

# Determination of Phthalate Esters in Egyptian Plastic-Bottled water under Various Storage Conditions

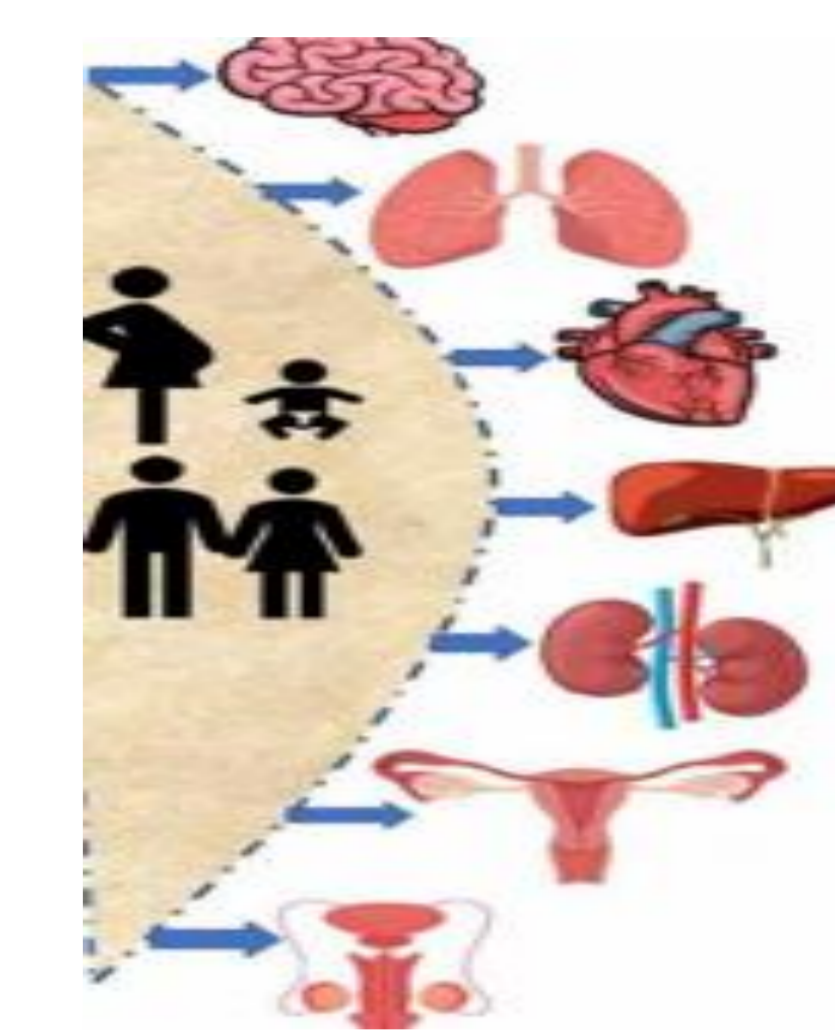
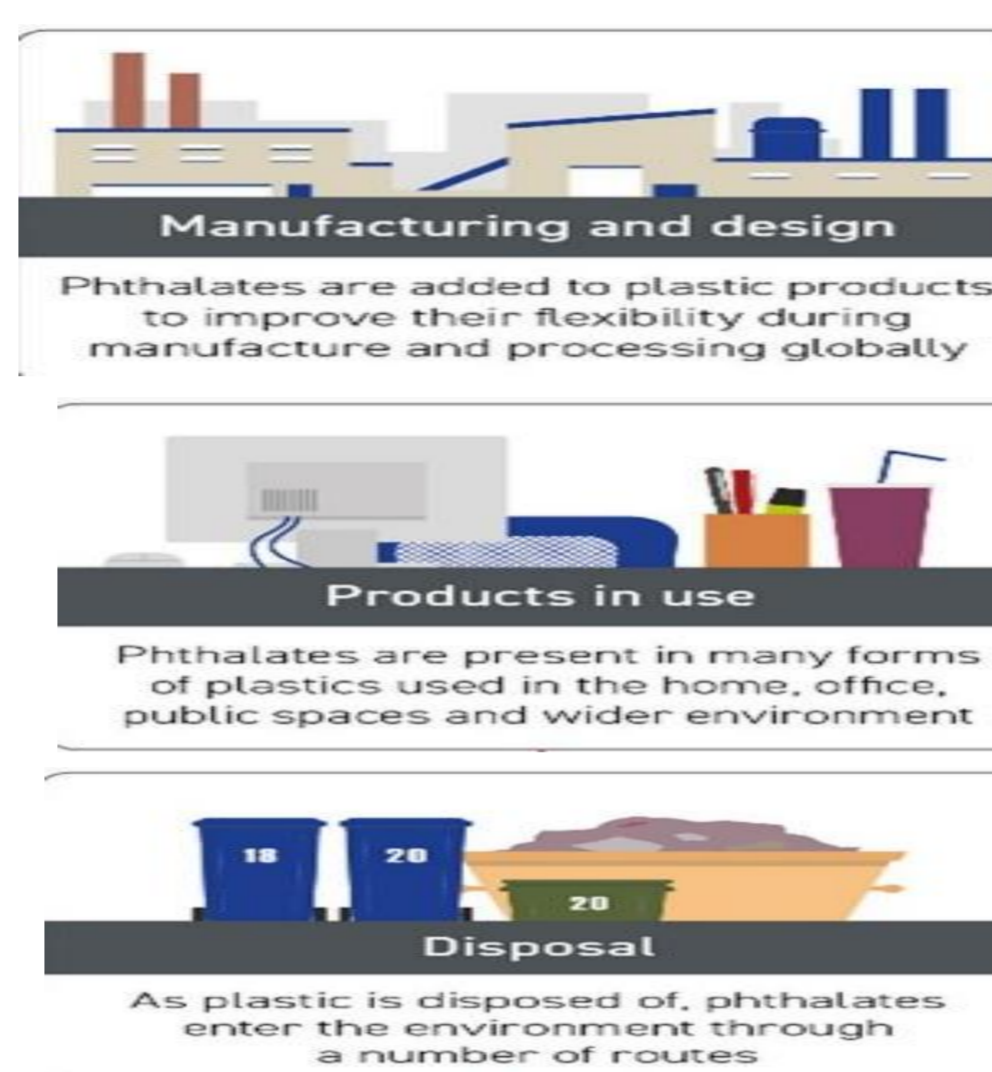
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## Background

