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Mini Review

The Use of Plant Products in Cancer Chemotherapy

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Abstract

Plants have been used since the existence of man for food. Plants and plant products are easily biodegradable, unlike synthetic products. In Nigeria, people have been dependent on plant materials largely for food and drugs. Thus, many people lived very long and it was common to see people who lived over 90 years in the past twenty to thirty years, up till the 1970s. In the past era, many plant extracts and fractions were used in the treatment of various diseases including various forms of cancers. In the present era, plants and their products have been jettisoned in the treatment of diseases and as food. This has led to early death in many Nigerian communities and diseases such as cancer are on the increase. This mini-review highlights some plant products that are being tested for use and those that are already in use for cancer chemotherapy.

Introduction

In the 1970s, I was a small boy in primary and secondary school up to the early 1980s. I remember vividly that in my small village in Nigeria, there were over a hundred people who lived up to eighty years and above. Most were bent and used walking sticks due to old age. The reason for their longevity was that they depended fully on natural products for both food and drugs.

In those years, the forest environment was filled with snails which they gathered and sold on market days. On certain days, women would shout out that some mushrooms had been discovered and the entire village women and girls would rush into the forest to harvest the mushrooms which they used for culinary purposes. In addition to these culinary ingredients were bush meat which men would kill and they would use for cooking. The only culinary ingredient that was lacking was salt. Soups and allied products were sweetened with condiments of fermented seeds of *Prosopis africana* [1,2]. Thus, all the food materials came from natural sources. It should be noted that the meat the natives ate then, also fed on herbs, and as such the meat was very healthy as some of the remnants of the herbal products in the body of the animals acted as immune stimulators that strengthened the human immune system. Similarly, when these natives were sick, they depended fully on plant products for their healing.

It should be noted that in those days health centres and hospitals were located very far away. Sometimes they were located over two hundred kilometres and going to such a distant place was never thought of by the natives. Only a few people who were wealthy or had wealthy relatives could be taken to such a place. Most who were taken there never returned alive. As such, it was those whose illnesses had become excessive were taken to health facilities located very far away.

I can remember very vividly that children born then were taken care of using plant and herbal materials. When any of these children developed malaria with resultant tropical splenomegaly syndrome, their mothers would send someone to the nearby forest to harvest some roots of *Alchormenea*

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deformis and this would be boiled and the decoction would be given to the child, and in a day or so, the child would recover. In the same way, I can remember a woman who developed anasarca (general body swelling) and the natives would grind a mixture of plant parts and the person would recover in a few weeks. Some of these generalized swellings might have been caused by cancer and that is what we want to talk about in this paper. It should be noted that these local people used herbs that prolonged their lives while today, it is difficult to see any person that lives up to eighty years. Anyone who lives up to eighty years is celebrated. As food and drugs began to be modernized, cancer and other diseases began to multiply among the people. The average lifespan of a Nigerian began to be reduced and currently, it is just about fifty-eight for women and fifty-six for men [3]. Many food sweeteners such as monosodium glutamate are leading to various forms of diseases such as cancer. There are other variants of these food sweeteners now. Others are used to sweeten drinks.

Recent estimates show that the burden of cancer is rising and is projected to rise much faster in developing countries because of some of the issues raised above [4]. The total number of new cases in Nigeria in 2020 was 124,815, of which 51,398 occurred in males with prostate cancer as the commonest at 29.8% and 73,417 occurred in females with breast cancer being the commonest at 38.7%, followed by cancer of the cervix at 16.4% [5]. Excluding nonmelanoma skin cancer, the top five most frequent cancers in males were prostate, colorectal, non-Hodgkin lymphoma, liver, and leukemia. In females, the top five were breast, cervical, non-Hodgkin lymphoma, ovarian, and colorectal. There were an estimated 78,889 cancer deaths with 34,200 in males and 44,699 in females [6]. This paper concentrates on the use of plant products for cancer treatment.

What is Cancer?

Cancer is a disease in which some of the body's cells grow uncontrollably and spread to other parts of the body [7]. The medical study of cancer is called oncology and those who specialize in it are called oncologists.

Cancer can start almost anywhere in the human body, which is made up of trillions of cells. Normally, human cells grow and multiply (through a process called cell division or mitosis) to form new cells as the body needs them. When cells grow old or become damaged, they die, and new cells take their place.

Sometimes this orderly process breaks down, and abnormal or damaged cells grow and multiply when they should not. These cells may form tumours, which are lumps of tissue. Tumours can be cancerous or not cancerous (benign).

Cancerous tumours spread into, or invade, nearby tissues and can travel to distant places in the body to form new tumours (a process called metastasis). Cancerous tumours may also be called malignant tumours. Many cancers form solid tumours, but cancers of the blood, such as leukemias, generally do not.

Benign tumours do not spread into, or invade, nearby tissues. When removed, benign tumours usually do not grow back, whereas cancerous tumours sometimes do. Benign tumours can sometimes be quite large, however. Some can cause serious symptoms or be life-threatening, such as benign tumours in the brain.

