Available online at www.japt.tpa.usab-tm.ro

Journal of Agroalimentary Processes and Technologies 2009, *15* (4), 530-535

Journal of Agroalimentary Processes and Technologies

Safety of plastic packages in contact with cheeses

Corina Aurelia Zugravu, Gabriela Cilincă

Institute of Public Health, Bucharest, dr. Leonte str., nr.1-3, Bucharest, Romania

Received: 02 Octomber 2009; Accepted: 11 November 2009

Abstract

In the contemporary world, almost all foodstuffs on market are packed. Once the package material chosen, it is essentially to know if there is any interaction between food and the material in contact. The objective of this study was the supervising and control of materials in direct contact with cheeses in 2005 and 2008 and consisted in: identifying the conditions of contact between food and package, identifying the extraction conditions and verifying the global migration of components. The value of global migration of components from plastics tested before and after the contact with cheeses was not over the limits imposed by the legislation (10 mg/dm2 or 60 mg/kg). In conclusion, plastic materials in contact with foods are stable and respect the in force legislation.

Keywords: package, material in contact, migration, food

1. Introduction

Nowadays, almost all foodstuffs on market are packed. Once the package material chosen, it is essentially to know if there is any interaction between food and the material in contact.

Though even small interactions can be detected by means of sophisticated analytical procedures, the monitoring of migration can be relatively simple. The surplus of the global migration of components, going beyond the limits imposed by legislation, is due to the transfer of unwanted substances from the package, to the food and represents a hazard for human health.

The objective of this study was the supervising and control of materials in direct contact with cheeses in 2005 and 2008.

2. Material and methods

The study was carried in 2005 and 2008 in 19 Romanian counties: Bihor, Brasov, Braila, Botoşani, Călăraşi, Cluj, Constanţa, Dâmboviţa, Dolj, Galaţi, Harghita, Maramureş, Prahova, Satu Mare, Salaj, Sibiu, Suceava, Timis and Vrancea.

The supervising and control of the materials in contact with food consisted in: identifying the conditions of contact between food and package, identifying the extraction conditions and verifying the global migration of components.

$$M = \frac{m \cdot a_2}{a_1 \cdot q} \cdot 1000$$

The global migration of components, *M*, representing the mass of substance migrating from the tested material, into the simulant (Government Decision no. 1.197/2002), was evaluated by gravimetry, followed by a correction made with the formula[1]:

Where:

M – is the migration in mg/kg;

M – is the weight of the substances eliminated by the sample which was determined by the test of migration, in mg;

a_1 – is the specific surface of the sample room temperature with food or the simulant during the test for migration, in dm^2;

Corresponding author: *e-mail address*: corinazugravu@gmx.net

a_2 – is the specific surface of the material or object in the real conditions of use, in dm^2;

q – is the amount of food that comes room temperature with the material or objects in the real conditions of use (in grams). Global migration of components in an extraction liquid, respectively in a simulant, are evaluated in severe conditions, in order simulate the most difficult situations to which the material could be exposed in its practical use [2]. Testing conditions are represented by temperature, contact duration and a specific simulant. In order to identify the food simulant for testing, it is necessary to know the type of food to come in contact with the analyzed material. Food simulants have been introduced in testing studies because it is not always possible to use food to test materials in contact. Simulants are classified, by convention, in function of the characteristics of one or several types of foodstuff they can replace. The classification of foodstuff and simulants used in testing are figured in table 1 [3].

When it comes to diary products, the value of pH is very different, but always low [4, 5]. Sour diary products, a very diverse but frequently consumed category, have, as their name shows, a low (acid) pH, conferring them the propriety to interact aggressively with the package.

The pH is situated at the casein isoelectric point (4,2), but can be even lower during the preservation of the products at low temperatures (0-5^{0}C), due to the activity of oligosaccharide enzymes of the lactic fermenting flora, which is working even at low temperatures [6, 7].

The high acidity of fermented diary foodstuffs is caused by fermentation products, mainly by lactic acid, but there are also secondary substances, for example acetic acid in small quantities. There cannot be neglected secondary alcoholic fermentations, producing small quantities of ethylic alcohol, in products like “kefir” or “cumas”. Last, but not least, fermented diary products have in their composition carbon dioxide of natural origin [8, 9]. Regarding cheeses, pH is variable not only between sorts, but even between cheeses produced at different moments. Usually, the pH is between 5, 1 and 5, 9, with some notable exceptions, like camembert, that has 7, 4 [10-13].