- Packaging materials protect foods and beverages from chemical and environmental contaminations
- However, Packaging materials themselves can potentially cause chemical contamination by allowing chemical constituents to migrate into the packaged products, through intentionally or unintentionally added substances.
- Phthalates are synthetic organic compounds, extensively used in polymers manufacturing and commercial products
- Primarily used as **plasticizers** to increase Polymers softness flexibility and ease of processing in addition to other uses such as solvents and adhesives



Figures generated from: Eagles, J., et al. "Human health impacts of exposure to phthalate plasticizers: An overview of reviews." Environment international 158 (2022): 106903. <https://publicdomainvectors.org/en/free-clipart/City-skyline-vector-clip-art/7135.html>

- Food was shown to be the dominant source of human exposure, with packaging materials and food wrappers as the primary sources
- One of the products that use plastic containers extensively in its packaging
- Leaching of chemicals from the plastic bottles into water has become a subject of scientific and public concerns

### Put Down That Bottle

By Sarah Mosko, October 9, 2012



evidence that PET drink bottles can leach substances into the contents that mimic the sex hormone estrogen – phthalates and antimony – has put PET bottles in the crosshairs also of scientists worried about their health safety.

Plastic Bottles Are Bad for Your Health

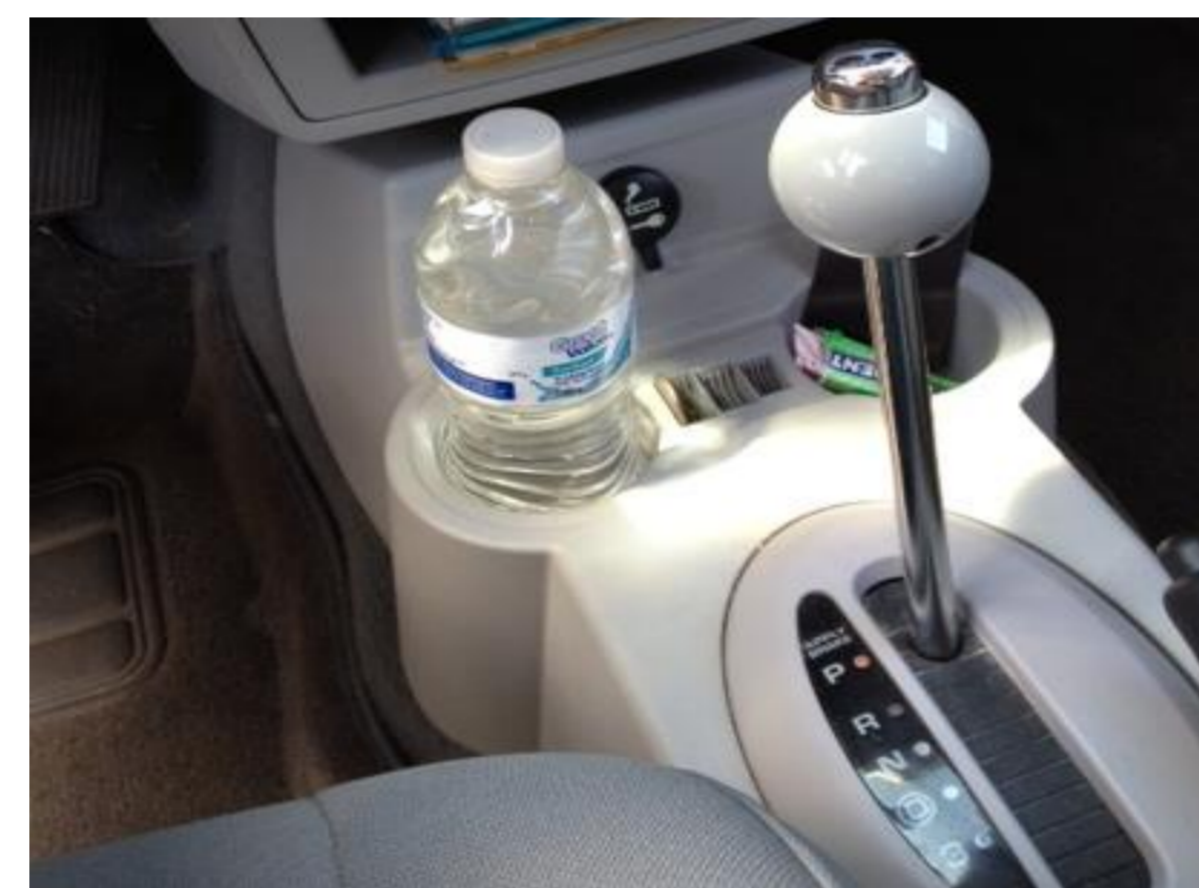
<https://emagazine.com/put-down-that-bottle/>

### Food packaging is full of toxic chemicals – here's how it could affect your health

If you care about what you eat, you should care about what it comes in



<https://www.theguardian.com/us-news/2019/may/28/plastics-toxic-america-chemicals-packaging>



Poor storage conditions by vendors and Consumers

## Research Objective

- Examine the occurrence and quantify the levels of phthalates in bottled water locally produced in the Egyptian market
- Investigate the effects of various storage conditions on the levels of these contaminants.

