



A REVIEW ON POTENTIAL CONTAMINATION OF NON-ALCOHOLIC BEVERAGES WITH PESTICIDES

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ABSTRACT

Soft drinks are non-alcoholic water-based flavoured drinks that are optionally sweetened, acidulated and carbonated. Some carbonated soft drinks also contain caffeine; mainly the brown-coloured cola drinks. The contamination of soft drinks with pesticides presents a multifaceted issue with implications for public health, environmental sustainability, and regulatory oversight. This introduction will explore the sources of pesticide contamination in soft drinks, the potential health risks associated with pesticide residues, regulatory frameworks governing pesticide use, and strategies to mitigate the risks posed by pesticide contamination in soft drinks. Excessive consumption of carbonated soft drinks has been putatively linked to health effects including dental caries, obesity, and osteoporosis.

KEYWORDS: Soft Drinks, pesticides, Health effects, Chemical contaminants, Non-alcoholic

INTRODUCTION

Chemical contaminants should not be present in beverages for human consumption, but could eventually be ingested by consumers as they may appear naturally from the environment or be produced by anthropogenic sources. These contaminants could belong to many different chemical sources, including heavy metals, amines, bisphenols, phthalates, pesticides, perfluorinated compounds, inks, ethyl carbamate, and others. It is well known that these hazardous chemicals in beverages can represent a severe threat by the potential risk of generating diseases to humans if no strict quality control is applied during beverages processing. This review compiles the most updated knowledge of the presence of potential contaminants in various types of beverages (both alcoholic and non-alcoholic), as well as in their containers, to prevent undesired migration. Special attention is given to the extraction and pre-concentration techniques applied to these samples, as well as to the analytical techniques necessary for the determination of chemicals with a potential contaminant effect. Finally, an overview of the current legislation is carried out, as well as future trends of research in this field.

Soft drinks have long been a popular choice for refreshment, enjoyed by people of all ages around the globe. However, recent concerns have emerged regarding the potential contamination of these beverages with pesticides. Pesticides, chemicals used to control pests and diseases in agriculture, have found their way into various food and drink products, including soft drinks, raising questions about the safety of these ubiquitous beverages. Soft drinks are typically made from a combination of water, sweeteners, flavorings, and preservatives. While these ingredients may seem innocuous, they can inadvertently introduce pesticide residues into the final product. Water, a primary component of soft drinks, can be a carrier for pesticide residues if it is sourced from contaminated water sources. Agricultural runoff, industrial pollution, and inadequate water treatment processes can all contribute to the presence of pesticides in drinking water, which may then be used in the production of soft drinks.

Furthermore, the ingredients used in soft drinks, such as fruits and sugars, may also contain pesticide residues. Fruits used for flavourings or extracts in soft drinks are often cultivated using pesticides to protect against pests and diseases. Similarly, sugar, a common ingredient in many soft drinks, is derived from sugar cane or sugar beets that may be treated with pesticides during cultivation. The contamination of soft drinks with pesticides can occur at various stages of the production process, including harvesting, processing, and bottling. Pesticide residues present in raw ingredients may persist through processing and manufacturing processes, ultimately ending up in the final product. Additionally, inadequate cleaning and sanitation practices in bottling facilities can lead to cross-contamination, further exacerbating the issue.

The presence of pesticide residues in soft drinks raises concerns about potential health risks for consumers. Pesticides are designed to be toxic to pests, and even at low concentrations, they can have adverse effects on human health. Chronic exposure to pesticide

residues has been linked to a range of health problems, including neurological disorders, reproductive issues, and certain types of cancer. Children, pregnant women, and individuals with compromised immune systems may be particularly vulnerable to the effects of pesticide exposure.

