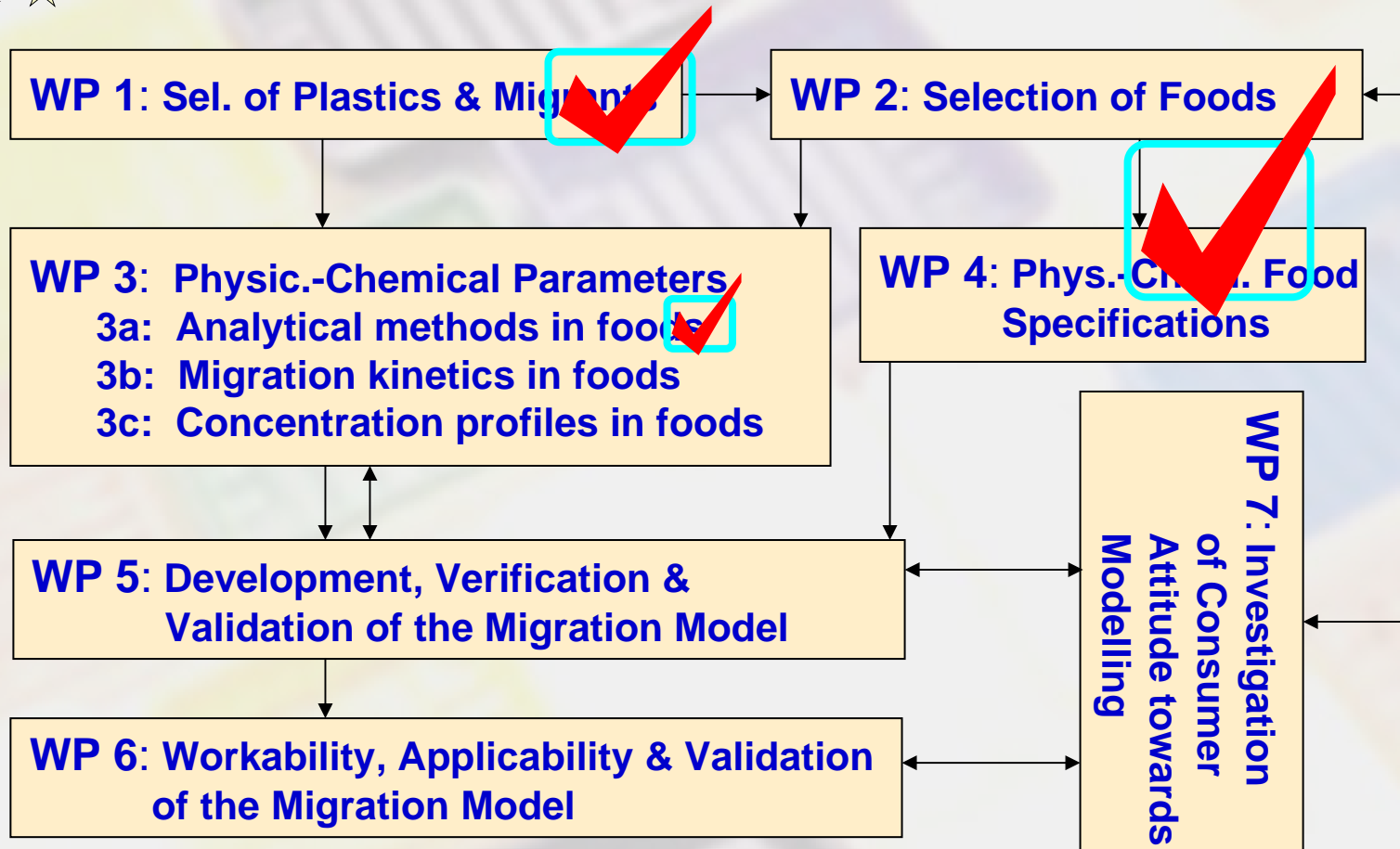


Systematic Migration Studies into Foods

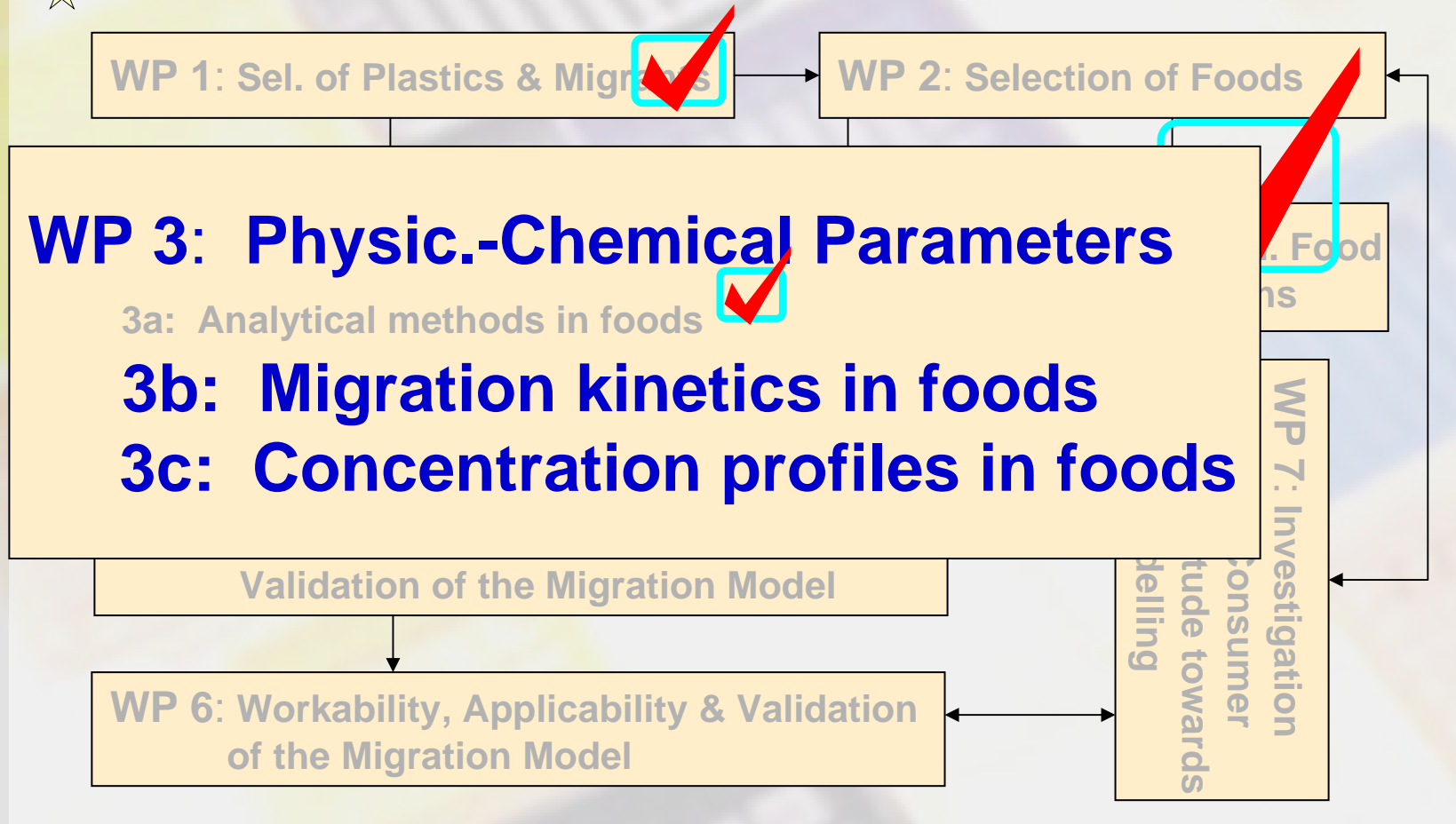
Roland Franz,
on behalf of project partners
in work packages 3b and 3c,



Project structure



Project structure



Target parameters for migration



$$M = f(C_{P,0}, D_P, D_F, K_{P/F})$$

- Migration **M** from a polymer into food is mainly a function of
- initial migrant concentration in the polymer, **C_{P,0}**,
 - mobility of migrant in the polymer, i.e. its diffusion coefficient **D_P**
 - transfer of migrant from polymer surface into and its mobility in the food, both could be summarized as effective diffusion coefficient **D_F**
 - partition coefficient between polymer and food, **K_{P/F}**