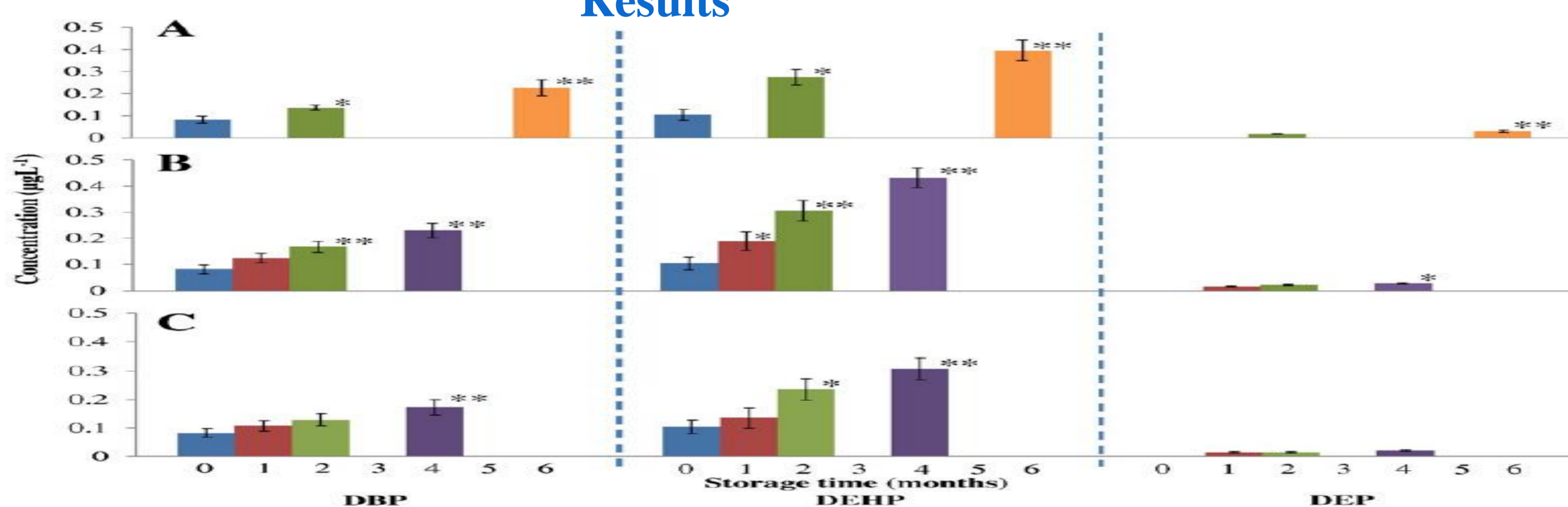
## Methods

Six common phthalates investigated in 108 bottled water locally produced in the Egyptian market for the first time. (12 bottles equivalent to 2 bottles from each brand per condition analyzed)

- Water samples were analyzed :
  1. Immediately after purchasing (~2 weeks after production)
  - After being stored at:
    2. Room temperature (25±5 °C) (2, and 4 months of storage )