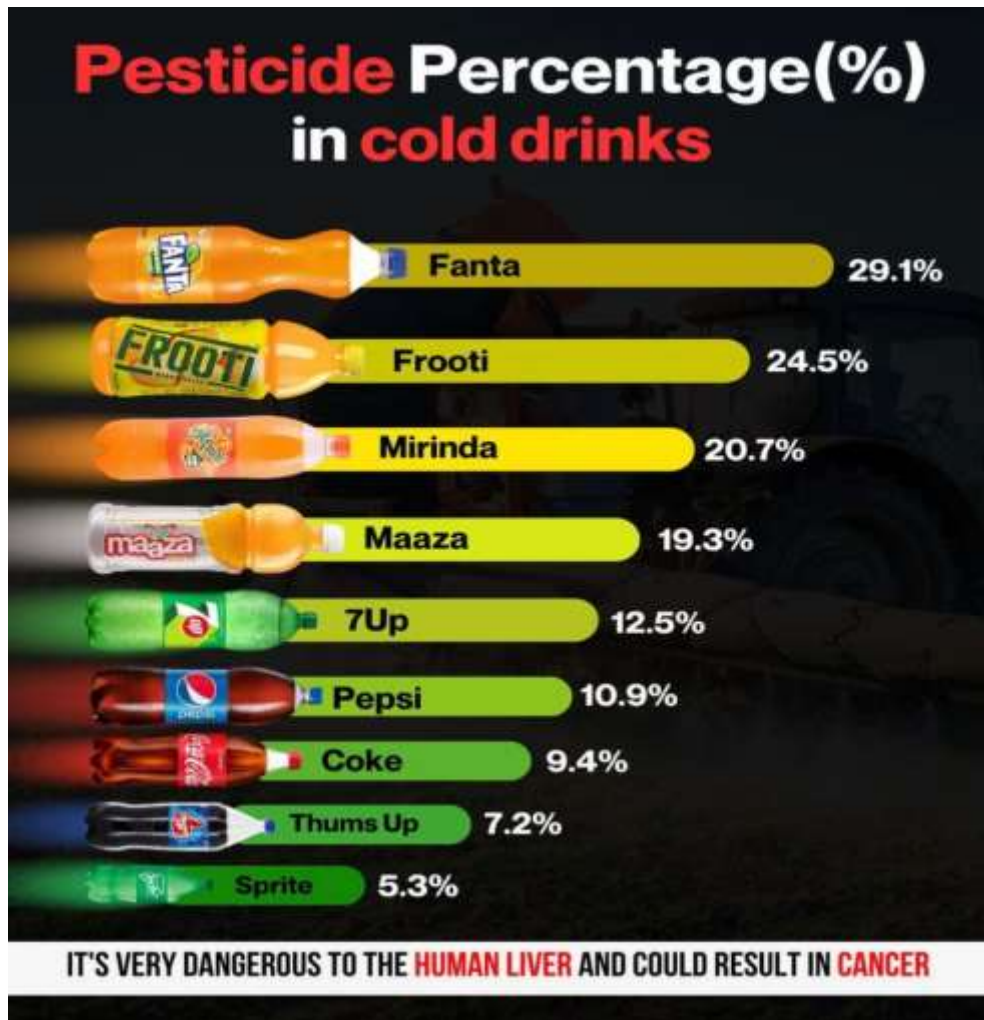
By definition, beverages are potable liquids for human consumption, which are essential for many physiological functions, such as giving energy and refreshing the body [1]. In general terms, “beverages” include many different products, such as milk, coffee, tea, juices, and alcoholic products, which humans commonly consume in their daily lives [2–7]. In agreement with recent literature [8–10], the most frequent drinks currently used in the human diet can be classified into two categories: Alcoholic and non-alcoholic beverages. A brief classification of beverages is shown in Figure 1. The vast majority of beverages, including alcoholic and non-alcoholic drinks, are based on large amounts of water. Nonetheless, water is not classified as a beverage, although in this review, bottled mineral water will be treated as a special kind of beverage, as suggested by some authors. The alcoholic group includes beverages, both distilled and non-distilled, mainly obtained from fruits or grains, with wine and beer having high rates of consumption worldwide, being typical examples of fruit-produced and cereal-produced beverages, respectively [11–13]

On the other hand, non-alcoholic beverages are subdivided into carbonated and non-carbonated drinks, including vegetable and fruit juices, prepared or embedded water-based beverages, such as coffee and tea, and dairy products. Carbonated soft drinks are those to which carbon dioxide has been lemon/lime, tonic, etc. added intentionally to produce a special kind of non-alcoholic liquor, including sodas, cola, lemonade.



Figure 1: A Brief Classification of beverages

Pesticides are defined as a broad spectrum of chemical and organic mixtures including insecticides, fungicides, plant growth regulators, etc. The primary source of pesticides in the ecosystem are agriculture and forestry. It is well known that the rapidly growing population needs enhanced global food production. Preferably, a pesticide must be fatal to the target organisms to control the effect of weeds species, instead of creating havoc on human beings and the environment. The disproportionate use of these lethal pesticidal compounds affects the plants and animals of the whole ecological structure. The widespread use of these hazardous chemical-based pesticides has a greater impact on human and other systems. The pesticidal applications in the forest, public health and industries have yielded enormous benefits. Pesticides mainly help the farmers to get higher food yield. Other benefits such as improved productivity of the crops, protect the damage of crops from weeds, vector disease controls, and food quality improvements pave the way for greater use of pesticides, despite having lethality [14]. Several new and powerful pesticides have been formulated in large quantity by researchers and manufacturers to combat the world's population demands. This results in creating more pesticide resistance, healthy controls and a great food thirst [15].



