As a result of the destruction of entomophagous organisms, mass reproduction of pests occurs. The initial treatment with biocides was aimed to prevent these species from reproducing. Cases of mass reproduction of spider mites, red fruit mites, beet and cabbage aphids, etc. are known (Thomas & Brooks, 2010). During chemical treatments of cultivated crops, bees, bumblebees, and other plant pollinators die. The use of integrated protection systems can normalize the natural relationships of organisms in biocenosis (Little, 2007). With the intensive cultivation of agricultural land using biocides and violation of instructions of their use, poisoning of birds, especially chicks, has been reported (Møretrø & Langsrud, 2017).

In fields and forests, when using biocides, hares, foxes, and other warm-blooded animals die. The most dangerous substances for them are organochlorine and organophosphorus compounds (Gil & Sinfort, 2005). After being washed out of the soil during rains, biocides infiltrate reservoirs. Massive death of fish can be observed in this case. Also, poisonous chemicals accumulate in fish tissues and aquatic plants. Organophosphorus compounds, synthetic pyrethroids, and most biocides are less toxic to fish compared to dinitrophenol compounds and chlorinated benzenes (Møretrø & Langsrud, 2017). The action of biocides on plants is determined by the anatomical, morphological, biological, and physiological-biochemical characteristics of the individual plant species (Paul, Chakraborty, & Mandal, 2019). The structure of the epidermis, the integrity of the cuticle, the presence of pubescence, and wax coating determine the retention of poisons on the plant, penetration and the degree of their impact.

4. The Impact of Biocides on the Human Organism

Humans come into contact with biocides during fieldwork, and on household plots. Harm can occur to them in the case of direct contact with drugs - through the skin, mucous membranes of the mouth, nose, and respiratory tract. Biocides can also enter the human body in food, which passes through the gastrointestinal tract. Entering the blood, poisonous substances are carried to internal organs. In the body, poisons undergo chemical transformations (oxidation, hydrolytic degradation, and other processes). In some cases, the poison is neutralized; in others, it turns into more toxic compounds. The liver plays an important role in the processes of neutralizing poisons (Gilbert & McBain, 2003). In the human body, poisons largely accumulate in adipose tissue and liver (Paul, Manna & Mandal, 2018). If the amount of poison released from the body (through the kidneys, gastrointestinal tract, skin and lungs) is less than the amount received during the same period, the poison accumulates in the body. Organochlorine and mercury biocides possess material accumulation (Passivirta, et al., 1983). Alternatively, biocides can be accumulated functionally. In this case, products of biocides metabolism are accumulated in the body. Some organophosphorus biocides possess functional accumulation, binding the cholinesterase enzyme in the body (Poole, 2002).

In humans, pesticide poisoning can be acute and chronic. With acute poisoning, a large dose of the poison enters the body immediately, causing a cessation of its functions with specific symptoms. Chronic poisoning occurs with prolonged re-entry of small doses of poison that can accumulate (Garry, Schreinemachers, Harkins, & Griffith, 1996). In addition to the toxic effect of biocides on humans and warm-blooded animals, they have skin-resorptive, blastogenic, and other negative effects (Gil & Sinfort, 2005).

For solving the problem of the impact of biocides on health and environment, priority must be given to the safety of agricultural products, as it is primarily by this route that biocides enter the human body. By employing "green" agriculture, such as cultivating crops hydroponically, or cleaning soil, this will ensure the ecological safety of agricultural products.

5. Green Biocides

Biocides can be classified into four categories, which are preservative, pest control, disinfectant, and other biocidal products (Ashraf et al., 2014). A substance such as a bactericide that causes minimal harm to the environment or destroys the growth of microorganisms is considered a green biocide. The significant requirements of any industrial biocide are to be effective against microorganisms, economical, and compatible with the environment where it is applied. Currently, there is a great need for green biocides that are less toxic, environmentally friendly, safe, and easy to handle and store. For any biocide to be declared a green biocide that is safe for living beings and the environment, it has at first to adhere to the 12 principles of green chemistry.

Further, a green biocide should be prepared from the least toxic renewable raw materials in a manner that avoids waste formation so that it would be cost-effective to produce. It ought to be prepared without solvents, consume minimal energy, and produce no by-products. The production process of green biocides should be safe and hazard-free. The process needs to be accelerated by particular catalysts that are regenerated at the end of the reaction for reuse.

Moreover, the process needs to be monitored using analytical techniques and tools to inhibit contaminants from spreading into the environment.

Ongoing research aims to eliminate the use of traditional biocides or replace them with green, environmentally friendly biocides. Jie et al. (Jie Wen, Zhao, Gu, & Raad, 2009) introduced a green biocide enhancer, ethylenediaminedisuccinate (EDDS), for the treatment of sulfate-reducing bacteria (SRB) biofilms on carbon steel surfaces using glutaraldehyde. Experiments were conducted on 100ml anaerobic vials with carbon steel coupons. They found that EDDS reduced the glutaraldehyde amounts significantly in the inhibition of SRB biofilm establishment and the treatment of established biofilms on carbon steel coupon surfaces. Jie et. al. also (J Wen, Xu, Gu, & Raad, 2012) used a mixture of three green biocides, namely tetrakis-hydroxymethyl phosphonium sulfate (THPS), glutaraldehyde, and ethylenediaminedisuccinate (EDDS) for the treatment of the planktonic sulfate-reducing bacteria (SRB) and to eliminate established SRB biofilms. It was inferred from their experiment that biofilm removal was achieved when 50ppm glutaraldehyde combined with 15% methanol and 1,000ppm EDDS. Omran et. al. (Omran, Fatthalah, El-Gendy, El-Shatoury, & Abouzeid, 2013) developed three green biocides from readily available natural non-edible domestic waste for the treatment of the aforementioned SRB. These three green biocides consisted of the hot water extracts of orange, mandarin peels, and water extract of lupine seeds. Such natural extracts express good biocidal activity against SRB. Silva et. al. (Silva, Rosado, Teixeira, Candeias, & Caldeira, 2015) proposed the formation of green biocides based upon combined methodologies that utilize antifungal tests, chromatographic techniques, FTIR-ATR (Fourier Transform Infrared – Attenuated Total Reflection) spectroscopy, microscopic approaches, and simulation assays that permit the detection of antifungal potential and rapid identification of ground-breaking bioactive compounds. Thus the proposed green biocides indicate great potential for future applications in cultural and built heritage rehabilitation and in being green substitutes to the biocides currently used.

6. Limitations of Using Green Biocides

There is a need for novel green biocides derived from natural products that are easily biodegradable. The desire for safe biocides that are green to the environment is both a primary and policy concern in the USA, Canada, and Europe. The strict US EPA regulations may result in the removal of a large number of biocidal products that are incompatible with the environment. Green biocides may be somewhat less effective than conventional biocides, and regrowth may occur. Moreover, there is concern that bacterial, fungal, and algal species may develop resistance against a commonly used green biocide.

7. Conclusion

Biocides are highly significant in many technical, economic, agricultural, and industrial applications in which they are dosed to avoid any complications associated with microbial, fungal, and algal growth. However, biocides are toxic chemicals that can harm human beings and the environment. Therefore, there is a great need to develop novel types of biocides that are green and environment-friendly. This paper discussed types of traditional biocides, their effects on humans and the natural world, their limitations and how they ought to be replaced by green biocides that are environmentally safe.

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