Table 1. Types of foodstuff and food simulants

Type of food/ Abbreviation	Conventional classification	Food simulants
Simulant A Food with water content that have the pH > 4.5	Food for which only the test with simulant A is envisaged	Distilled water or water of equivalent quality
Simulant B Food with acid content (food with water content that have the pH ≤ 4.5)	Food for which only the test with simulant B is envisaged	3% acetic acid (m/v)
Simulant C Food with alcohol content	Food for which only the test with simulant C is envisaged	10% ethanol (v/v) This concentration can be adapted to the real alcoholic concentration of the food if it exceeds 10% (v/v)
Simulant D Food with fat content	Food for which only the test with simulant D is envisaged	Refined olive oil or other simulants with fat content
Dehydrated foods	None	None

When it comes to diary products, the value of pH is very different, but always low [4, 5]. Sour diary products, a very diverse but frequently consumed category, have, as their name shows, a low (acid) pH, conferring them the propriety to interact aggressively with the package. The pH is situated at the casein isoelectric point (4,2), but can be even lower during the preservation of the products at low temperatures (0-5^{0}C), due to the activity of oligosaccharide enzymes of the lactic fermenting flora, which is working even at low temperatures [6, 7].

The high acidity of fermented diary foodstuffs is caused by fermentation products, mainly by lactic acid, but there are also secondary substances, for example acetic acid in small quantities. There cannot be neglected secondary alcoholic fermentations, producing small quantities of ethylic alcohol, in products like “kefir” or “cumas”. Last, but not least, fermented diary products have in their composition carbon dioxide of natural origin [8, 9]. Regarding cheeses, pH is variable not only between sorts, but even between cheeses produced at different moments. Usually, the pH is between 5, 1

and 5, 9, with some notable exceptions, like camembert, that has 7, 4 [10-13].

3. Results and discussion

In table 2 there are the average values of global migration of components from different types of package plastic materials used in contact with cheeses in 2005: polyamide, polyamide /polyethylene, polystyrene, polyethylene, polypropylene and a plastic material whose composition was not specified in the papers.

The value of global migration of components from plastics tested before and after the contact with cheeses, using as simulants , the simulant A, B or D, during 10 days and at two temperatures (room temperature and 5º C) isn't over the limits imposed by the legislation (10 mg/dm^2 or 60 mg/kg). In table 3 there are figured the results of the same test, but carried out in 2008. It has to be underlined that the values have an orientative value, because the producers/retailers of each type of material are different.

Table 2. Global migration of components from package, to cheeses (tested in 2005)

Nr crt.	Nr.of samples	Package	Extraction conditions	Value of migration: mg/Kg A	Value of migration: mg/Kg B	Value of migration: mg/Kg D
1	11	PA film - non-utilized	5º C	15.03	8.31	13.64
			room temperature	14.70	27.69	15.75
		- in contact	5º C	9.94	9.85	13.97
			room temperature	14.77	4.53	28.83
2.	13	PA/PE film - non- utilized	5º C	-	-	-
			room temperature	10.308	16.958	42.56
		- in contact	5º C	-	-	-
			room temperature	-	-	134.27
3.	10	PS film - non-utilized	5º C	0	0	0
			room temperature	0	0	0
		- in contact	5º C	-	-	-
			room temperature	-	-	-
4.	5	PP film - non-utilized	5º C	0.27	0.52	0.72
			room temperature	0.58	0.86	0.37
		- in contact	5º C	3.55	1.02	2.27
			room temperature	2.15	1.96	4.16
5.	4	PE film - non-utilized	5º C	1.41	0.25	3.38
			room temperature	3.16	0.02	5.25
		- in contact	5º C	2.56	0.34	7.54
			room temperature	7.84	0.06	13.55
6.	7	Al film - non-utilized	5º C	0.011	-	-
			room temperature	-	-	-
		- in contact	5º C	-	-	-
			room temperature	-	-	-
7.	21	film - non-utilized	5º C	10.35	-	14.29
			room temperature	16.90	0.08	15.97
		- in contact	5º C	9.62	-	8.77
			room temperature	19.46	-	10.21