Target parameters for migration



3b: Migration kinetics



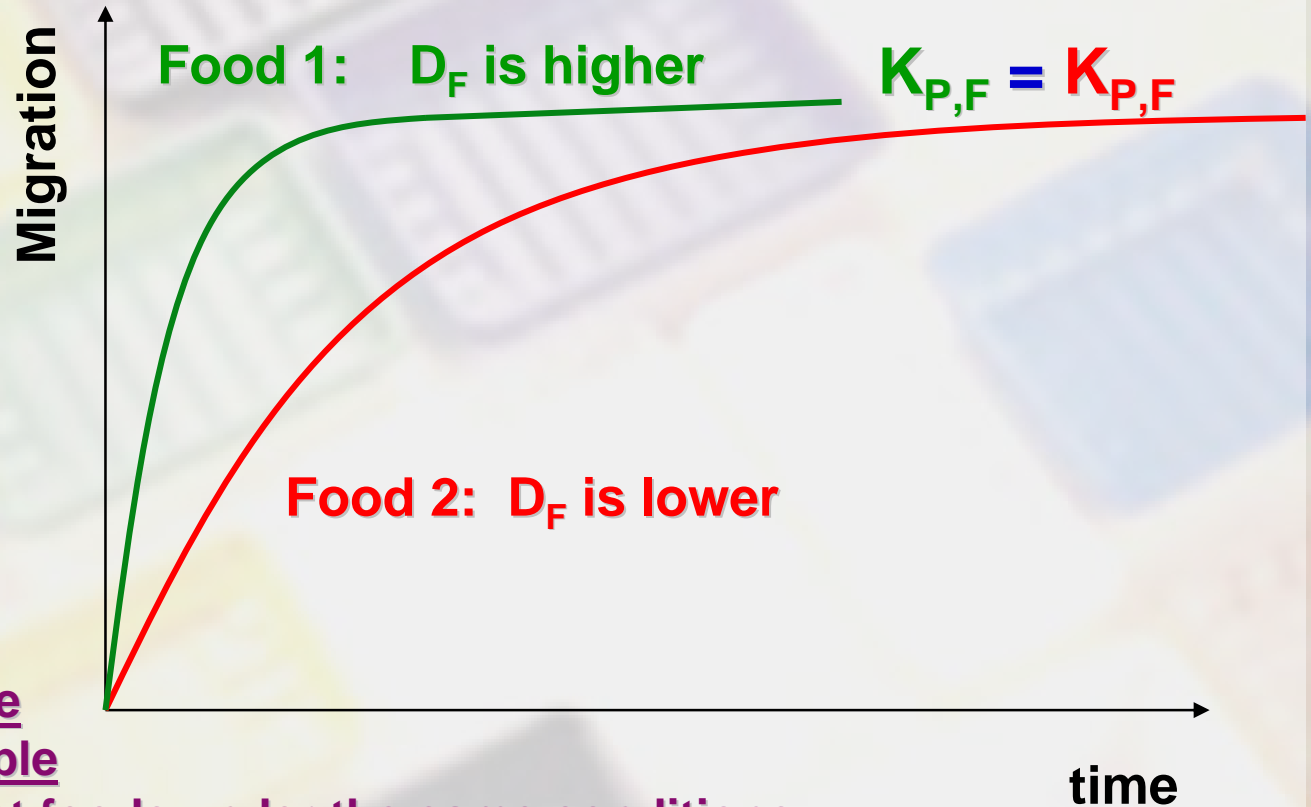
Migration from the same polymer sample into 2 different foods under the same conditions



Target parameters for migration



3b: Migration kinetics



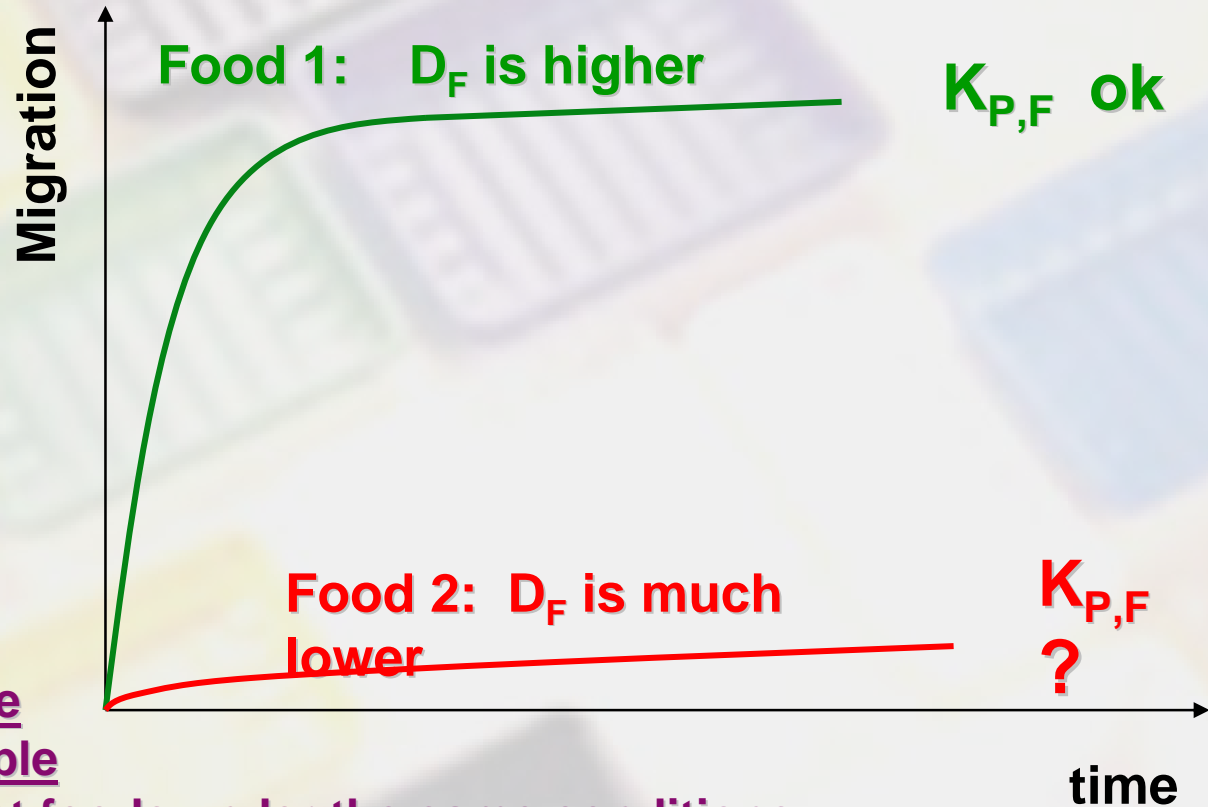
Migration from the same polymer sample into 2 different foods under the same conditions



