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Future Microbiology 2020 Impact of Cancer-Causing Metabolites on Our Lives and Their Effects on Human Health

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Invisible living Creatures were responsible for disease Did you know that you're mostly a microbe? There are more microbial cells in your body than your own cells. Everywhere you look, even though you can't see them, there is a hidden world of microorganisms. They had been on earth for some 4000 million years when Anthony van Leeuwenhock started his pioneering microscope work in 1673.

Microbiology is the scientific study of this hidden world of organisms that affect our health, help make our food, and influence our environment.

Over many decades, a plethora of bacteria, viruses and fungi were isolated and designated etiological agents of human infection disease. As with many instances at the interference between cause and effective therapy, the further characterization of these alleged pathogens remained in the hands of a few devoted investigators until drugs with therapeutic potential became available . This vague period before the advent of proper cures for infection explain the shadowy origin of clinical or diagnostic microbiology. As example, trying to clarify my idea, right now we are living with a large fear from a super tiny microorganism, sure I am talking about COVID-19 that we are currently suffering from. There is every day a large number of infected people, with a very high mortality rate due to this dangerous Virus, that's why all of us are still waiting for the cure, crossing our fingers and hoping to find the magical vaccine after this very long time. This is what I called the ''shadowy and vague period''.

Most of the microbes, or bacteria, in your body are meant to be there and are called "Resident bacteria". These bacteria that are well-established residents of your body, especially the skin and gut. Despite all the good microbes do, when we hear news stories about microbes, it is usually about pathogens.

Pathogens are the invading microbes in our bodies that make us sick. It is usually our immune system's reaction to foreign microbial invaders that give us the crummy symptoms, like a fever or stomachache.

Viruses are a different story. They can only reproduce by using a host cell. Sometimes this can be other bacteria, and sometimes this can be the cells in your body.

Fungi, have both positive and negative roles in our daily life, so they are our friends as well as enemy.

Parasites are commonly seen in a host organism and gets its food from or at the expense of its host. There are three main classes of parasites that can cause disease in humans: Protozoa, helminths and ectoparasites.

As well, we can say that the effect of some viruses, bacteria, fungi.. are supposed to be acute with symptoms. Other, can have a chronic effects such as liver cancer, reduction of immunity, alterations in the protein metabolism, gangrene, convulsion, respiratory problems …. So in your opinion what would be scarier? Microorganisms with acute effects or malignant microorganisms with chronic and hidden side effects?

I knew both of them are effectively dangerous but I believe that each and every year the number of deaths caused by cancer is largely above the number of deaths caused by acute symptoms causing microorganisms such as coronavirus.

Even though, all of us knew that bacteria and viruses are the most common in our environment, but what

about fungi? Specially that nowadays the importance of fungal infection become much more known and much more interesting (as example concerning the situation we are living now, there is a recently published study talking about the effect of COVID-19 on patients with pulmonary Aspergillosis disease, showing us that the mortality rate increase due to the infection by coronavirus if the infected patient is also suffering from pulmonary Aspergillosis).

In my research, I was focused on one of the most ridicules clever fungi, frequently found in food and indoor environment. This one is capable to synthesis one of the grave metabolite, classified as the first cancer causing and immuno-suppressive agent released by fungal microorganisms.

The interest of microbiologists in fungal contaminants of food production and environment is still increasing and there is a need to study these microorganisms in more detail. Although, Fungi producing toxins or which causing health hazards, are ubiquitous and belongs to the common contamination mycobiota.

Many type of food could be contaminated by various numbers of fungi, such as cereals, nuts, almond, milk, peanuts, dried fruits and many more. In foods spoiled by Fungi it is often possible to observe the responsible fungal growth directly by the naked eye and/ or by observation in stereomicroscope. This is due to the size of the fungal colony and that fungal growth normally takes place on the surface of the product.

By definition, a heat resistant fungus produces propagule that can survive a heat treatment for at least 30 minutes at 75 Celsius degree. These propagules are often called ascospores, but also structures like sclerotia, chlamydospores and thick walls hyphae are able to withstand higher temperatures.

