ESTIMATION OF EXPOSITION TO SELECTED CONTAMINANTS IN DAIRY PRODUCTS CONTAINED IN PLASTIC PACKAGING

Antía Lestido*, Ana Rodríguez Bernaldo de Quirós*, Raquel Sendón*, Juana Bustos**, Perfecto Paseiro*

*Department of Analytical Chemistry, Nutrition and Food Science, Faculty of Pharmacy. University of Santiago de Compostela, Spain.
** National Centre for Food, Spanish Agency for Food Safety and Nutrition, Majadahonda, Spain.

INTRODUCTION

It is essential guarantee the safety of packaging materials since low-molecular substances can migrate from the material into the food and represent a risk for the health of the consumers. In the present study a methodology based on a total diet study (TDS) approach was designed to estimate the exposure to different chemicals present in plastic food packaging. As a first step, a gas chromatography with mass spectrometry (GC-MS) screening was conducted to simply and rapidly determine the identity of potential contaminants present in the materials. Then, some chemicals previously detected in the packaging (diethyl phthalate, benzophenone, 1,3-diphenylpropane, diisobutyl phthalate, dibutyl phthalate, bis(2-ethylhexyl)phthalate, bis(2-ethylhexyl) terephthalate) were selected and analyzed by GC-MS in the foodstuffs. The proposed methodology was applied to dairy products contained in plastic packaging that were purchased in local supermarkets, lyophilized and stored until the analysis. The foodstuffs included (whole milk, semi-skimmed milk, natural yogurt, strawberry yogurt, egg flan with caramel, egg flan, custard, semi-cured cheese, molten cheese, mozzarella and pasteurized cheese) were pooled into three groups according to the population age (12-35 months, 3-9 years and 10-17 years) and based on the Spanish consumption data (Enalia). The exposure was calculated by combining the concentration of compounds in the packaged foods with the consumption data.

MATERIALS AND METHODS

IDENTIFICATION OF POTENTIAL MIGRANTS IN PACKAGING MATERIALS
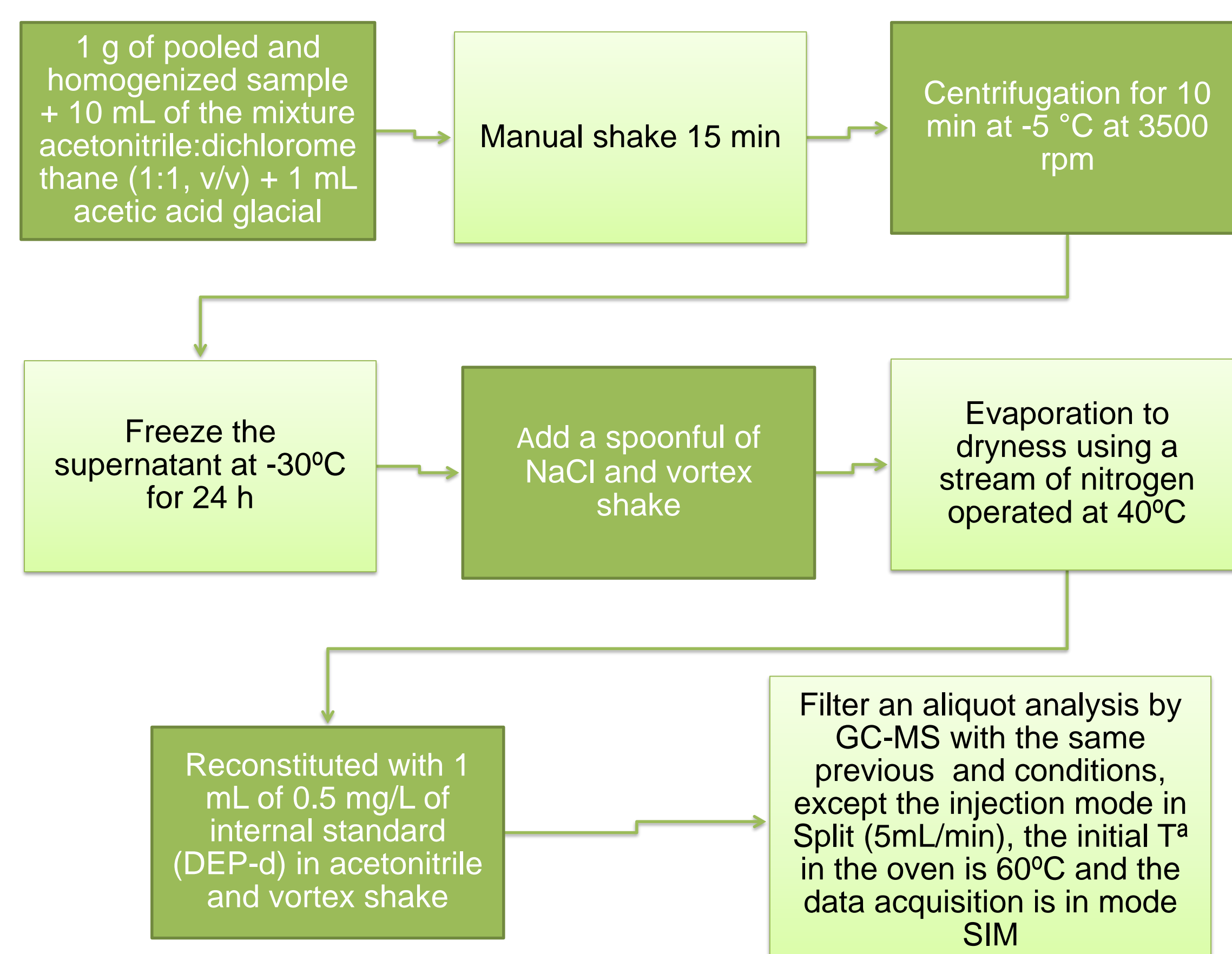
A gas chromatography with mass spectrometry (GC-MS) method was developed to identify potential migrants in an extract of the packaging. For this purpose, a Trace 1300 Series Gas Chromatograph with a Trace ISQ LT mass detector and an AI 1310 autosampler was used.