Table 3. Global migration of components, from package, to cheese (tested in 2008)

Nr crt.	Nr. of samples	Package	Extraction conditions	Value of migration mg/Kg - A	Value of migration mg/Kg - B	Value of migration mg/Kg - D
1	47	PE film - non-utilized	5^o C	14.7	-	2.72
			room temperature	2.13	13.2	2.63
		- in contact	5^o C	19.87	-	6.21
			room temperature	21.53	-	-
2.	10	PA/PE film - non-utilized	5^o C	16.85	-	10.41
			Room temperature	12.31	-	12.51
		-in contact	5^o C	17.1	-	8.46
			Room temperature	9.23	-	9.57
3.	4	PVC film - non-utilized	5^o C	13.28	-	15.63
			Room temperature	15.88	-	17.45
		-in contact	5^o C	5.00	-	9.13
			Room temperature	9.95	-	9.71
4.	2	PET/PA/ EVOH/PE - non-utilized	5^o C	42.06	-	31.69
			room temperature	-	-	-
		- in contact	5^o C	41.88	-	34.14
			room temperature	-	-	-
5.	2	PE/Tie/PA/ EVOH/PA/ Tie/PE - non-utilized	5^o C	1.98	-	1.17
			room temperature	-	-	-
		- in contact	5^o C	1.89	-	1.3
			room temperature	-	-	-
6.	1	PAfilm - non-utilized	5^o C	12.57	-	3.76
			room temperature	-	-	-
		- in contact	5^o C	-	-	-
			room temperature	-	-	-
7.	1	Polystyrene - non-utilized	5^o C	-	-	28.56
			room temperature	-	-	-
		- in contact	5^o C	-	-	22.68
			room temperature	-	-	-
8.	1	PP film - non-utilized	5^o C	0.87	-	1.13
			room temperature	1.00	-	1.91
		- in contact	5^o C	-	-	-
			room temperature	-	-	-

Comparing, both in 2005, and in 2008, the values of global migration of components from polypropylene coming in contact with food at room temperature are the lowest, the highest value being of 2.15 mg/kg. It is much lower than the migration from polyamide (10-20 mg/kg) or even from polyethylene (10-20 mg/kg).

For the multilayer material PE/Tie/PA/ EVOH/PA/ Tie/PE, the global migration is also very low (1.98 mg/kg). Regarding polystyrene, the values of global migration are rather high: 28.56 mg/kg, in the following extracting conditions: 10 days, 5^0C temperature and as simulant, the D type (refined olive oil) or other simulants containing fat.

In figures 1^a and 1^b, there has been figured the distribution of types of materials tested in 2005 and 2008.

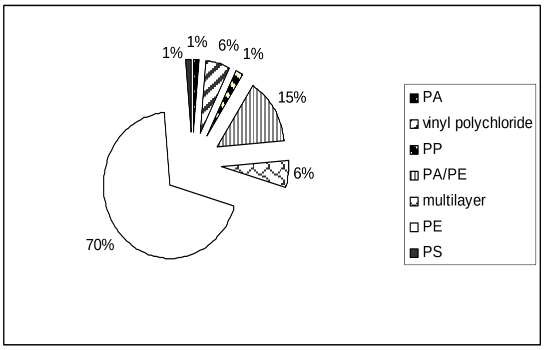

Figure1[a]. Materials in contact with cheeses in 2005

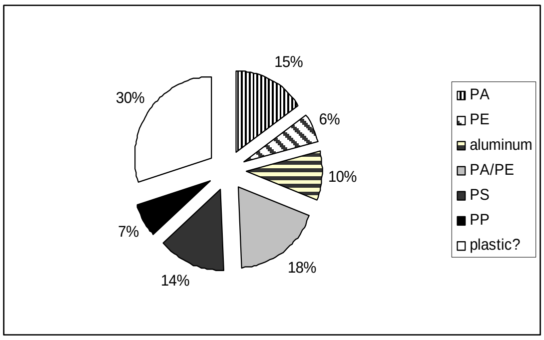

Figure 1[b]. Materials in contact with cheeses in 2008

In 2008 there have been tested multilayer materials in a percent of 6% of the total number of samples, compared with 2005, when only double layers materials have been tested. Comparing with 2005, in 2008 the package material polyethylene was tested in a considerable amount – 47 samples – over a half of the total number of tested samples.

