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Food & Pesticides - A major health concern

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Abstract
Present review article was made to throw light on importance of pesticides in food. This review was collected all researches related to pesticides and food during last twenty years. These articles were collected from Googleschloar, Pubmed and other research web portals and meta analysis was done to understand the concept more thoroughly under every spectrum. It was found that on one hand, pesticides are beneficial to improve crop yield by destroying harmful pests, insects and weeds, simultaneously on other hand, these put many harmful effect on human health in the form of cancers of many types, parkinsonism, Alzheimer's etc. Besides this, in children, side effects of autism and hyperactivity syndrome were also noticed. Organic pesticides showed lesser side effects in comparison to synthetic pesticides. There is further need to invent more effective technology with lesser or no side effects.

Keywords
Food, pesticides, crop, harvesting, health

Introduction
World population is expected to be increased to more than 9 billion till 2050, in this scenario; issue of food security is of major concern. On one side, pesticides and other products that protect crop from pests, pathogens and weeds, on other side simultaneously these may have some harmful effect on human health, therefore their use is controversial (Philippe, 2013).

About pesticides
These are chemical compounds that are used to protect crops from harmful pests, insects, weeds and fungi. These are chemicals used to control invasion of food and crop by harmful organisms (Thorpe and Link, 2021).

Types of pesticides
Pesticides can be categorized as per varieties of pests found in food or crops. These are as following:

- Insecticides: Damage of crops by insects is reduced by these pesticides
- Herbicides: These are known as weed killers also
- Rodenticides: These pesticides protect crops from vermin and rodent-borne diseases
- Fungicides: These are very useful in protecting crops and seeds from fungal spoilage

Pesticides can also be classified as synthetic and organic.

Synthetic pesticides
- Organophosphates: These are synthetic pesticides affecting nervous system. These have been restricted in many countries to prevent toxic exposures

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- Carbamates: Another synthetic insecticide shows similar effect on nervous system but at a slower rate due to faster clearance time that contributes to lesser exposure
- Pyrethroids: These may harm the nervous system. These mimic a natural pesticide obtained from chrysanthemums
- Organochlorines: Also known as dichlorodiphenyltrichloroethane (DDT). Due to environmental pollution, these are also restricted at many places
- Neonicotinoids: These are applied on leaves and trees that are under observation of Environmental Protection Agency (EPA) as these have potential to harm bees
- Glyphosate: These are also identified as Roundup. It is majorly used in genetically modified crops

Organic pesticides

- Rotenone: It is an insecticide that has toxicity to fish as well
- Copper sulfate: It is good to destroy fungi and weeds. It can be produced industrially also although it is a biopesticide
- Horticultural oils: From many plants, oil is extracted out that have insecticidal properties (Arti et al., 2019)
- Bt toxin: This insecticide is produced by bacteria. It is found in some genetically modified organism (GMO) crops also

Benefits of pesticides

- Pesticides have beneficial role also as crop yield can be significantly enhanced by applying these on crops
- Turnover of the crops can be markedly increased by reducing pests infestation and destroying weeds that ultimately improve plant growth
- These were proved like a boon in India at the time of famous “Green Revolution” when India was facing deadly food shortage after independence

With these side effects, pesticides have adverse effects on human health as shown in further segments

Pesticides and human health

Yolanda et al. (2007) performed a research work on extraction of pesticides from food through different extraction techniques and developed a technology to reduce time of extraction. Similar type of research work was also carried out by Capoferri, 2018.

A new model was presented by Fantke et al. (2011) to study health issues linked to pesticides in food. Human intake, effect and characterization factors were studied to assess its impact on life cycle assessment for 726 pesticide -crop pair with different time of application. The study found that impact on human health varied at different levels from crop and pesticides. It shows the important correlation between environment - crop and pesticides.

Study documented the residual time of pesticides at various levels. It showed that pesticidal toxicity can be reduced by suitable substitute. Study reported that inspite of minimal amount of consumption of leafy vegetable, it has toxic pesticidal effect on human health as compared to higher consumption of cereals due to later application time and higher intake fraction.

Pesticides of earlier time were more economic but their residues have been found for

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years in soil and water. It's a major health concern due to which many developed countries have banned these pesticides but these are still in use in the developing countries like India as they are less costly.

To protect human being from the negative aspects of pesticides, WHO has developed some international guidelines for maximum residue level of pesticides.