Target parameters for migration



3b: Migration kinetics



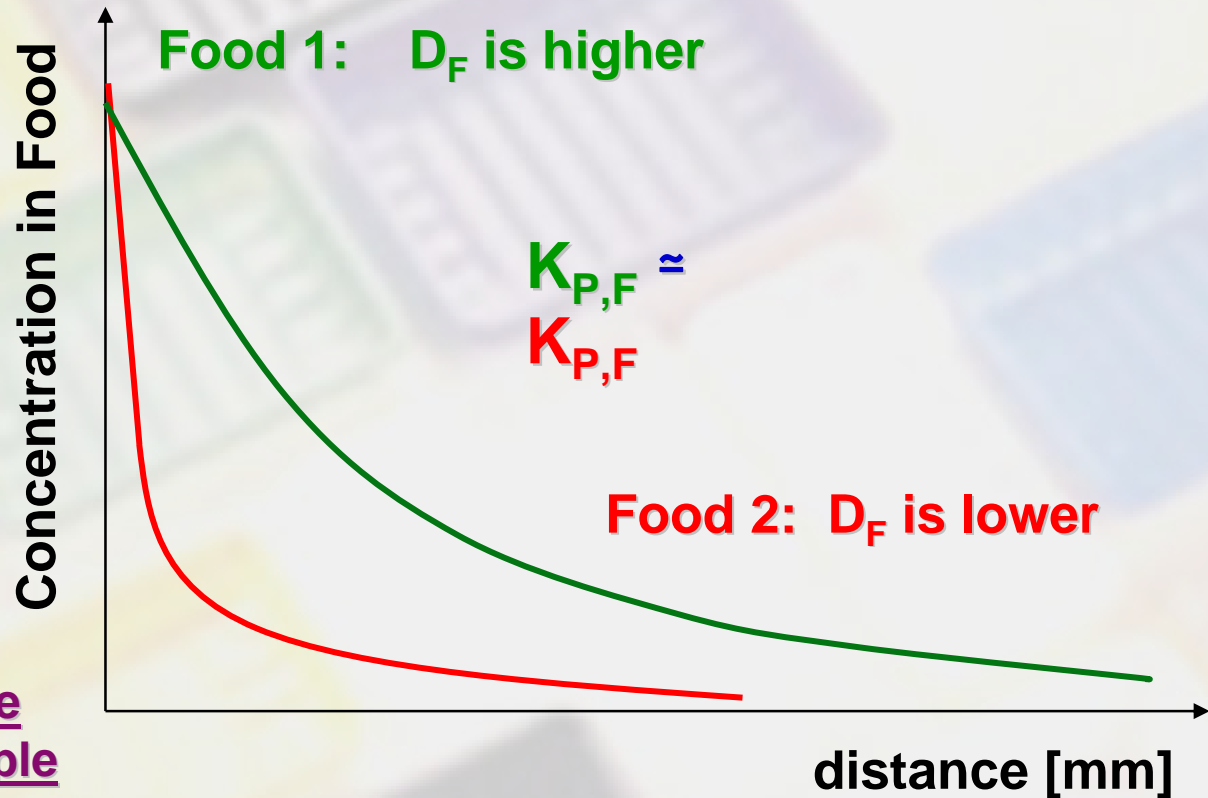
Migration from the same polymer sample into 2 different foods under the same conditions



