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DEGRADATION OF HONEY BEES AND ENVIRONMENTAL POLLUTION : A REVIEW

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Abstract

Environmental pollution is the inappropriate transformation of all or most of our ocean as a result of human and natural activities through its direct and indirect effects of changes in energy methods, radiation levels, physical and chemical composition, abundance of organisms, and the degradation of honey bees as a result of environmental pollutants from pesticides which are of particular importance in the agricultural field. The need to increase the amount of food to the need to increase the size and equipment of agricultural production and the presence of large fields for one crop increased the problems of pests, requiring more pesticide treatments that led to the disappearance of many solitary bees and pollinators Therefore, the importance of bees as a pollinator for flowers because of the possibility of increasing numbers easily and transported to farms, bees come into contact with pesticides during his visit. Since air, water and soil contain heavy metals as a result of various industries and produced by car exhaust and burning garbage and others, as well as radiation emitted by electric power towers and mobile phone towers, some of which carry electric charges affect bees and the behavior of bees and affect the navigational capacity of bees. He used bees and their products as an indicator of environmental pollution with heavy elements, pesticides, radiation and antibiotics because of its behavioral and synthetic characteristics that enable it to deal with all components of the environment and when returned be loaded with these pollutants, which have an impact on the immune system as a result of residues in bee products, including honey and the deterioration of honey bees It is a serious environmental phenomenon that leads to losses in the production of many strategic crops as well as large losses in the number of honey bee hives.

Keywords **:** Environmental pollution, Honey bees, *Apis mellifera L.*

Introduction

Honey bees *Apis mellifera* L. insect distinct characteristics of structural, anatomical and behavioral, has been loved by God Azoujl inspired and inspired by all the work done inside and outside the colony, including the work of making a drink mentioned in the Koran (syrup of various colors in which healing for people) and honey One of the products of the insect donor to the sweetest taste collected from the nectar glands in plants and turn it into honey by enzymes by the workers that convert complex and bilateral sugars into monosaccharides by evaporation of excess water to become honey palatable drink (Adenekan,1993; Bagdanov *et al.*, 2009). In addition to the benefits of honey bees at the present time is to detect environmental pollution with heavy metals and radioactive materials (Bahrampoor,2012). Bees have behavioral and synthetic properties that enable it to deal with all components of the environment such as soil, plant, water and air. Its stable in the environment and find their way into aquatic environments and possible multiply Trakizhabersath food chains until it locks into the bodies of two neighborhoods vary by age, including cadmium, lead, zinc, copper, nickel and barium (Erbilir and Erdogrul, 2005).

Honeybee colonies are the most sensitive and sensitive to insecticides of other insects because they lack a number of genes that produce pesticide-decomposing enzymes such as cytochrome P450 monooxygenases (P450s) glutathione-S-transferases and carboxylesterases (Johnson *et al.*, 2010). Research has shown that old bees and undernourished are more susceptible to pesticides than young bees, because large bees have levels of vitellogenin, hemolymph, protein and antioxidants that are lower than other insects (Johnson, 2015). In addition, honey bees are more sensitive to pesticides due to a shortage of genes that form detoxification enzymes (Claudianos, 2006). Genetic differences between species have an impact on bees' sensitivity to pesticides (Suchail and Belzunec, 2001).

The degradation of honey bees is a serious environmental phenomenon that ultimately leads to losses in the production of many strategic crops, where the loss of beekeepers from 30 to 90% of their hives has been attributed for many reasons, which lead to environmental pressures that negatively affect the immune system and make it more sensitive to diseases In 2006, an increase in the death rate in bee cults was observed in the United States of America due to the use of pesticides (Kamel, 2010).

Due to the lack of studies in the field of environmental pollutants of heavy elements, pesticides and antibiotics and the impact of electromagnetic radiation emitted from telecommunication towers or mobile phones and their impact on the honey bee colonies, which is the first pollinator, the study aimed to review the sources in the field of environmental pollutants and their impact on honey bees.

Environmental pollutants

Honey bees are an insect looking for food among the flowers of plants to collect nectar and pollen. They deal with the components of the environment. Colony Collapse Disorder (CCD) breaks down where bees leave their cells despite the existence of suitable living conditions (VanEngelsdorp *et al.*, 2009).

The phenomenon has been attributed, inter alia, to environmental pollutants, pathogens, parasites, environmental stress, beekeeping practices, malnutrition and genetically modified plants (Cornman *et al.*, 2012; Duan *et al.*, 2008; Potts *et al.*, 2010). The most important environmental pollutants that reach the bees and its products and water is the first pollutant, the air, soil and plants are additional sources of this pollution as the bees transport the pollutants into the hive, and thus to its products causing large losses because they contain heavy metals such as cadmium, lead and mercury, radioactive isotopes and pollutants Another source of contamination is the use of dream

pesticides and antibiotics such as tetracycline and various wax repellent chemicals (Sanchez-bayo and Goka, 2014).

