Identification and estimation of phthalate esters in the commonly used deodorants in UAE by using HPTLC method

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ABSTRACT

Objective: The study aims to identify and estimate four phthalate esters viz., Dibutyl phthalate (DBP), Diethyl phthalate (DEP), Di (2-ethylhexyl) phthalate (DEHP), Dimehtyl phthalate (DMP) in commonly used deodorants by using High performance Thin Layer Chromatography (HPTLC).

Material and Methods: 10 brands of most commonly used deodorants; the volume and frequency of their use were selected based on a q**uestionnaire based survey in UAE. DBP, DEP, DEHP, and DMP** were identified in deodorants by comparing the R_f value with their respective standards by using HPTLC. The estimated phthalate contents were extrapolated to calculate the hazard indices.

Results: The results showed that these 4 different phthalates were present in various brands of deodorants. DBP was found to be present in highest concentrations in most of the deodorants. The hazard indices of all four phthalates were found to be less than 1.

Conclusion: In our study, the different phthalates (DBP, DEP, DEHP and DMP) contents in 10 brands of commonly used deodorants in UAE were identified and estimated. The Hazard Indices for phthalates estimated (DBP, DEP, DEHP and DMP) in different brands of commonly used deodorants in UAE were found to be below 1 indicates the safety of these products for human use.

Keywords: Phthalate esters, deodorants, HPTLC.

INTRODUCTION

Phthalic acid diesters (PAEs) are commonly known as phthalates, multifunctional synthetic chemicals with wide range of uses. They are used mainly as plasticizers to improve flexibility or elasticity in many plastic products[1]. Phthalate esters are used as solvents, to hold fragrance, and as a fragrance stabilizer agent in perfumes. They are also used in deodorants as solvents and to increase prolonged existence by helping the product to persist on the skin[2]. With respect to health effects, studies have revealed that phthalates can cause many problems including asthma, endocrine disruption, reproductive abnormalities, cancer, low birth weight, autism, *attention deficit-hyperactivity disorder,* kidney and liver damage and mortality[3]. They have the ability to disrupt the endocrine system in the body, and that is why they are classified as potent endocrine disruptors[4].

Phthalates esters including Dimehtyl phthalate, Dibutyl phthalate, Diethyl phthalate and di (2-ethylhexyl) phthalate (DEHP) are the main phthalates that are commonly used in cosmetics including deodorants. Inhalation of those phthalates through deodorants is considered as a potential source of phthalate exposure[5]. Hence, the present study was undertaken to determine the level of different phthalate esters present in the commonly used deodorants.

OBJECTIVE OF THE STUDY

To identify and estimate the amount of phthalates *viz.*,(DBP), (DEP), (DEHP), (DMP) present in the commonly used deodorants in UAE by using HPTLC.

MATERIALS AND METHODS

Chemicals

HPTLC plates, DEP, DEHP, DBP and DMP standards were purchased from Sigma-Aldrich. Toluene, ethyl acetate, and hexane were purchased from Merck (Darmstadt, Germany). Toxi tubes (A) tubes were purchased from Agilent Technologies (Delaware, USA).

Samples

Ten brands of most commonly used deodorants; the volume and frequency of their use were selected based on a q**uestionnaire based survey**

Sample preparation

Liquid –liquid extraction was carried out by measuring accurately 1 ml of each deodorant sample and transferred into Toxi tube A (1.5 ml of buffering solution- pH 9 & organic solvent). The mixture was gently vertexed for 4 min and then centrifuged

for 5 min. The supernatant solution containing phthalate was removed carefully and used for analysis.

Phthalate identification and estimation

The HPTLC (CAMAG, Muttenz, Switzerland) was optimized for phthalate identification and estimation in deodorants. Three solvent systems *viz.*, Toluene & Ethyl acetate (8:2), Toluene & Ethyl acetate (5:5) and Toluene & Hexane (8: 2) were showed better resolution and they were used for identification of phthalates. Densitometric scanning was performed with a wavelength range of 200-400nm (TLC scanner, CAMAG, Muttenz, Switzerland) and the spectrum showed an absorption maximum wavelength (λ_{max}) was used for the identification and estimation of phthalates.

Phthalates were identified in deodorants by comparing R_f value with that of standards. Five point calibration curves were prepared for each phthalate ester. The linearity range was determined by using the stock solution of 0.1 mg/ml of DMP, 1.0 mg/ml of DBP & DEP and 5.0 mg/ml of DEHP. HPTLC peak areas were determined and a calibration curve for each phthalate was obtained by plotting peak area versus concentration of phthalate. Estimation of each phthalate ester was done using the standard calibration curve for each phthalate ester.