Target parameters for migration



3c: Concentration profiles



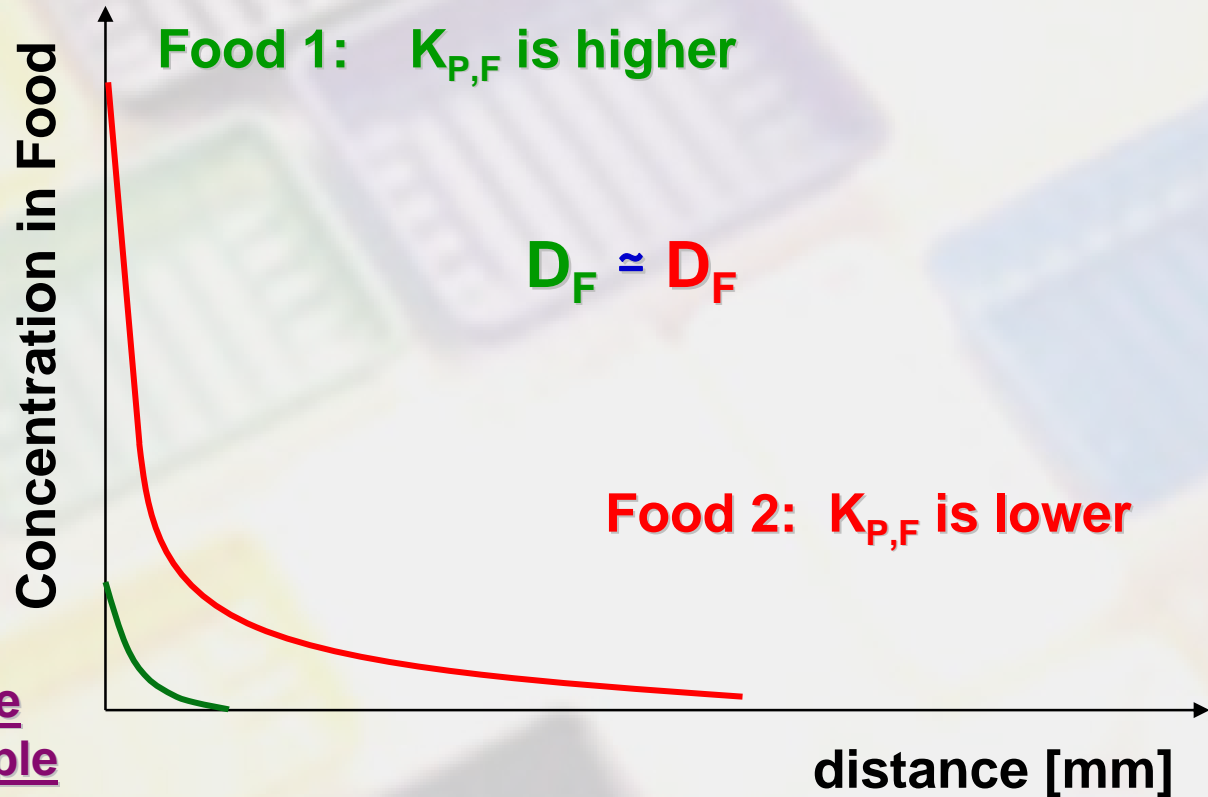
Migration from the same polymer sample into 2 different foods under the same conditions



Target parameters for migration



3c: Concentration profiles



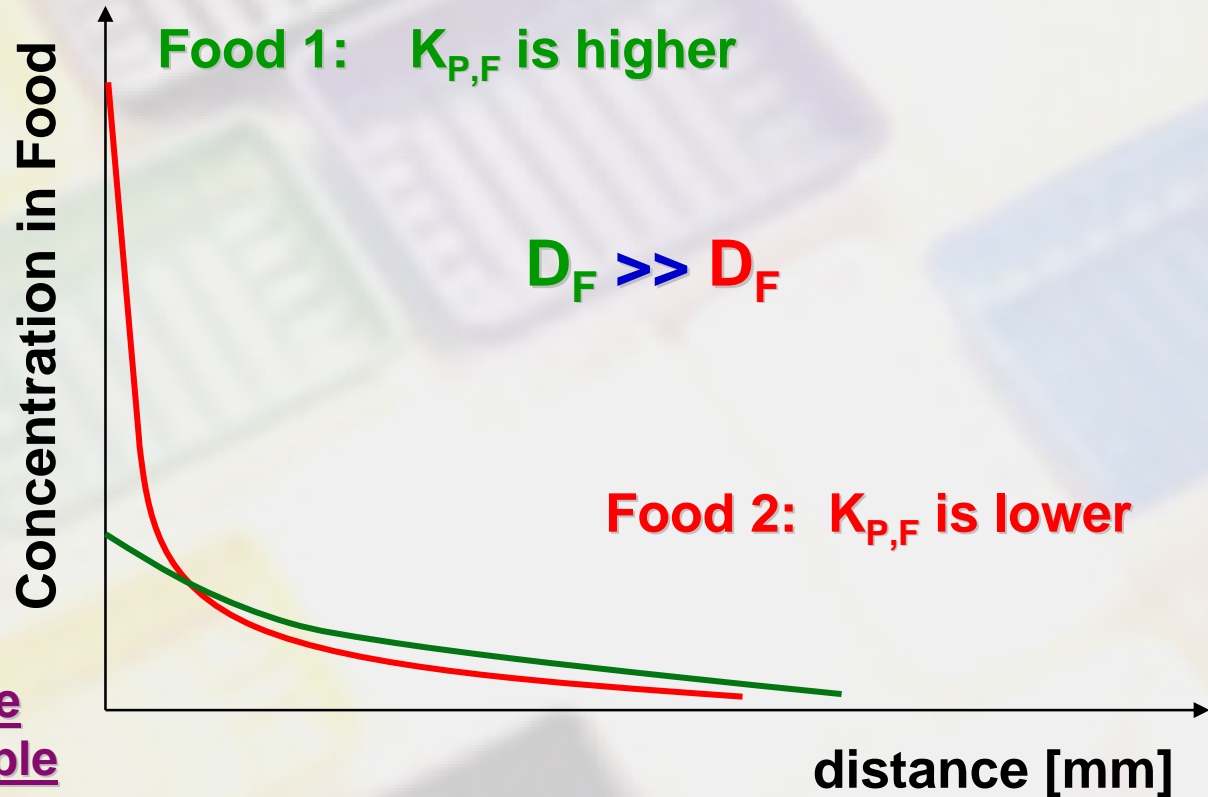
Migration from the same polymer sample into 2 different foods under the same conditions