    3. In a refrigerator (4±1 °C) (1, 2, and 4 months of storage )
    4. Outdoor under sun exposure (daylight temperature of 40±5 °C) (1, 2, and 4 months of storage )
- **Instrumental Analysis:**

Liquid –Liquid extraction with dichloromethane and analyzed with GC/MS/MS

## Results



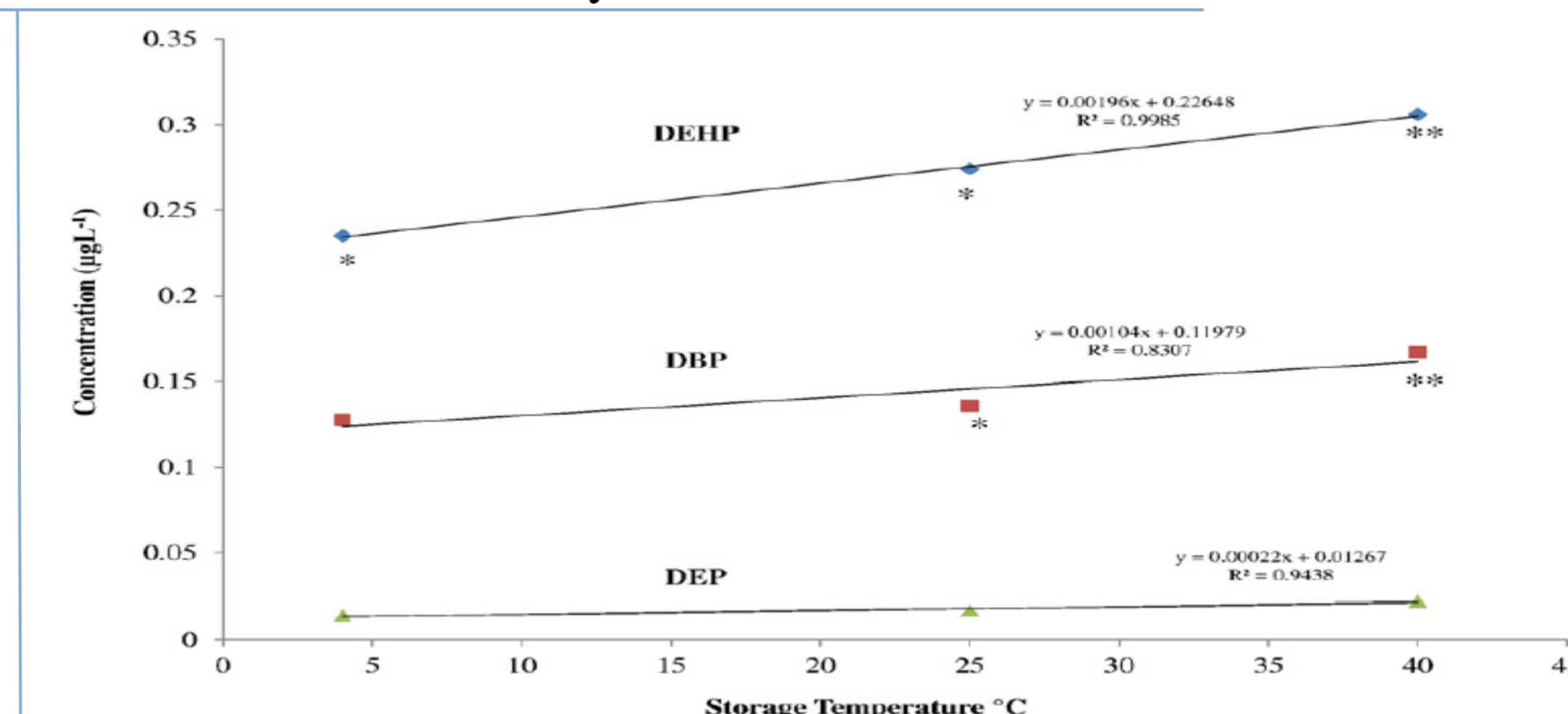
Mean concentrations of DBP, DEHP and DEP in µg l<sup>-1</sup> observed in PET water samples analyzed at various time points under different storage conditions,