Antibiotics

Antibiotics have been used since ancient times more than 250 years ago, and have also been used in medicine if traces of tetracycline are found in skeletal remains dating from 352-550 from the Roman era in Egypt (Nelson *et al.*, 2010). Antibiotics have been used in the field of honeybee control and agriculture since 1940,one of the first antibiotics was Sulphathiozole sodium, Streptomycin , nitrofurans and Tetracycline, used by beekeepers to treat European, American and brood rot, they are a preventive treatment in Argentina, Canada and the United States to prevent the spread of the disease (Alippi *et al.*, 2007).

Oxytetracycline (OTC) is the most commonly used in honey bees, due to the group of tetracyclines and the isolation of this antibiotic from *Streptomyces aureofaciens* in soil (Reeves, 2012). It is widely used to treat a range of diseases and promote growth in veterinary animals, as well as to treat bee diseases, which are infected with European and American brood rot (Johnson and Nimisha, 2010). It is also effective for positive, negative, aerobic, anaerobic, rickettsia and mycoplasma bacteria, inhibiting the synthesis of proteins by blocking the tRNA molecule that transports the essential amino acids to make proteins (Koesukwiwat *et al.*, 2010; Hills, 2010).

The presence of antibiotic residues was detected during 2000–2001 as streptomycin was found in 4 samples of honey in Belgium out of 248 samples and tetracycline 2 samples out of 72 samples (Reybroeck, 2003). A total of 34 honey samples from Asian countries were found, with 13 samples containing chloramphenyl residues at a concentration of 0.4-6 mmg / kg (Ortelli *et al.*, 2004).

In India, in 2006, 14% of honey samples were contaminated with tetracycline, also In 2007-2008, 28% of honey samples contained tetracycline and chloramphenicol residues (Johnson and Nimisha, 2010). (Solomon *et al.*, 2006) Analyzed nectar and honey samples to measure antibiotic residues The results showed the presence of streptomycin at 4-7, 11-29 mmg/kg and ampicillin 17-34, 26-48 mmg/kg, respectively.

The use of antibiotics in Iraq was used antibiotic Tetracycline to treat the disease of European brood rot, by adding to the solution of diabetes at 1 g/l (Al-Naji and MohyAl-Din, 1986). (Al-Kinani, 2000) used the same antagonist with thyme extract to fight the European brood rot and found it to completely eliminate the disease. (Al-Hujaimi, 2002) Cinnamon extract and oxytetracycline were used to treat American brood rot. A study conducted by (Shaher and Taher, 2012) on the contamination of honey with heavy elements found that the total honey from some governorates of the central region of Iraq was contaminated with cadmium and lead. In another study on pollen contamination with heavy metals Cd, Pb, Cu, Ni, Zn and (Shaher *et al.*, 2014) found pollen samples collected from some governorates of the central region to be contaminated with these elements within the limits allowed internationally. (Shaher *et al.*, 2017) also found total honey contamination from some governorates in the Central Region Contamination Cd, Pb, Cu, Ni, Zn and the results were within the limits allowed internationally.

Al-ogaidi (2017) also found the presence of residues of the oxytetracycline antibiotic in pollen substitutes, where the Chinese pollen was found to have a concentration of 0.002 ppm and local dough 0.001 ppm.

In the study of (Al-ogaidi, 2017) on the effect of adding antibiotics of oxytetracycline to bee food and detection of residues in honey produced using HPLC device, collected 25 samples of honey newly sorted from different apiaries for some provinces of Iraq for the central region of Baghdad, Karbala, Diyala, Wasit and Babylon. The antibiotic was found in all samples except Wasit province and the highest percentage in Karbala province was 1.54%.

Agricultural pesticides

The most toxic pesticides for honey bees were divided into 5 groups: organic phosphorus, methyl carbamate, pyrethroid and nicotinic pesticides, the latter being the most dangerous and toxic group of honeybee colonies (Laure *et al.*, 2011; Suchail *et al.*, 2001). This group was first introduced in the nineties and has become the most widely used pesticide in various countries (Jeschke *et al.*, 2011; Durkin and Casida, 2013). It was used in the beginning of this century due to its use with seeds and water solubility and use in small quantities, and as a result of melting it will be systemic and enter through the roots and move through the receptacles of the tissue to the leaves of the plant, which makes the plant protected against insects that feed on it. The protective system of this group of pesticides is very extensive, in 2011 in the United States of America on maize plant in the range of between 79 and 100% ha (Douglas and Tooker, 2015). Crops consume about 5% of the total treatment with these pesticides and the other is spread in the environment (Sur and Stork, 2003).

