DETECTION OF SOME MIGRATORY CHEMICAL COMPOUNDS FROM NATURAL DRINKING WATER BOTTLES

By

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B.Sc. Agri. Sc. (Food Technology), Ain Shams University, 1998

M.Sc. Agric. Sc. (Food Science and Technology), Ain Shams University, 2015

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ABSTRACT

Hussein Fahim Mohamed Abd EL-Salam: Detection of Some Migratory Chemical Compounds from Natural Drinking Water Bottles. Unpublished Ph.D., Thesis, Department of Food Science, Faculty of Agriculture, Ain Shams University, 2018.

The present study was carried out to determine the migrated compounds from polyethylene terephthalate (PET) and polycarbonate (PC) to bottled drinking water (BDW) samples of different volumes (0.6, 1.5 and 19L) as well as different color (clear and blue) which available in retail shops in Egypt when the BDW was exposured to sunlight or when stored at different temperatures for 210 day and comparing to those of drinking water standards. The water samples were analyzed for various parameters. This study was also carried out the somatic mutation effect of dibutyl phthalate and dioctyl phthalate on drosophila and the effect of cytotoxicity on human cell line (colon cancer cell-liver cancer cell).

Analysis of different performs used in packaging of bottled drinking water (BDW) indicated the following results:

Twelve of heavy metals; Fe, Ni, Cu, Sb, Pb, Mn, As, Cd, Zn, Ti, BPA and total phthalates (TP) were detected in both of PET material either clear or blue one as well as the polycarbonate (PC) material.

Most of detected metals were ranged between 0.02-0.06ppm, while only two metals Zn and Cd were 0.01ppm or less in three investigated performs.

The heavy metals concentration of sample A (PET, clear, 0.6L) stored at 25°C±2/ 210 day were statistically differed from 90th day of storage tell the end of storage (210 day). Except Cu and Al metals which had a permissible level of such metals from the beginning of storage (at zero day).

Sample A (PET, clear, 0.6L) and B (PET, clear, 1.5L) could be easily seen that:

- Absence of BPA compound through whole storage period (210 day).
- Sb compound was detected at 30^{th} day of storage.

Another five compounds; i.e. DEHP, DMP, DEP, DBP and DOP were detected after 90^{th} day of storage and significantly increased till 150 day of storage then be stable till the end of storage.

Regarding to formaldehyde (FA) and acetaldehyde (AA) compounds the aforementioned trend was also detected but from zero time till the end of storage.

Changing bottle's material from PET to be PC in addition to bottle size (19L), showed the effect of such factors on migrated compounds (sample D). BPA compound was no absent but detected at the beginning of storage then had an incremental pattern till the end of storage. Only four compounds (DMP, DEP, DBP and DOP) were detected after 90 days and increased with increasing storage period. FA compound was not detected at zero time of storage but at 15^{th} day it was dramatically increased till the end of storage. Regarding to the storage at higher temperature (50°C) sample A (PET, clear, 0.6L), contained only two compounds at zero day storage; i.e. FA and AA. After 15 day, all of other seven compounds were detected and suddenly increased with high concentrations at 90^{th} day till the end of storage period.

In case of sample B (PET, clear, 1.5L), only three compounds did not appear at zero day. Similar trend was also detected in the same four compounds (DBP, DOP, FA and AA).

In case of sample C (PET, blue, 1.5L), presence of only four compounds was noticed (Sb, DOP, FA and AA).

It could be reported that either colour's bottle and/or filling capacity did not greatly affect.

Regarding to another packaging material (PC, 19L) at 50°C, the absence of FA compounds beside other four compounds (DMP, DEP,

DBP and DOP) at zero time storage was noticed. A continuous increase in such compounds was gradually detected till the end of storage except in case of (BPA), (FA) and (AA) that suddenly recorded higher concentrations initiated from 90^{th} day of storage at 50°C. Regarding the effect of bottle´s color on migrated compounds concentration during storage under sunlight, only four compounds were detected before storage named Sb, DOP, FA and AA, the lowest level (0.006ppb) was noticed in DOP while the moderate level was recorded in FA (0.03ppb) and Sb (0.08ppb). The highest one (0.40ppb) was recorded in case of AA. Five of detected compounds were constant after 30^{th} day till the end of storage (210 day). Other four detected compounds; i.e. DBP, DOP, AA and DEP were consequently increased with higher levels.

The frequencies of spontaneous tumors in drosophila in both of negative control was very low, thirteen small tumors were scored among 310 flies with an average of 0.042 tumor/fly. Meanwhile, After MMC treatment of F1 larvae, the frequency of induced tumors was highly significant increased, whereas, 288 induced tumors were obtained among 230 flies with a frequency of 1.25tumor/fly. These tumors were found on all body parts and most of them were undifferentiated large tumors. In DOP (30µg/ml) and DBP (30µg/ml) treatments 158 tumors and 135 were scored, respectively.

The cytotoxicity and cell viability of di-octyl phthalate (DOP) and di-butyl phthalate (DBP) with the concentrations (0.5, 1, 5, 10 and 20µg/ml) and a positive control 3µg/ml were evaluated in vitro against human liver cell lines (hepatoma cells HepG2). The viability of positive control was 62.85%, and the viability of HepG2 was reduced as the concentration increased of the tested phthalates, but the reduction was non-significant in 0.5µg/ml. The significant reduction in the viability was observed in 1 and 5µg/ml, moreover, highly significant in 10 and 20µg/ml. The Dose inducing 50% cell growth inhibition (IC_{50}) against hepatoma cell line cells (HepG2) are presented.

Empty bottles were filled with tap water without any treatments while a second one was filled by de-chlorinated tap water (with sodium thiosulphate) to study the effect of chlorine on the physicochemical properties of such tap water at home temperature throughout seven days storage. All of investigated parameters did not affect by de-chlorination process at zero time.

After 7 days storage the anion of chlorine (Cl^-) was minimized with 1.71 fold.

Total bacterial count (TBC) was higher in chlorinated tap water with 1.69 fold but in free chlorine tap water such parameter was increased by only 1.10 fold.

Key words: Polyethylene terephthalate (PET) bottles; bottled water; Sunlight; Phthalates; Migration; Toxicity; Carcinogenic; Genotoxic effects.

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