The presence of pesticide residues in soft drinks raises concerns about potential health risks for consumers. Pesticides are designed to be toxic to pests, and even at low concentrations, they can have adverse effects on human health. Chronic exposure to pesticide residues has been linked to a range of health problems, including neurological disorders, reproductive issues, and certain types of cancer. Children, pregnant women, and individuals with compromised immune systems may be particularly vulnerable to the effects of pesticide exposure.

Regulatory agencies around the world have established maximum residue limits (MRLs) for pesticides in food and beverages, including soft drinks, to protect public health. These MRLs are based on scientific assessments of the potential risks associated with exposure to pesticide residues and are intended to ensure that consumers are not exposed to harmful levels of pesticides through their diet. However, enforcement of these regulations can vary widely between countries, and lapses in oversight can occur, allowing contaminated products to enter the market.

The term “contaminants” in beverages includes those compounds that are dangerous to health, whether chemical, physical, or microorganisms. Potential contamination is one of the main issues for consumers when selecting beverages for their use, as it could represent a risk for their health and well-being [16]. Although chemical and biological contaminants are strictly banned in beverages formulation, they can sometimes be unintentionally formed during processing, packaging, and distribution processes. In addition, physical contaminants such as foreign bodies that may be present in beverages must be taken into account (glass, wood, metal fragments, etc.). These may come from raw materials, but also from unintentional contamination from personnel or devices used during the processing and packing of the final product.

SOFT DRINK INDUSTRY AND REGULATIONS

Definition of soft drink

Soft drinks are non-alcoholic water-based flavoured drinks that are optionally sweetened, acidulated and carbonated. Some carbonated soft drinks also contain caffeine; mainly the brown-coloured cola drinks.



The Market

Global Scenario

Globally, carbonated soft drinks are third most consumed beverages. Per capita annual consumption of carbonated soft drinks is nearly four times the per capita consumption of fruit beverages (Source: Data from the Beverage marketing Corporation, as reported by the Canadian Soft drink Association). Soft drink consumption is growing by around 5% a year, according to the publication Global Soft drinks 2002, published by the Zenith International. Total volume reached 412,000 million litres in 2001, giving a global per capita consumption of around 67.5 litres per year.

The Centre for Science and Environment (CSE) announced that 12 soft drink brands collected for testing from in and around Delhi contained residues of four toxic pesticides and insecticides - lindane, DDT, malathion and chlorpyrifos. The multinational companies Coca-Cola and PepsiCo immediately challenged the report and indicated that they might consider legal action. In all the samples, the levels of pesticide residues far exceeded the maximum residue limit for pesticides in water used as "food" as set down by the European Economic Commission (EEC). Each sample had enough poison to cause long-term cancer, damage to the nervous and reproductive systems, birth defects and severe disruption of the immune system. The tested soft drinks include Pepsi, Coca-Cola, Mountain Dew, Diet Pepsi, Mirinda Orange, Mirinda Lemon, Pepsi Blue, 7Up, Fanta, Limca, Sprite and Thums Up. According to the findings, Coca-Cola and Pepsi had almost similar concentration of pesticide residues. While contaminants in Pepsi were 37 times higher than the EEC limit, Coca-Cola overstepped the norm having 45 times the prescribed limit of pesticide contamination. The worst results were of Mirinda Lemon (70 times the normal limit) followed by Coca-Cola, Pepsi, Fanta, Mirinda Orange, 7Up, Mountain Dew, Limca, Thums Up and Sprite. It was also found that pesticides in soft drinks were similar to bottled water. The CSE tests, conducted over the past six months, showed the amount of DDT in Pepsi was 16 times higher than EU norms and nine times higher in Coca-Cola. The Indian units of rival soft drink giants, Coca-Cola and PepsiCo, jointly denied the environmental group's report that their beverages contained high levels of pesticides. According to them the report is baseless and should be disregarded. They conform to the best international norms and are open to their product being tested anywhere in the world by an independent and accredited laboratory. However, CSE found no pesticides in tests of Coke and Pepsi soft drink brands sold in the United States. According to the centre, soft drinks in India had high pesticide residues because the soft drink and bottled water industry used an enormous amount of ground water as the basic raw material.

CONCLUSION

In conclusion, the contamination of soft drinks with pesticides is a complex issue that requires attention from multiple stakeholders, including regulatory agencies, manufacturers, and consumers. By addressing the sources of contamination, strengthening regulatory oversight, and promoting consumer awareness, we can mitigate the risks posed by pesticide residues in soft drinks and ensure that these beverages remain safe and enjoyable for all

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