Reports in recent years in some European countries and America have shown the disappearance of some honeybee colonies, the losses of bees are partly due to pesticide exposure, as it was found that the rate of losses in Spain up to 80% of the hives has been attributed to pollen containing pesticide residues because it is the only source of protein consumed in different seasons 47.8% of stored pollen samples (Bernal *et al.*, 2010). Also found that the amount of residues in pollen was not correlated with the proportion of dead bees in the field (Chauzat *et al.*, 2009; Nguyen *et al.*, 2009).

Concerns about the impact of this group of pesticides on non-target organisms have increased due to the spread of dust from seed drilling machines resulting in poisonings in honeybee colonies in Alanya and Italy (Pistorius *et al.*, 2009; Bortolotti *et al.*, 2003). Residues of these pesticides were discovered in agricultural soils, pollen and nectar of crops treated with pesticides Neonicotinoids (Bonmatin *et al.*, 2005). A study by (Christian *et al.*, 2012) sampling honey and pollen stored in cells and several pathways of exposure to Neonicotinoids (including taking pesticide residues from nectar, pollen, or dust from uncultivated land tillage) showed that bees may be exposed to these compounds. And other agricultural pesticides in several ways throughout the search for food.

The European Food Safety Authority (EFSA), the regulatory body for agriculture and chemicals, carried out research to assess the risks to three of the most widely used pesticides, Clothianidin, Imidacloprid and Thiamethoxam in

terms of hazards and confusion for bees. The results obtained a temporary or voluntary suspension of the use of these pesticides for the treatment of crops, which was obtained the approval of the European Commission of the European Union at the end of 2013, and is continuing its research on the impact of these pesticides on honeybee colonies to re-evaluate the suspension (EFSA, 2013 a, b, c).

The accumulation of pesticides in plants due to their continuous spraying with systemic pesticides, collected by honeybee workers and stored as a food source in the hive in the winter season and consumed by the same generation within the hive, is a cause of poisoning with a sub-lethal dose, which leads to a change in the behavior of the colony as a result of acute poisoning later, thus, bees do not continue to operate in the social system, and then a breakdown is observed in the honeybee colony collapse disorder (CCD), and this situation occurs in powerful colonies that are more active and collecting food sources of plants containing pesticides (Tomasz *et al.*, 2016).

In order to reduce honeybee poisoning, which causes unacceptable weakness in the honeybee class, prevention and control operations on crop products are restricted. A significant decrease was observed in cases of poisoning of bee colonies as a result of restricting pesticides in most European and North American countries, as it was found that cases of Poisoning detected in the UK was halved during 1994-2003 (Barnett *et al.*, 2007). In Germany, poisoning decreased due to the decrease in the number of samples sent for detection, which were from 400-67 in 1970-2004 (VanEngelsdorp and Meixner, 2010). But despite the significant decrease in cases of poisoning and the presence of residues in the honeybee sects, they still constitute a problem for many countries, whether they are individual problems or a general problem, as there has been an increase in the enamel in honey poisoning cases in recent years (Bischoff *et al.*, 2005). It was also found that the methods used in sampling, the time of sampling, or the limits of detection of pesticides analyzed, as well as devices used to detect residues, may be outdated and this would give incorrect results (Tomasz *et al.*, 2016). The monitoring of poisoned honeybees after registration gives real data on the effect of pesticides on bee poisoning, in addition that the concentrations of residues present in the dead bees are an indication of pesticide poisoning (Blacquire *et al.*, 2012).

Some researchers have concluded that nicotinic pesticides have no effect on honey bees through field trials, but statistical analysis was unable to distinguish lethal doses of the pesticide (Cresswell, 2011). However, after a period of exposure to the pesticide and its storage within the hive through food, it has resulted in high death rates (Pistorius *et al.*, 2009).

The United States is one of the first countries to rely on honey bees as pollinators for its various crops, but the number of hives decreased by 45% in the previous 60 years, from 1966-1970, as a result of restricting the use of organic chlorine, carbamate, organic phosphorus and pyrethroid. Without increasing it is not to spray pesticides during the flowering of crops, and in the years that followed increased losses in honey bee hives as a result of diseases that affect cells, namely Varroa and wax worm and a change in approach to protect economic crops from pests by introducing genetically engineered crops and The use of new groups of pesticides, which are nucotine and phenyl pyrosil, which are characterized by being systemic.

