer chemopreventive and chemotherapeutic agent. *Molecular nutrition & food research*, *52*(S1), S103-S127.

[54] Majdalawieh, A. F., & Carr, R. I. (2010).In vitro investigation of the potential immunomodulatory and anti-cancer activities of black pepper (Piper nigrum) and cardamom (Elettariacardamomum). *Journal of Medicinal Food*, *13*(2), 371-381.http://online.liebertpub.com/doi/abs/10.1089/jmf.2009.1131

[55] Milner, J. A. (2001). Mechanisms by which garlic and allyl sulfur compounds suppress carcinogen bioactivation. In *Nutrition and Cancer Prevention* (pp. 69-81). Springer US.

[56] Mock, C. D., Jordan, B. C., & Selvam, C. (2015). Recent advances of curcumin and its analogues in breast cancer prevention and treatment. *RSC Advances*, *5*(92), 75575-75588.

[57] Nicastro, H. L., Ross, S. A., & Milner, J. A. (2015). Garlic and onions: Their cancer prevention properties. *Cancer Prevention Research*, *8*(3), 181-189.

[58] Nirmal Babu, K., Divakaran, M., Yamuna, G., Ravindran, P. N., & Peter, K. V. (2016). Protocols for Improvement of Black Pepper (Piper nigrum L.) Utilizing Biotechnological Tools. *Protocols for In Vitro Cultures and Secondary Metabolite Analysis of Aromatic and Medicinal Plants, Second Edition*, 367-385.

[59] Pizzo, P. A., & Poplack, D. G. (2015). *Principles and practice of pediatric oncology*. Lippincott Williams & Wilkins.

[60] Puangsombat, K., Gadgil, P., Houser, T. A., Hunt, M. C., & Smith, J. S. (2012). Occurrence of heterocyclic amines in cooked meat products. *Meat Science, 90*(3), 739-746. doi:10.1016/j.meatsci.2011.11.005

[61] Ramírez-Gómez, K., Moguel-Ordoñez, Y., Segura-Campos, M. R., Ruiz-Ruiz, J. C., Chel-Guerrero, L. A., & Betancur-Ancona, D. A. (2016). Antioxidant Capacity of Capsicum chinense Genotypes. In *Functional Properties of Traditional Foods* (pp. 241-249). Springer US.

[62] Ravindran, P. N. (Ed.). (2003). *Black pepper: Piper nigrum*. CRC Press.

[63] Ravindran, P. N., Babu, K. N., & Sivaraman, K. (Eds.). (2007). *Turmeric: the genus Curcuma*. CRC Press.

[64] Reverter, M., Bontemps, N., Lecchini, D., Banaigs, B., & Sasal, P. (2014). Use of plant extracts in fish aquaculture as an alternative to chemotherapy: current status and future perspectives. *Aquaculture*, *433*, 50-61.

[65] Richard, T. S., Kamdje, A. H. N., & Mukhtar, F. (2015). Medicinal plants in breast cancer therapy. *J Dis Med Plants*, *1*, 19-23

[66] Rosen, J. M., & Jordan, C. T. (2009). The increasing complexity of the cancer stem cell paradigm. *science*, *324*(5935), 1670-1673.

[67] Sankar, R., Karthik, A., Prabu, A., Karthik, S., Shivashangari, K. S., & Ravikumar, V. (2013). Origanum vulgare mediated biosynthesis of silver nanoparticles for its antibacterial and anticancer activity. *Colloids and Surfaces B: Biointerfaces*, *108*, 80-84.

[68] Sawadogo, W. R., Schumacher, M., Teiten, M. H., Cerella, C., Dicato, M., & Diederich, M. (2013). A survey of marine natural compounds and their derivatives with anti-cancer activity reported in 2011. *Molecules*, *18*(4), 3641-3673.

[69] Schafer, G., & Kaschula, C. (2014). The immunomodulation and anti-inflammatory effects of garlic organosulfur compounds in cancer chemoprevention. *Anti-Cancer Agents in Medicinal Chemistry (Formerly Current Medicinal Chemistry-Anti-Cancer Agents)*, *14*(2), 233-240.

[70] Sears, S. R., Stanton, A. L., & Danoff-Burg, S. (2003). The yellow brick road and the emerald city: benefit finding, positive reappraisal coping and posttraumatic growth in women with early-stage breast cancer. *Health Psychology*, *22*(5), 487.

[71] Sengupta, A., & Bhattachanjee, S. (2009). *Cardamom (Elettaria cardamomum) and its active constituent, 1, 8-cineole* (pp. 65-86). B. B. Aggarwal, & A. B. Kunnumakkara (Eds.). World Scientific Publishing, Singapore.

[72] Sherr, C. J. (1996). Cancer cell cycles. *Science*, *274*(5293), 1672-1677.

