



Chemical migration and food contact materials

Edited by Karen A. Barnes, C. Richard Sinclair
and D. H. Watson

Contents

<i>Contributor contact details</i>	<i>xiii</i>
1 Chemical migration into food: an overview	1
<i>L. Castle, Defra Central Science Laboratory, UK</i>	
1.1 Introduction	1
1.2 Chemical migration and the main factors that control it	3
1.3 The range and sources of chemicals in food packaging that pose a potential risk	7
1.4 Health issues	8
1.5 Key scientific advances – achieved and needed	9
1.6 Future trends	12
1.7 Sources of further information and advice	12
Part I Regulation and quality control of chemical migration into food	15
2 Regulation of food contact materials in the USA	17
<i>M. L. Twaroski, L. I. Batarseh and A. B. Bailey, United States Food and Drug Administration, USA</i>	
2.1 Introduction	17
2.2 Regulatory authority	17
2.3 Regulatory considerations	22
2.4 Food contact notifications	24
2.5 Pivotal and emerging issues in FDA's approach to safety assessment	38
2.6 Conclusions	41
2.7 Acknowledgements	42
2.8 References	42
3 Regulation of food contact materials in the EU	43
<i>A. Schäfer, European Commission, Belgium</i>	
3.1 Introduction	43
3.2 Community legislation	44

3.3	Framework regulation	44
3.4	Plastics	47
3.5	Other materials	49
3.6	Control of food contact materials in the EU.....	53
3.7	Specific national legislation	55
3.8	Strengths and drawbacks of EU legislation	56
3.9	Future trends	60
3.10	References	62
4	Traceability and food contact materials	64
<i>D. Dainelli, Sealed Air Corporation, Italy and The European Plastics Converters Association (EuPC), Belgium</i>		
4.1	Introduction	64
4.2	Regulation of traceability of food contact materials	65
4.3	Industrial guidelines for traceability of materials and articles for food contact	68
4.4	Ensuring the traceability of food contact materials	72
4.5	Case study: traceability of plastic materials for food contact	77
4.6	Conclusions	82
4.7	References	83
Part II	Assessing the risks and improving the safety of food contact materials	85
5	Compliance testing of chemical migration from food contact materials	87
<i>R. Veraart and L. Coulier, TNO Quality of Life, The Netherlands</i>		
5.1	Introduction	87
5.2	Administrative compliance evaluation	88
5.3	Conventional experimental compliance testing	92
5.4	Non-target migration testing	106
5.5	Future trends and requirements for screening and analysis of migrants	114
5.6	Sources of further information and advice	119
5.7	References and further reading	119
6	Exposure estimation – the missing element for assessing the safety of migrants from food	122
<i>P.K.T. Oldring, The Valspar Corporation, UK</i>		
6.1	Introduction	122
6.2	What is exposure?	124
6.3	Who and what should be considered in any exposure assessment?	126
6.4	What data are needed in order to estimate exposure?	128
6.5	Obtaining concentration data	129
6.6	Obtaining food consumption data	136

6.7	Estimating exposure to migrants from food contact articles	141
6.8	Conclusions	153
6.9	Sources of further information and advice	154
6.10	References and bibliography	155
7	Toxicology and risk assessment of chemical migrants from food contact materials	158
	<i>K. B. Arvidson, M. A. Cheeseman and A. J. McDougal, United States Food and Drug Administration, USA</i>	
7.1	Introduction	158
7.2	Regulatory framework for food contact materials in the United States	158
7.3	Safety assessment of food additives	159
7.4	Safety assessment for non-carcinogenic endpoints	161
7.5	Threshold approaches to safety assessment	161
7.6	Carcinogenicity risk assessment for constituents of food additives	166
7.7	Structure activity relationship (SAR) analysis in the safety assessment of constituents of food additives	169
7.8	Qualitative SAR analysis of food additives and constituents	170
7.9	Quantitative SAR (QSAR) analysis in the safety assessment of constituents	172
7.10	Safety assessment of carcinogenic constituents of food additives	173
7.11	Future trends	175
7.12	References	176
8	Mathematical modelling of chemical migration from food contact materials	180
	<i>O. Piringer, Fabes GmbH, Germany</i>	
8.1	Introduction	180
8.2	Transport equations	181
8.3	Solutions of the diffusion equation	185
8.4	The diffusion coefficient	195
8.5	The partition coefficient	198
8.6	Possibilities and limitations of migration modelling	198
8.7	Exercises	199
8.8	References	201
Part III Chemical migration from particular food contact materials	203	
9	Recycled plastics and chemical migration into food	205
	<i>F. Welle and R. Franz, Fraunhofer Institute for Process Engineering and Packaging, Germany</i>	
9.1	Introduction	205