Regarding polystyrene, its use in contact with cheeses is quite rare, because the material is a week barrier for water vapors, oxygen and carbon dioxide. [14].

4. Conclusions

In 2005, the main materials tested in contact with cheeses were polyamide/polypropylene, polyamide, polystyrene, aluminum film, polypropylene, polyethylene and a plastic with unknown composition. In 2008, the main materials tested were polyethylene, polyamide/polyethylene, PVC, multilayer film PET/PA/EVOH/PE, multilayer film PE/Tie/PA/EVOH/PA/Tie/PE, polystyrene, polyamide and polypropylene.

The multilayer materials are a very good alternative for preserving in optimal conditions packaged foodstuff. In spite of this fact, multilayer materials, with the exception of double layer materials PA/PE, are used in a small proportion, compared with the classical monolayer materials.

Choices made by food producers regarding package materials utilized in contact with foodstuff are motivated on one hand by economical reasons and on the other hand, by the intrinsic and physical proprieties of the material. Such proprieties can be resistance, oxygen, carbon dioxide, water permeability, and so on.

In conclusion, plastic materials in contact with food are stable and respect the in force legislation.

Abbreviations

Al - aluminum
EVOH - Copolymer ethylene vinyl alcohol
PA- polyamide
PE –polyethylene
PS - polystyrene
PP - polypropylene
PVC - polyvinyl chloride
PET - polyethylene terephthalate

References

1. *** Hotararea nr. 1197/2002 pentru aprobarea Normelor privind materialele si obiectele care vin room temperature cu alimentele, publicata in Monitorul Oficial al Romaniei, Partea I, nr. 883/7.02.2002.
2. *** Directiva 93/8/CEE a Comisiei din 15 martie 1993 de modificare a Directivei 82/711/CEE a Consiliului de stabilire a normelor de bază privind verificarea migrării constituenților materialelor şi ai obiectelor din material plastic care vin în contact cu produsele alimentare, publicată în Jurnalul Oficial al Comunităților Europene nr. L 90, 14.4.1993.
3. *** Directiva Consiliului 82/711/CEE care stabileşte regulile fundamentale necesare pentru testarea migrării constituenților materialelor şi obiectelor din material plastic care vin în contact cu alimentele, publicată în Jurnalul Oficial al Comunităților Europene nr. L 297 din 23 octombrie 1982
4. Mănescu, S., Tănăsescu, G., Dumitrache, S., Cucu, M., *Igiena*, Editura Medicală, Bucureşti, 1991, p. 286.
5. Horne, D.S., *Casein interactions: casting light on the Black Boxes, the structure in dairy products*, International Dairy Journal, **8**, 1998, p. 171-177.
6. Lawrence, R.C., Heap, H.A. şi Gilles, J., *A controlled approach to cheese technology*, Journal Dairy Science, **67**, 1984, p. 1632-1645.
7. Mullan, W.M.A., *Classification of cheese types using calcium and pH*, [On-line] UK: Available: http://www.dairyscience.info/cheese-manufacture/114-classification-of-cheese-types-using-calcium-and-ph.html. Accessed: 3 October, 2009, (2005)

8. Florea, T., Bahrim, G., *Analiza chimică şi microbiologică a brânzeturilor* în Ştiința şi tehnologia brânzeturilor, Editura Academica Galați, 2003, p 476-560.
9. Walstra, P., *Physical Chemistry of Foods*, Marcel Dekker Inc New York, 2003, p. 684.
10. Krager, M., *Kefir* în Cultured Daily Product Journal, **28**(2):26, 1999, p. 28-29.
11. Stepaniak, L., Fetlinski, A., *Kefir*, în Encyclopedia of Diary Sciences, Academic Press, London, 2003.
12. Wilde, J., Baumgartner, C., Fertsch, B., Hinrichs, J., *Matrix effects on the kinetics of lactose hydrolysis in fermented acidified milk products*, Chem. Biochem Eng., **15**(4), 2001, p.143-147.
13. Bahrim, G., Borda, D., Costin, G., *Produse lactate fermentate,* Editura Academica Galați, 2006, p. 105-114, 248-303.
14. *** ILSI Europe Report Series Packaging Materials **2.** *Polystyrene for Food Packaging Application,* ILSI Press, 2002, p.5.