Target parameters for migration



3c: Concentration profiles



Migration from the same polymer sample into 2 different foods under the same conditions



Overview kinetic migration experiments



Foods according to WP2	Food source	Temp [°C]	Test conditions		Test film no.				
			Times (LDPE Mw 182-318)	Times (LDPE Mw 370-531) (HDPE/PA Mw all)	1	2	3	4	5
Orange juice	Nestlé for all partners	5	2, 4, 10, 20, 30 d	2, 4, 10, 20, 30 d		x	x	x	x
		25	1, 2, 4, 10, 20 d	2, 4, 10, 20, 30 d		x	x	x	x
		40	1, 2, 4, 7, 10 d	1, 2, 4, 10, 20 d	x	x	x	x	x
Apple sauce	Nestlé for all partners	25	1, 2, 4, 10, 20 d	2, 4, 10, 20, 30 d				x	x
Milk (3.5% fat) UHT	Supermarket Each partner	5	2, 4, 10, 20, 30 d	2, 4, 10, 20, 30 d			x	x	x
		25	1, 2, 4, 10, 20 d	2, 4, 10, 20, 30 d			x	x	x
		40? ^{+))}	1, 2, 4, 7, 10 d	1, 2, 4, 10, 20 d	x		x	x	x
Tomato Ketchup	Nestlé for all partners	25	1, 2, 4, 10, 20 d	2, 4, 10, 20, 30 d		x		x	x
		70	2, 4, 8, 16, 24 h	8, 16, 24, 48, 96 h		x		x	x
Cola Drink Decarbonated ⁺⁺⁾	Supermarket -each partner	25	1, 2, 4, 10, 20 d	2, 4, 10, 20, 30 d				x	x
		40	1, 2, 4, 7, 10 d	1, 2, 4, 10, 20 d				x	x
Beer decarbonated ⁺⁺⁺⁾ & wine (white, ~11%)	Supermarket – each partner (in glass bottle)	25	1, 2, 4, 10, 20 d	2, 4, 10, 20, 30 d			x	x	x
Margarine	Supermarket – each partner	5	2, 4, 10, 20, 30 d	2, 4, 10, 20, 30 d	x	x	x	x	
		25	1, 2, 4, 10, 20 d	2, 4, 10, 20, 30 d	x	x	x	x	
Mayonnaise (80 % fat)	Nestlé for all partners	5	2, 4, 10, 20, 30 d	2, 4, 10, 20, 30 d	x		x	x	x
		25? ^{+))}	1, 2, 4, 10, 20 d	2, 4, 10, 20, 30 d	x		x	x	x
Cheese Gouda 45%	Supermarket – each partner pre-packed (middle aged)	5	2, 4, 10, 30, 90 d	2, 4, 10, 30, 90 d	x	x	x		
		25	1, 2, 4, 10, 20 d	2, 4, 10, 20, 30 d	x		x		
Soft cheese (68% in dry matter)	Supermarket - each partner	5	2, 4, 10, 20, 30 d	2, 4, 10, 20, 30 d		x	x	x	
		25? ^{+))}	1, 2, 4, 10, 20 d	1, 2, 4, 10, 20 d	x		x	x	
Cottage cheese ~10% fat	Supermarket - each partner	5	1, 2, 4, 10, 20 d	2, 4, 10, 20, 30 d	x	x			
		25? ^{+))}	0.5, 1, 2, 4, 10 d	0.5, 1, 2, 4, 10 d	x				
Cheese sauce ~18.5% fat	Nestlé for all partners	5	2, 4, 10, 20, 30 d	2, 4, 10, 20, 30 d	x		x		x
		90	5, 10, 30, 60, 120 min	5, 10, 30, 60, 120 min	x		x	x	x
Yoghurt drink	Nestlé for all partners	5	2, 4, 10, 20, 30 d	2, 4, 10, 20, 30 d			x	x	x
Condensed milk	Nestlé for all partners	25	1, 2, 4, 10, 20 d	2, 4, 10, 20, 30 d				x	x
Whipping cream (~30% fat) UHT	Supermarket - each partner (in carton or similar)	5	2, 4, 10, 20, 30 d	2, 4, 10, 20, 30 d	x		x	x	
		25	1, 2, 4, 10, 20 d	2, 4, 10, 20, 30 d	x		x	x	