Effect of pesticides on bees and their products

Exposure to lethal doses of nicotine pesticides has been found to weaken important behaviors in sperm and food search (Williamson and Wright, 2013), as well as their impact on gene expression in honey bee larvae (Gregorc *et al.*, 2012) and increase the level of disease Nosema (Pettis *et al.*, 2012). The highest proportion of residues is found in migratory colonies compared to existing ones, which is the main cause of hives migration as well as other factors of repeated varroa pesticide use resulting in pressure for colonies (Anderson and Trueman, 2000).

The use of Imidacloprid is permitted in Spain, despite widespread concerns and is widely used in the treatment of many crops and vegetables, losses in honeybee colonies in Spain are an individual problem and not a widespread problem(Alaux, 2010). The effect of neonicotinoids (imidacloprid) on 7073 adult individuals and 36 hives was studied by laboratory and field samples and the results were that imidacloprid had no lethal effect but reduced the performance of individuals by 6-20% (Cresswell, 2011). Persistent and chronic exposure to high levels of pesticide residues or acute and sub-lethal doses affects neurotoxicity leading to a decrease in the efficiency of honeybees.

Residues of pesticides on honey bees and products

A sub-lethal dose study of three types of insecticides Diazinon, Carbaryl and Resmethrin was given to two categories of workers (0 and 14) days old. In the search for food, followed by the medium toxicity Resmethrin and less toxic Diazinon, 14-day-old workers carbaryl less toxic followed by the medium toxic Diazinon and then highly toxic Resmethrin (MacKenzie *et al.*, 1989).

Marie *et al.* (2006) surveyed French apiaries to monitor vulnerability in apiaries, randomly distributing 5 colonies in 5 regions of France, studied for 3 years (beginning in autumn 2002), and visited 4 times a year (after winter and before Summer and during the summer and before winter) amounts of pollen were collected at each visit, chemical analyzes of the multiple pesticide residues in the pollen were then conducted to search for 36 pesticide residues, 19 of which were found in the samples. Pesticide contamination rates ranged from 0-50%, survival rates varied according to different pesticide types and there was no difference between the places where the samples were taken except for the fipronil residues.

Fawzy *et al.* (2014) detected pesticide residues in 46 honey samples from 18 apiaries located in 9 districts of Kafr El-Sheikh Governorate in Egypt. Samples were analyzed using QuEChERs and found that 55.6% of the collected samples were contaminated with pesticides, the obtained data were used to estimate the potential health risks associated with exposure to these pesticides, Acceptable Daylily Intake (ADI) was estimated to be significantly lower than the daily intake of pesticides, which showed that consumption of this quantity of honey is within the minimum toxicity risk level and studies indicate that regular pesticide residue programs in honey should be pursued at the national level for health protection.

Bargańska (2015) estimated the multiple residues of pesticides in honey and bee samples and collected samples

from northern Poland. 34 and 30 pesticide residues were estimated, respectively, in honey and bee samples respectively. And 2.2-29 ng/g in bee samples were below the limit.

The United States is one of the first countries to use the nicotine pesticide group, mainly in fumigating sorghum and soya beans to protect them from various pests, especially in North America. In 2010, it was found that the total area under cultivation is more than 110 million hectares, PANNA-Pesticide Action Network of North America, 2012 (NASS-National Agriculture Statistics Service, 2010) and Clothianidin and Thiamethoxm are the most colony used pesticides used for corn and soybean seeds because they contain Clothianidin that impedes metabolism, these compounds are highly toxic to bees, as the dose of these pesticides needed to kill 50% of a group of adult honey bees after 24 hours was found to be 22-44 ng / bee when contacted, and about 3 ng / bee by mouth (Iwasa *et al.*, 2004). However, the applied rate of these pesticides for crops is 0.25-1.25 mg / seed, i.e. one seed contains the active substance to eliminate the entire range of bees (Tennekes *et al.*, 2013).

This group has been found in water ponds or water storage areas in areas where crops are irrigated and have been found to be fatal due to accumulation of frequent exposure, leading to bee poisoning and degradation of the hive as a result of its use (Olivier *et al.*, 2014). Bees as individuals or denominations are affected by either poisoning or other symptoms such as increased sensitivity to viral infections, reduced food consumption, reduced fertility, reduced pharyngeal glands size and reduced incidence (Whitehorn *et al.*, 2012). This group includes several types of insecticides Neonicotinoid most importantly Imidacloprid, Acetamiprid, Dinotefuran, Thiamethoxam and Clothianidin (Steve, 2018).