Plant sources as cancer agents

Plant sources of anti-cancer agents are plants, the derivatives of which have been shown to be usable for the treatment or prevention of cancer in humans [8,9].

In the 1950s, scientists began systematically examining natural organisms as a source of useful anti-cancer substances [8]. It has been argued that the use of natural products has been the single most successful strategy in the discovery of novel medicines [10].

Plants need to defend themselves from attack by micro-organisms, in particular fungi, and they do this by producing anti-fungal chemicals that are toxic to fungi. Because fungal and human cells are similar at a biochemical level, it is often the case that chemical compounds intended for plant defence have an inhibitory effect on human cells, including human cancer cells [11]. Those plant chemicals that are selectively more toxic to cancer cells than normal cells have been discovered in screening programs and developed as chemotherapy drugs [12].

Research and development process

Some plants that indicate potential as an anticancer agent in laboratory-based *in vitro* research – for example, *Typhonium flagelliforme*, and *Murraya koenigii* [13] are currently being studied. There can be many years between promising laboratory work and the availability of an effective anti-cancer drug. Monroe Eliot Wall discovered anti-cancer properties in *Camptotheca* in 1958, but it was not until 1996 – after further research and rounds of clinical trials – that topotecan, a synthetic derivative of a chemical in the plant, was approved for use by the US Food and Drug Administration [7,14].

Currently, few plant extracts and products are currently being used to treat various forms of cancer. It should be noted, however, that a lot of plant products exist that have shown very promising anti-cancer properties *in vitro* and need to be evaluated in clinical trials for human use. A lot of research is needed to determine the efficacy of these plant products in treating cancers of various forms and origins. This is because, with the changes in the diets of various people globally, cancer diseases are on the rise [15].

***Camptotheca acuminate*:** The cancer treatment drug topotecan is a synthetic chemical compound similar in chemical structure to camptothecin which is found in extracts of *Camptotheca* (happy tree) [7]. The bark and stems of *Camptotheca acuminata* contain the alkaloid camptothecin. Several chemical derivatives of camptothecin are under investigation or used as drugs for cancer treatment, including irinotecan, topotecan, and rubitecan. *Camptotheca acuminata* also contains the chemical compounds trifolin and hyperoside [14].

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Catharanthus roseus: Vinca alkaloids were originally manufactured by extracting them from *Catharanthus* (Madagascar Periwinkle) [8]. *Catharanthus roseus*, commonly known as Vinca Rosea or Madagascar periwinkle, is a significant plant species within the Apocynaceae family, known for its diverse medicinal properties and ornamental attributes, long embraced by Chinese traditional medicine practices [16]. Many alkaloids from this plant have been used in the treatment of various cancer diseases [17].

***Podophyllum spp.*:** Two chemotherapy drugs, etoposide and teniposide, are synthetic chemical compounds similar in chemical structure to the toxin podophyllotoxin which is found in *Podophyllum peltatum* (May Apple) [8]. The toxin from this plant from this plant has been used for various forms of cancer including breast cancer [18].

***Taxus brevifolia*:** Chemicals extracted from clippings of *Taxus brevifolia* (Pacific yew) have been used as the basis for two chemotherapy drugs, docetaxel and paclitaxel [19]. The popular anticancer drug used for treatment, particularly for breast cancer, Paclitaxel, is derived from this plant.

***Euphorbia peplus*:** Contains ingenol mebutate (Picato) which is used to treat skin cancer [20]. The sap from this plant is known to be effective in the treatment of human skin cancers.

***Maytenus ovatus*:** Trastuzumab emtansine (Kadcyla) is an antibody conjugated to a synthetic derivative of the cytotoxic principle of the Ethiopian plant *Maytenus ovatus*. It is used to treat breast cancer [21]. Maytansine, a benzo-ansamacrolide (ansamycin antibiotic) is a highly potent compound that induces mitotic arrest and kills tumor cells at sub-nano-molar concentrations.

***Mappia foetida*:** Some of the research has been showing that it has an effective anticancer property against breast cancer [8]. *Mappia foetida* also contains camptothecin used in the treatment of cancer.

Conclusion

The average age of Nigerians has decreased and this may be dependent on many factors such as food, Western-type drugs, lifestyle, and so on. Many natives depended on plants and herbs for their sources of food and drugs. With the changes in the consumption of Western-type drugs and food, cancer diseases too have increased. These cancer diseases were treated with mainly herbs and plant extractives. Thus, there is a need for greater study of pharmacogenetics before certain Western drugs and food are used in various parts of the world, particularly among some African populations. There is also the need for further studies on various tropical plants for use in cancer chemotherapy. It should be noted that most of these tropical plants are used for food in one part of the continent or the other. Thus, there is little concern as far as toxicity is concerned. Various plants may also possess different healing properties and should be evaluated.

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