In my study, i tried to see how much nuts, dried fruits and spices could be contaminated, also, I tried to evaluate the correlated risk and side effects of this contamination. As well, I studied the effect of many environmental conditions on the growth of several types of fungi, such as Temperature, humidity…

Molecular, morphological and metabolic studies was done on the samples collected from all over Lebanon. Here, I have to mention the important role of the molecular technics, helping us a lot in our microbiological studies, especially the important role of RT-PCR (Real Time Polymerase Chain Reaction), a method widely used to rapidly make millions to billions of copies of a specific DNA sample, allowing us to take a very small sample of DNA and amplify it to a large enough amount to study in detail, helping us to identify the microbe we are searching for.

In this article I am going to show you some of the results I have obtained while studying the spices samples collected from the Lebanese territory as I mentioned before.

Spices can be contaminated with various hazards , among which toxigenic fungi are probably the most important. Indeed, some fungal species produce toxic secondary metabolites named mycotoxins as they develop on human food and animal feed . Among the hundreds of known mycotoxins, aflatoxins are the major ones for public health because they are the most potent of the known natural carcinogens, and the International Agency for Research on Cancer classified aflatoxin B1 (AFB1) in the group of molecules that are carcinogenic for both humans and animals (group 1). Chronic exposure to AFB1 is a major cause of hepatocarcinoma and this food contaminant has been associated with the highest number of DALYs (deaths and disability adjusted life years). Aflatoxins may contaminate many foods including cereals, dry fruits, and groundnuts. They are also frequent contaminants of spices. Indeed, spices are mainly produced in areas where both temperature and humidity favour fungal development and subsequent toxinogenesis. Methods of post-harvest processing (sun drying, handling, storage) ca n also allow secondary contamination and the development of moulds. Previous studies have demonstrated that spices can be contaminated by mycotoxins and thus represent a direct source of exposure for consumers, as recapitulated in a recent review. That is why spices are specifically concerned by regulations on aflatoxins. For instance, the E.U. regulation restricts contamination to 10 µg/kg for total aflatoxins and 5 µg/kg for AFB1. However, contamination of spices may exceed regulations and justify the withdrawal of contaminated products. As

an illustration, in 2016, the European Rapid Alert System for Food and Feed recorded 79 notifications of mycotoxin contamination of spices and herbs, most of which corresponded to the presence of aflatoxin B1 at levels exceeding European limits.

Aflatoxins are produced by different fungal species that belong to the genus Aspergillus and more specifically to the Flavi section. For years, three main aflatoxigenic species were commonly considered in the section Flavi: A. flavus, A. parasiticus and A. nomius. In the last decade, the use of molecular tools enabled the identification of new species belonging to the section Flavi, comprising 33 different species, of which 16 are aflatoxigenic. These species can be distinguished by subtle morphological specificities, molecular changes in some gene sequences, and, most importantly, through their ability to produce different mycotoxins. Indeed, some species, including A. flavus, A. pseudotamarii and A. togoensis, produce aflatoxins of B type, whereas others, including A. parasiticus, A. minisclerotigenes, A. mottae, A. nomius, A. parvisclerotigenus, A. arachidicola and A. korhogoensis produce both B and G type aflatoxins. Some species may also produce other toxic secondary metabolites such as cyclopiazonic acid.

So the aim of this study was to finely characterize the Aspergillus section Flavi that can contaminate spices marketed in Lebanon and to determine the toxigenic potential of the isolated strains.

Spices are used extensively in Lebanon not only to flavour foods but also for their medicinal properties. To date, no data are available regarding the nature of the toxigenic fungal species that may contaminate these products at the marketing stage in this country. Eighty samples corresponding to 14 different types of spices were collected throughout Lebanon to characterize the Aspergillus section Flavi contaminating spices marketed in Lebanon and the toxigenic and carcinogenic potential of these fungal species. Most fungal genera and species were identified as belonging to Aspergillus section Flavi. Aspergillus flavus was the most frequent species, representing almost 80% of the isolates. Although identified as A. flavus by molecular analysis, some strains displayed atypical morphological features. Seven strains of Aspergillus tamarii and one Aspergillus minisclerotigenes were also isolated. Analyses of toxigenic potential demonstrated that almost 80% of strains were able to produce mycotoxins, 47% produced aflatoxins, and 72% produced cyclopiazonic acid, alone or in combination with aflatoxins

As a conclusion, microbiology has proved to be one of the most important disciplines in biology, making it possible to identify how some of these organisms cause diseases. Advances in microbiology are largely driven by improvements in technology and this technology is still going on.

In the process, we have still discovered perhaps 1% of all microorganisms, and possibly an even lower percentage. Microbiology has come a long way , and has a longer way to go.

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