The zero month storage time point refers to analysis ~2weeks after production. The P values for statistical significance are indicated as \* for P ≤ 0.05, \*\* for P ≤ 0.01 relative to values at zero month storage for DBP and DEHP and values at 1 month storage for DEP.

Room temperature storage (25±5 °C, data collected at the 2 and 6 months time points)

outdoor storage with sun exposure (daylight temperature 40±5 °C, data collected at the 1, 2 and 4months time points)

refrigerated Storage (4±1 °C, data collected at the 1, 2 and 4months time points).



Mean concentrations of DBP, DEHP and DEP in µg l<sup>-1</sup> determined at 4, 25 and 40 °C after 2months storage. The P values for statistical significance are indicated as \* for P ≤ 0.05, \*\* for P ≤ 0.01 relative to values at zero month storage for DBP and DEHP and values at 1 month storage for DEP. The zero month storage time point refers to analysis ~2weeks after production. The P values for statistical significance of the slopes of the regression lines are 0.025 for DEHP, 0.270 for DBP and 0.152 for DEP. Values of P ≤ 0.05 are considered significant for the slopes of the regression lines.

## Discussions

- Only DEHP and DB were detected in the samples analyzed immediately after purchasing with a detection frequency of 50 and 58% and mean concentrations of 0.104 and 0.082 µg l<sup>-1</sup> respectively.
- Phthalates concentrations and frequency of occurrence (reached 100%) were increased after being exposed to the various storage conditions
- A Significant positive correlation was obtained between the storage time, temperature and the concentration of phthalate
- The highest concentrations were recorded after 4 months of outdoor storage and 6 months in room temperature storage.
- The overall trend observed of increasing phthalate concentrations due to different storage conditions tested here suggests that PET plastic bottles may be a source for the detected phthalates.
- This trend is also supported by other reports of phthalates concentration increases in PET bottled water stored under various conditions
- Phthalates are not typically used in PET manufacturing and their presence therefore, is non-intentional.
- The use of recycled Plastics, the wide use of phthalates in various industries, their ubiquitous presences as environmental contaminants can cause their non-intentional addition in many products, including PET polymer and glass bottles

## Conclusion and Recommendations

- The smallest increase in concentrations was observed at 4°C indicating that refrigeration is an optimal condition bottled water storage

While, Small amounts of phthalates have been detected in Egyptian bottled water not exceed 1 µg l<sup>-1</sup>, that are far beyond the maximum allowable limits set by regulatory agencies such as the FDA and EPA 6 µg l<sup>-1</sup> And given the potential risks associated with phthalates, and their present in our environment, leading to potential accumulations and chronic exposure in the human body.

- ✓ It is crucial that thorough monitoring and testing be carried out to protect consumers from any potential health hazards.
- ✓ By staying vigilant and proactive in monitoring phthalate levels in bottled water, we can ensure that consumers are not exposed to harmful substances and can continue to trust in the safety of their drinking water.

## References

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Zaki, Ghada, and Tamer Shoeib. "Concentrations of several phthalates contaminants in Egyptian bottled water: Effects of storage conditions and estimate of human exposure." Science of the Total Environment 618 (2018): 142-150 <https://publicdomainvectors.org/en/free-clipart/City-skyline-vector-clip-art/7135.html>

Eales, J., et al. "Human health impacts of exposure to phthalate plasticizers: An overview of reviews." Environment international 158 (2022): 106903. <https://emagazine.com/put-down-that-bottle/>