[73] Shishodia, S., Chaturvedi, M. M., & Aggarwal, B. B. (2007). Role of curcumin in cancer therapy. *Current problems in cancer*, *31*(4), 243-305. http://www.sciencedirect.com/science/article/pii/S0147027207000219

[74] Shukla, Y., & Kalra, N. (2007). Cancer chemoprevention with garlic and its constituents. *Cancer letters*, *247*(2), 167-181.
[75] Shukla, Y., & Singh, M. (2007). Cancer preventive properties of ginger: a brief review. *Food and chemical toxicology*, *45*(5), 683-690. http://www.sciencedirect.com/science/article/pii/S027869150600322X
[76] Singh, G., Maurya, S., & Catalan, C. A. (2007). A comparison of chemical, antioxidant and antimicrobial studies of cinnamon leaf and bark volatile oils, oleoresins and their constituents. *Food and chemical toxicology*, *45*(9), 1650-1661. http://www.sciencedirect.com/science/article/pii/S0278691507000889
[77] Singletary, K. (2016). Thyme: History, Applications, and Overview of Potential Health Benefits. *Nutrition Today*, *51*(1), 40-49.
[78] Skoula, M., & Harborne, J. B. (2002). 3 The taxonomy and chemistry of Origanum. *Oregano: the genera Origanum and Lippia*, 67.
[79] Sobin, L. H., & Fleming, I. D. (1997). TNM classification of malignant tumors, (1997). *Cancer*, *80*(9), 1803-1804.
[80] Sotiriou, C., Neo, S. Y., McShane, L. M., Korn, E. L., Long, P. M., Jazaeri, A., & Liu, E. T. (2003). Breast cancer classification and prognosis based on gene expression profiles from a population-based study. *Proceedings of the National Academy of Sciences*, *100*(18), 10393-10398.http://www.pnas.org/content/100/18/10393.short
[81] Stephens, P. J., Tarpey, P. S., Davies, H., Van Loo, P., Greenman, C., Wedge, D. C., & Yates, L. R. (2012). The landscape of cancer genes and mutational processes in breast cancer. *Nature*, *486*(7403), 400-404.
[82] Surh, Y. J. (2003). Cancer chemoprevention with dietary phytochemicals. *Nature Reviews Cancer*, *3*(10), 768-780.
[83] Tan, B. K., & Vanitha, J. (2004). Immunomodulatory and antimicrobial effects of some traditional Chinese medicinal herbs: a review. *Current Medicinal Chemistry*, *11*(11), 1423-1430. http://www.ingentaconnect.com/content/ben/cmc/2004/00000011/00000011/art00006
[84] Tavassoli, F. A., & Devilee, P. (2003). *Pathology and genetics of tumours of the breast and female genital organs*. Iarc.
[85] Tseng, T. H., Chien, M. H., Lin, W. L., Wen, Y. C., Chow, J. M., Chen, C. K., & Lee, W. J. (2016). Inhibition of MDA-MB-231 breast cancer cell proliferation and tumor growth by apigenin through induction of G2/M arrest and histone H3 acetylation-mediated p21WAF1/CIP1 expression. *Environmental toxicology*. https://www.ncbi.nlm.nih.gov/pubmed/26872304
[86] Vogelstein, B., & Kinzler, K. W. (2004). Cancer genes and the pathways they control. *Nature medicine*, *10*(8), 789-799.
[87] Wells, J. E., Howlett, M., Cole, C. H., & Kees, U. R. (2015). Deregulated expression of connective tissue growth factor (CTGF/CCN2) is linked to poor outcome in human cancer. *International Journal of Cancer*, *137*(3), 504-511.
[88] What is cancer? A guide for patients and families. (n.d.). Retrieved April 11, 2016, from http://www.cancer.org/cancer/cancerbasics/what-is-cancer
[89] Wogan, G. N., Hecht, S. S., Felton, J. S., Conney, A. H., & Loeb, L. A. (2004, December). Environmental and chemical carcinogenesis. In *Seminars in cancer biology* (Vol. 14, No. 6, pp. 473-486). Academic Press.
[90] Wu, J. E., Lin, J., & Zhong, Q. (2014). Physical and antimicrobial characteristics of thyme oil emulsified with soluble soybean polysaccharide. *Food Hydrocolloids*, *39*, 144-150. http://www.sciencedirect.com/science/article/pii/S0268005X14000022
[91] Yang, C., Su, X., Liu, A., Zhang, L., Yu, A., Xi, Y., & Zhai, G. (2013). Advances in clinical study of curcumin. *Current pharmaceutical design*, *19*(11), 1966-1973.
[92] Yarney, J., Donkor, A., Opoku, S. Y., Yarney, L., Agyeman-Duah, I., Abakah, A. C., & Asampong, E. (2013). Characteristics of users and implications for the use of complementary and alternative medicine in Ghanaian cancer patients undergoing radiotherapy and chemotherapy: a cross-sectional study. *BMC complementary and alternative medicine*, *13*(1), 1.
[93] Zarzuelo, A., & Crespo, E. (2002). The medicinal and non-medicinal uses of thyme. *Thyme: The Genus Thymus*, 263-292.
[94] Zhuang, S. R., Chiu, H. F., Chen, S. L., Tsai, J. H., Lee, M. Y., Lee, H. S., & Wang, C. K. (2012). Effects of a Chinese medical herbs complex on cellular immunity and toxicity-related conditions of breast cancer patients. *British Journal of Nutrition*, *107*(05), 712-

718.http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=8487237&fileId=S0007114511100345X