Boobis et al. (2008) defined LOAEL as the "lowest observed adverse effect level". This is a threshold level to make people aware of the safe upper limits of pesticides in a certain food product by various agencies of global repute including WHO, European Food Safety Authority, USDA and FDA. Above these threshold levels, both synthetic and organic pesticides have harmful impact on human health.

Pesticides and food

Lozowicka (2015) showed in their study that 3% polished apples were found with pesticides above safe limit, although the levels found were not as high as to harm human including children.

European Union also documented in a review that 2.8% of food samples contained pesticidal remains more than permitted levels. Glyphosate levels were found on a higher side in 1.3% food samples (Canadian report).

By cooking and other processing methods, foods can be rendered pesticides free or at low levels. Process of peeling and trimming is also helpful in decreasing amount of pesticidal traces in fruits and vegetables. It decreases the nutritive value also (Bajwa and Sandhu, 2014; Yang et al., 2017). Keikotlhaile et al. (2010) also supported this fact that the level of pesticides can be lowered by 10–80% after cooking and various processing methods in foods. Even cleaning by washing under tap water reduces pesticidal levels by 60–70% (Liang et al., 2014).

Many studies (Yang et al., 2017; Wu et al., 2019) exhibited that even rinsing with water is not useful in removal of pesticides as it deeply penetrates in the fruits and vegetables. Commercial cleaning agents may be helpful to get rid of these health culprits.

Pesticides in organic foods

Organic foods have trace amounts of pesticides, therefore there is reduced risk of pesticide generated diseases (Hurtado – Barroso, 2019). Curl et al. (2015) also showed in their study performed on more than 4,400 adults showed significantly lower levels of pesticides in urine of samples who were on organic produce rather than people who were on synthetic produce. Although organic produce are higher in biopesticides.

In fact higher levels of biopesticides were found in the study of olives using organic pesticides (Simeone et al., 2009). Miller (2019) reported that organic pesticides also have negative effect on the environment although these are less harmful in comparison to the synthetic pesticides as the synthetic pesticides have more shelf life and remains for more duration in the body and environment.

There are some of the organic pesticides that last longer in the body and the environment than synthetic pesticides (Trewavas, 2004).

One study showed that organic pesticides are less effective, so are used in higher doses

in comparison to synthetic pesticides. It was found that synthetic pesticides exceeded safety thresholds in lesser than 4% food products. On the opposite side, organic pesticides including rotenone and copper were at a significantly higher level than their safety limits (Winter and Davis, 2006; Simeone 2009).

Effect of pesticides on human health

Pesticides are toxic to human health. These may have either acute or chronic health problems that depend on the quantity and ways of exposure. Human beings may come into contact with pesticides at work or at home or at garden.

Ahmed et al. (2017) found harmful effect of pesticides in higher risk of Parkinson's disease. Pesticides have potential to alter genes responsible for development of parkinson's disease. Similar types of results were achieved by Yan et al. (2016), but this time on alzheimer's disease. Some researches exhibit harmful impact of pesticides in different types of cancers as well. Lerro et al. (2015) found in their study on 30,000 pesticides applicators that females with exposure to organophosphates, were at significantly higher risk of breast cancer or cancers related to thyroid and ovaries. A similar type of research conducted on animal, human and test tube studies reported that high exposure to pesticides like malathion, terbufos and chlorpyrifos (that come under the category of organophosphate) are associated with increased risk of breast cancer (Yang et al., 2020). Different studies showed associated risk of pesticides in developing cancers of prostate, lung, and liver Silva et al., 2016; Bonner et al., 2017; VoPham et al., 2017).

Effects of pesticide exposure in children

Children are particularly at higher risk of negative health impacts from pesticides. Even accidental exposure of children to pesticides is linked to different types of cancers, attention deficit hyperactivity disorder (ADHD) and autism (Kalkbrenner et al., 2014). Liu and Schelar (2014) exhibited that even lower dose exposure to pesticides in children is responsible for impaired neurological and behavioral development. One research work carried out on 1139 children by Bouchard et al. (2010) showed that children exposed to high doses of pesticides have 50 – 90% more chances of developing ADHD as compared to low dose exposure.

Another research carried out on prenatal exposure to different pesticides exhibited higher chance for autism spectrum disorder (Ehrenstein et al., 2019). On the other hand, Yolton et. al. (2013) did not found any noticeable effect on development of infant after pesticide exposure during pregnancy.

Conclusion

It can be concluded that the harm from pesticide depends on the particular and its levels applied and the stage of application, amount of food consumed etc. There is a lot of technological advancement due to which newer and better pesticides are available in the market with lesser side effects.

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