Overview kinetic migration experiments



- ▶ **5 reference films with**
- ▶ **7 model substances in contact with**
- ▶ **32 different foodstuffs**
- ▶ **mostly as single side exposure at**
- ▶ **T = 5°C, 20°C, 25°C, 40°C, 70°**

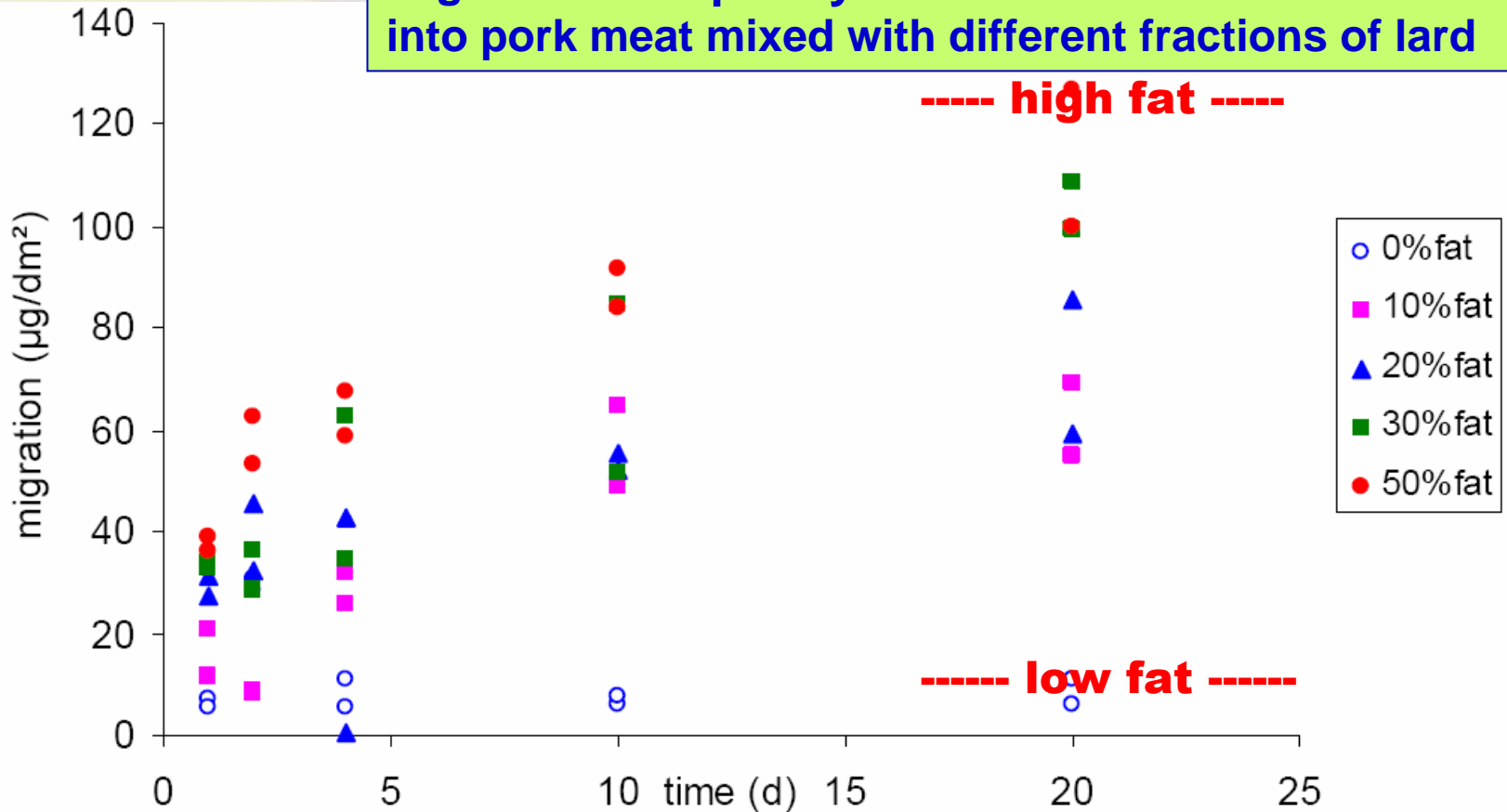