A study conducted by (Hamad, 2019) on the results of the residues of Imidacloprid and in honey reached the highest rate in the fourth week 3.07 mg/kg and vanishing in the fifth week, pollen highest rate in 48 hours was 2.59 mg/kg and vanishing in the fourth week, and the remaining In the bee body within 48 hours it was 1.06 mg/kg and its fading in the fifth week, Azoxystrobin had the highest rate of honey residue in the second week 5.18 mg/kg and fading in the fourth week, in pollen 3.72 mg/kg and fading in the third week, In the bees, the first week had the highest rate of 6 mg/kg and disappeared in the fourth week, The results also showed the effect of Imidocloprid on the pharyngeal glands as they were small and spaced at 9,14 days, while the effect on the stomach appeared after 12 hours of feeding.

Radioisotopes

Radioactive isotopes are very important pollutants as they are found in bees and their products because of their serious health consequences for the consumer, radioactive isotope 40K was found in naturally occurring honey, and radioactive isotope Cs137 was found in honey produced in the areas of the Chernobyl nuclear power plant accident in 1986, In Ukraine, radioactive cesium was found in honey samples at a rate of 4430 Bq / kg during 1986-89, which is higher than that found in the rest of the country because of its proximity to the city of Chernobyl. On plants or their collection in soil in high proportions (Alexenitser and Bodnarchuk, 1999).

Other studies of honey in Croatia found that the concentration of cesium was between 1-21 BQ/kg, in Slovenia it was between 8 - 51 BQ/kg, and in Italy in 1986, the average concentration of Cs137 was about 30 - 360 BQ / kg honey, Radiation was found at a concentration of 1-5 Bq / kg in 1994-1996, and in 2000-2001 the rate of radioactivity was about 2 Bq/kg. (Barisic *et al.*, 2002). The remaining bee products were in Italy at a concentration of 1000-2500 Bq/kg in pollen in 1986, Pollen and propolis are better indicators for measuring radiation from honey because they are directly exposed to it (Alexenitser and Bodnarchuk, 1999; Porrin *et al.*, 2002). In Croatia in 1990 it was found that the proportion of radiation in honey is about 1 - 15.9 Bq / kg, while in pollen between 20.1-32.3 Bq/kg (Barisic *et al.*, 1992).

Poor feeding

Bees are naturally looking for different types of flowers, including pollen and nectar and the quantities needed for his food and brood food, and when this food becomes limited and insufficient, it leads to a lack of nutrition, and this happens a lot in the inexperienced beekeepers who raise their hives near residential areas limited plant diversity and few Quantum, this causes a weakening of the bee immune system (Oldroyd, 2007; Cornman, 2012).

Electromagnetic radiation

Like other organisms, bees are exposed to the electromagnetic effects of electric power towers and cell phone towers, some of which carry electric charges that affect organisms, since these bodies carry self-charged electrical charges, they will be negatively or positively affected by the emitted waves and thus will affect the behavior of the honeybee colonies, this effect will put pressure on the specific genes of this behavior, over time, and these changes may lead to the emergence of CCD, although this hypothesis requires accurate scientific and genetic evidence (Kimmel *et al.*, 2007). Navigational for bees, birds and butterflies where the sun is used as a compass for navigation and bees can be discharged to gum food in cloudy days because it depends on ultraviolet radiation, the presence of electromagnetic rays affect this activity. (El-halabi *et al.*, 2013) indicated that mobile phones affect the honeybee's lifestyle. It was found that by placing the phones inside the hives for a month and used for 50 minutes a day, 80% of the bees were lost and eggs did not turn into larvae (Sharmal and Kumer, 2010). Mobile phones have an impact on the decrease in brood and honey as a result of the decrease in the number of bees and the lack of eggs set by the queen. A master study was conducted at the Faculty of Agriculture / University of Baghdad on the impact of communications towers on the activity of honeybee colonies where it had an impact on the area of brood, honey and pollen and the speed of building the wax foundation internally and on his surfaces and the whole bee pollen, nectar or water. On the activity of the queen in laying eggs where the average area of eggs set by the queen in the treatment at a distance of 500 m from the communications tower 292. 75 ing^2 The currency below the tower amounted to 151.33 Ing^2 the first treatment, the closed brood was 437.43 in. The under-tower treatment was 222.38 ing^2. (Al-Naimi, 2019) found the effect of telecommunication towers on the queen's egg-laying activity as the average egg area placed by the queen in the treatment at a distance of 500 m from the telecommunication tower 292. The first

transaction amounted to 437.43 inches and the treatment under the tower was 222.38 inches.

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