RESULTS

Identification of phthalates

DEP, DEHP, DBP, and DMP were found in most of the deodorants and all these four phthalates were present together in only two deodorants.

Estimation of phthalates

DEP, DEHP, DBP, and DMP were estimated with a concentration range of 23 to 924, 255-1402, 7-2119, and 16-84 ug/ml, respectively. DBP was found in higher concentration followed by DEHP and DEP. DMP was found only in 4 samples and its concentration was found to be less when compared to other phthalates (Table 1). In order to calculate the hazard indices, the daily phthalate exposure for humans was calculated from volume and frequency of deodorant use. Further, the human phthalate absorption data were not available, rat dermal absorption of phthalates was extrapolated[5] to calculate the daily human exposure. The Hazard Indices for all the estimated phthalates were found to be below 1.

Table 1. Estimation of Different Phthalates in Deodorants Samples by HPTLC

SL.No.	Concentration (µg per ml)			
	DEP (Mean ± SD)	DEHP (Mean ± SD)	DBP (Mean ± SD)	DMP (Mean ± SD)
1.	344.70 ±16.24	255.06 ± 9.82	726.80 ± 33.56	-
2.	-	-	19.27 ± 1.88	-
3.	679.14 ± 6.00	469.43 ± 49.73	85.40 ± 4.42	83.81 ± 5.43
4.	924.4 ± 4.78	1402.44 ± 24.09	2119.35 ± 26.34	52.15 ± 7.31
5.	-	-	-	-
6.	703.60 ± 14.28	-	-	16.45 ± 0.62
7.	23.603 ± 0.04	-	16.10 ± 1.08	-
8.	661.37 ± 31.13	-		-
9.	-	-	44.07 ± 3.80	-
10.	-	-	7.67 ± 0.48	34.40 ± 0.53

DISCUSSION

We have identified and estimated the phthalates esters (DBP, DEP, DEHP and DMP) in commonly used deodorants in UAE. We have found that at least one phthalate was present in all the deodorants studied. Further, we also found that the calculated hazard indices were below one, which indicates the less human health risk associated with the use of deodorants studied.

Phthalate esters are used in deodorants or perfumes to stabilize the fragrance[6]. People are exposed to phthalates through their daily contact with consumer products, food, and indoor air[7]. In spite of their widespread presence in cosmetics and other common consumer products, little is known about human exposure to phthalates. In 2000, researchers at the Centers for Disease Control and Prevention (CDC) reported that they had identified 7 urinary phthalate metabolites in 289 subjects[3]. Hence, this necessitates calculating the human health risk associated with phthalate exposure. If sufficient information is not available regarding the human absorption of phthalates; animal data can be extrapolated[8] to find out the possible human health risk based on the volume and frequency of deodorant use. We have estimated volume and frequency of deodorants use based on previous validated protocol[9].

Hazard indices can be calculated using daily exposure level and regulation level. We have calculated the daily exposure level based on volume and frequency of

use and rate of absorption. However, there are no unified regulation levels for all the four phthalates from a single regulatory agency; we have used the available regulatory level from multiple sources. The Scientific Committee on Toxicity, Ecotoxicity, and the Environment CSTEE set a tolerable daily intake (TDI) of DEHP at 37 µg/kg/d. The Agency for Toxic Substances and Disease Registry (ATSDR) set a minimal risk level (MRL) of 7000 µg DBP/kg/d, and the International Programme on Chemical Safety (IPCS) set an acceptable daily intake (ADI) level of 66 µg DBP/kg/d[10-12].

The Hazard Indices for phthalates estimated in different brands of deodorants were found to be below 1, which implies that the daily exposure level is lower than the recommended regulation level. It should be also noted that the estimation of daily human exposure to phthalates and the risk assessment were performed in our study based on the assumption that only through skin absorption, which does not reflect the definite exposure conditions. However, the present finding suggests that necessary regulatory steps to be taken to monitor the use of phthalates in cosmetics and further studies should be done to calculate the human absorption rate of phthalates.

CONCLUSION

In our study, the different phthalates (DBP, DEP, DEHP and DMP) contents in 10 brands of commonly used deodorants in UAE were identified and estimated. The Hazard Indices for phthalates estimated (DBP, DEP, DEHP and DMP) in different brands of commonly used deodorants in UAE were found to be below 1. The actual intake of the individual phthalates should be reconsidered and determined more accurately using validated methodologies to calculate accurately the human absorption rate and then definite risk assessment of exposure to these four phthalates (DBP, DEP, DEHP and DMP) could be determined. The health and environmental protection agencies disagree that phthalates have not been proven to be safe for any use, including cosmetics and suggest that manufacturer should consider using alternative ingredients until further research proves the safety of phthalates.

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