9.2	Legislative aspects	206
9.3	Special considerations for using recycled materials as food contact materials	207
9.4	Assessing the safety of recycled food contact materials .	209
9.5	Use of functional barriers	215
9.6	Sources of further information and advice.....	221
9.7	Glossary	222
9.8	References	224
10	Plastics and chemical migration into food	228
	<i>I. Cooper, Pira International, UK</i>	
10.1	Introduction	228
10.2	Testing plastics materials for compliance with EU directives	229
10.3	Properties and composition of plastic FCMs	236
10.4	Degradation products and impurities.....	242
10.5	Future trends	248
10.6	Sources of further information and advice.....	249
10.7	References	249
11	Metal packaging and chemical migration into food	251
	<i>R. Whitaker, Crown Packaging, UK</i>	
11.1	Introduction	251
11.2	Regulation and use of metals as food contact materials .	257
11.3	Special considerations of using metals as FCMs	262
11.4	Assessing the safety of metal FCMs	265
11.5	Future trends	268
11.6	Sources of further information and advice.....	269
11.7	References	270
12	Rubber and chemical migration into food	271
	<i>M. Forrest, Rapra Technology, UK</i>	
12.1	Introduction	271
12.2	Rubber materials and products used in contact with food	273
12.3	Regulation and the use of rubber as a food contact material	278
12.4	Special considerations for using rubber as a food contact material	283
12.5	Assessing the safety of rubber as a food contact material	284
12.6	Improving the safety of rubber as a food contact material	292
12.7	Future trends	295
12.8	Sources of further information and advice.....	298
12.9	References	300

13 Food packaging inks and varnishes and chemical migration into food	302
<i>B. Aurela, KCL, Finland and L. Söderhjelm, Finland</i>	
13.1 Introduction	302
13.2 Major concepts	303
13.3 Inks and ink components	304
13.4 Regulations and recommendations as regards food packaging	305
13.5 Problems related to packaging inks	308
13.6 Testing	311
13.7 Sources of further information and advice.....	317
13.8 References	318
14 Food packaging adhesives and chemical migration into food	320
<i>E. Bradley and L. Castle, Defra Central Science Laboratory, UK</i>	
14.1 Introduction	320
14.2 Examples of adhesive types used in food packaging applications	321
14.3 Regulation of adhesives	323
14.4 Chemical migration from food packaging adhesives	324
14.5 Future trends	330
14.6 Sources of further information and advice.....	330
14.7 References	331
15 Safety assessment of paper and board used in food packaging	333
<i>A. von Wright, University of Kuopio, Finland</i>	
15.1 Introduction	333
15.2 Regulatory background	333
15.3 The perceived need for toxicological testing	335
15.4 Presently available short-term toxicological tests	336
15.5 The application of short-term tests to paper and board...	340
15.6 Conclusions	342
15.7 References	344
16 Chemical migration from multi-layer packaging into food ..	346
<i>J. Sidwell, Rapra Technology, UK</i>	
16.1 Introduction	346
16.2 Regulation and the use of multi-layer packaging	350
16.3 Special considerations about multi-layer packaging and chemical migration	352
16.4 Published data on migration from laminating adhesives.	359
16.5 Improving the safety of multi-layer packaging with regard to chemical migration	368

x Contents

16.6	Sources of further information and advice	369
16.7	References	369
17	Chemical migration from active and intelligent packaging materials into food	371
	<i>R. Rijk, Keller and Heckman LLP, Belgium</i>	
17.1	Introduction	371
17.2	Use of active and intelligent packaging	372
17.3	Regulation of active and intelligent packaging	376
17.4	Migration from active and intelligent packaging into foodstuffs	385
17.5	Future trends and sources of further information	391
17.6	References	391
18	Chemical migration from secondary packaging into foods ..	395
	<i>S. Jickells, King's College London, UK</i>	
18.1	Introduction	395
18.2	Materials in use	395
18.3	Length of time in secondary packaging	397
18.4	Legislation and testing	397
18.5	Chemical migration from secondary packaging materials	398
18.6	Improving the safety of secondary packaging materials with regard to chemical migration	409
18.7	Future trends	413
18.8	Sources of further information and advice	414
18.9	References	414
19	Case study: Chemical migration from snack and take-away food packaging	416
	<i>E. Bradley, Defra Central Science Laboratory, UK</i>	
19.1	Introduction	416
19.2	Definitions	417
19.3	Usage statistics for snack and take-away foods	417
19.4	Food packaging materials used for snack and take-away foods	418
19.5	Chemical migration	419
19.6	Sources of further information and advice	427
19.7	References	427
20	Case study: Poly EthyleneTerephthalate (PET) as a food contact material	429
	<i>M. Neal, Petkoncept, UK</i>	
20.1	Introduction	429
20.2	PET manufacture	430
20.3	PET uses	430
20.4	Self regulation	432

20.5	What is PET?	434
20.6	Monomers – the basic building blocks	434
20.7	Comonomers – the property changers	436
20.8	Other comonomers	438
20.9	Additives – production and processing additives	438
20.10	Effect additives	441
20.11	Recycled PET for food contact applications	443
20.12	PET issues	444
20.13	Future trends	444
20.14	Acknowledgements	446
20.15	References	446
	Index	448