Injection Tª	300ºC
Injection volume	1µL
Injection	Splitless mode
Carrier gas	Helium 1mL/min
Column	ZB-5MS (30 m x 0.25 mm x 0.25 µm)
Tª gradient	40-300ºC
Ionization source	Electron impact
Transfer line Tª	300ºC
Detector Tª	300ºC
Data acquisition	Full scan (range m/z 35-500)
Spectrum library	NIST/EPA/NIH 11 v. 2.0 & Wiley 8th

Table 1: Experimental conditions of GC-MS method.

QUANTIFICATION IN THE FOODSTUFFS

1 g of pooled and homogenized sample + 10 mL of the mixture acetonitrile:dichloromethane (1:1, v/v) + 1 mL acetic acid glacial → Manual shake 15 min → Centrifugation for 10 min at -5 °C at 3500 rpm

Freeze the supernatant at -30ºC for 24 h → Add a spoonful of NaCl and vortex shake → Evaporation to dryness using a stream of nitrogen operated at 40ºC

Reconstituted with 1 mL of 0.5 mg/L of internal standard (DEP-d) in acetonitrile and vortex shake → Filter an aliquot analysis by GC-MS with the same previous and conditions, except the injection mode in Split (5mL/min), the initial Tª in the oven is 60ºC and the data acquisition is in mode SIM

RESULTS AND DISCUSSION

TR	Compound	CAS no.	SML (1)	m/z
17.37	Diethyl phthalate (DEP)	84-66-2	-	149, 150, 177
18.02	Benzophenone (BP)	119-61-9	0.6 mg/kg	77, 105, 182
18.27	1,3- diphenylpropane (1,3-DPP)	1081-75-0	-	92, 105, 196
20.70	Diisobutyl phthalate (DIBP)	84-69-5	-	57, 149, 150
21.75	Dibutyl phthalate (DBP)	84-74-2	0.3 mg/kg	149, 150, 155
27.35	Bis(2-ethylhexyl)phthalate (DEHP)	117-81-7	1.5 mg/kg	57, 149, 167
29.11	Bis(2-ethylhexyl) terephthalate (DEHT)	6422-86-2	60 mg/kg	70, 112, 149

Table 2: Chemicals selected identified in the food packaging analyzed.

Compound	Regression line (mg/L)	R²	LOD (µg/g)	Sample Concentration (µg/g)
DEP	y=1.6592x+0.1137	0.9940	0.01	0.025-0.032
BP	y=0.5995x+0.0401	0.9941	0.05	<LOD
1,3-DPP	y=1.4391x+0.0164	0.9932	0.025	<LOD
DIBP	y=2.3345x+0.0726	0.9981	0.005	0.050-0.104
DBP	y=2.323x0.0116	0.9984	0.005	0.092-0.163
DEHP	y=0.9686x-0.0019	0.9900	0.005	0.067-0.090
DEHT	y=0.3052x-0.009	0.9909	0.025	<LOD

Table 3: Parameters of linearity and sample concentrations.

POOL	Mean (µg/kg bw per day)			P95		
	12-35 months	3-9 years	10-17 years	12-35 months	3-9 years	10-17 years
DEP	1.2	0.82	0.47	6.2	3.6	2.3
BP	-	-	-	-	-	-
1,3-DPP	-	-	-	-	-	-
DIBP	3.5	1.6	1.5	18	7.1	7.5
DBP	4.4	2.9	2.4	23	13	12
DEHP	4.1	2.1	1.3	21	9.4	6.5
DEHT	-	-	-	-	-	-

Table 4: Dietary exposure.

Results of this study indicate a low overall exposure of Spanish consumers to chemical compounds from plastic food packaging. Mean dietary exposure of identified compounds in pooled dairy products samples presents values ranging from 0.47 µg/kg bw/day (DEP, pool 10-17 years) to 4.4 µg/kg bw/day (DBP, pool 12-35 months). However, this high result for the DBP is below the value of the tolerable daily intake (TDI) of 50 µg/kg bw/day established by the EFSA´s Panel on Food Contact Materials, Enzymes and Processing Aids for this phthalate (2).

References

(1) Regulation (EU) No 10/2011 of 14 January 2011 on plastic materials and articles intended to come into contact with food. Official Journal of the European Union, 2011, L 12: 1–89.
(2) European Food Safety Authority [Online]. Available on: http://www.efsa.europa.eu/en/press/news/190221 [Cited Mar 2019].

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