- ▶ **235 kinetic curves**



migration kinetics - examples



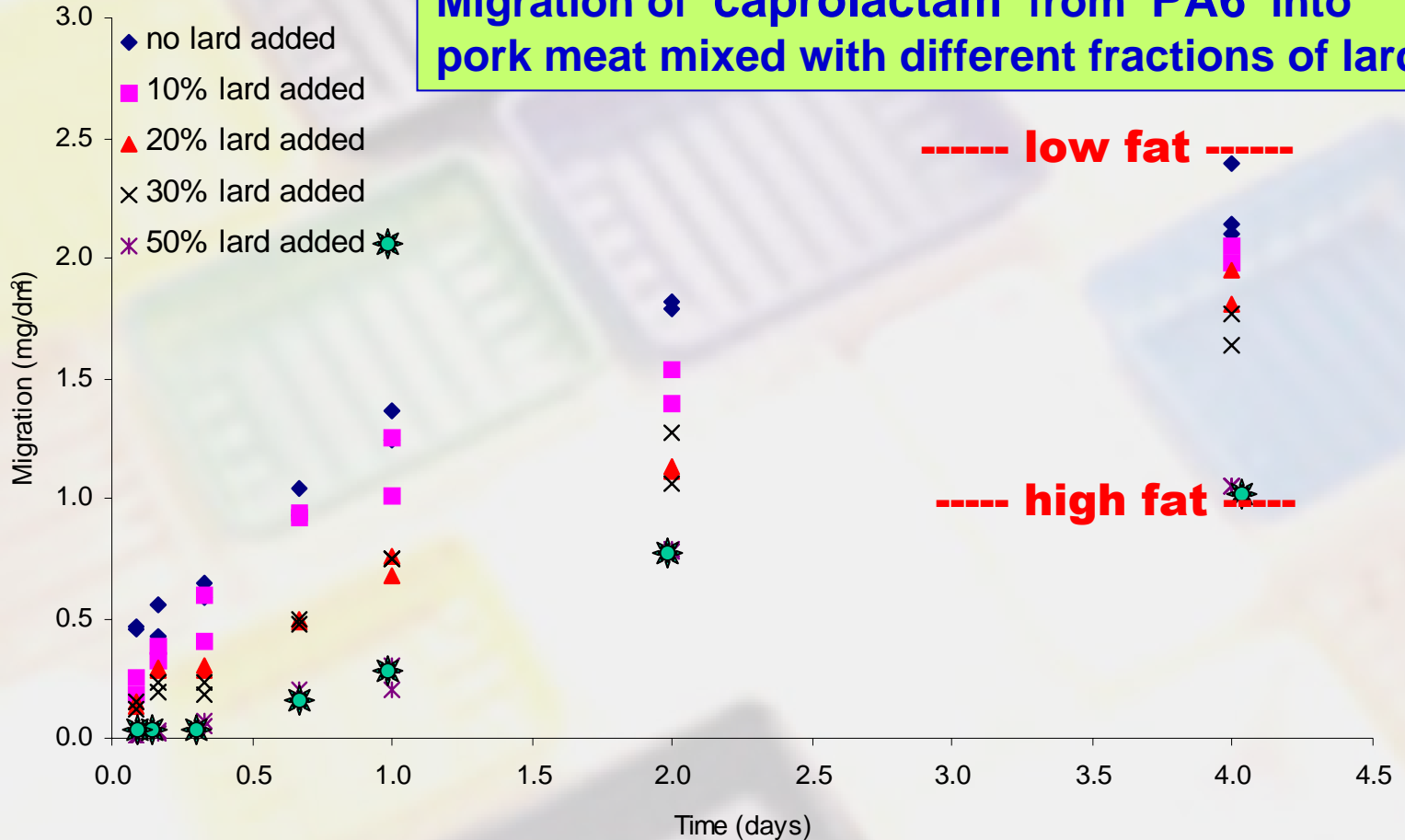
Migration of diphenyl butadiene from LDPE into pork meat mixed with different fractions of lard



migration kinetics - examples

FOOD
MIGRATION

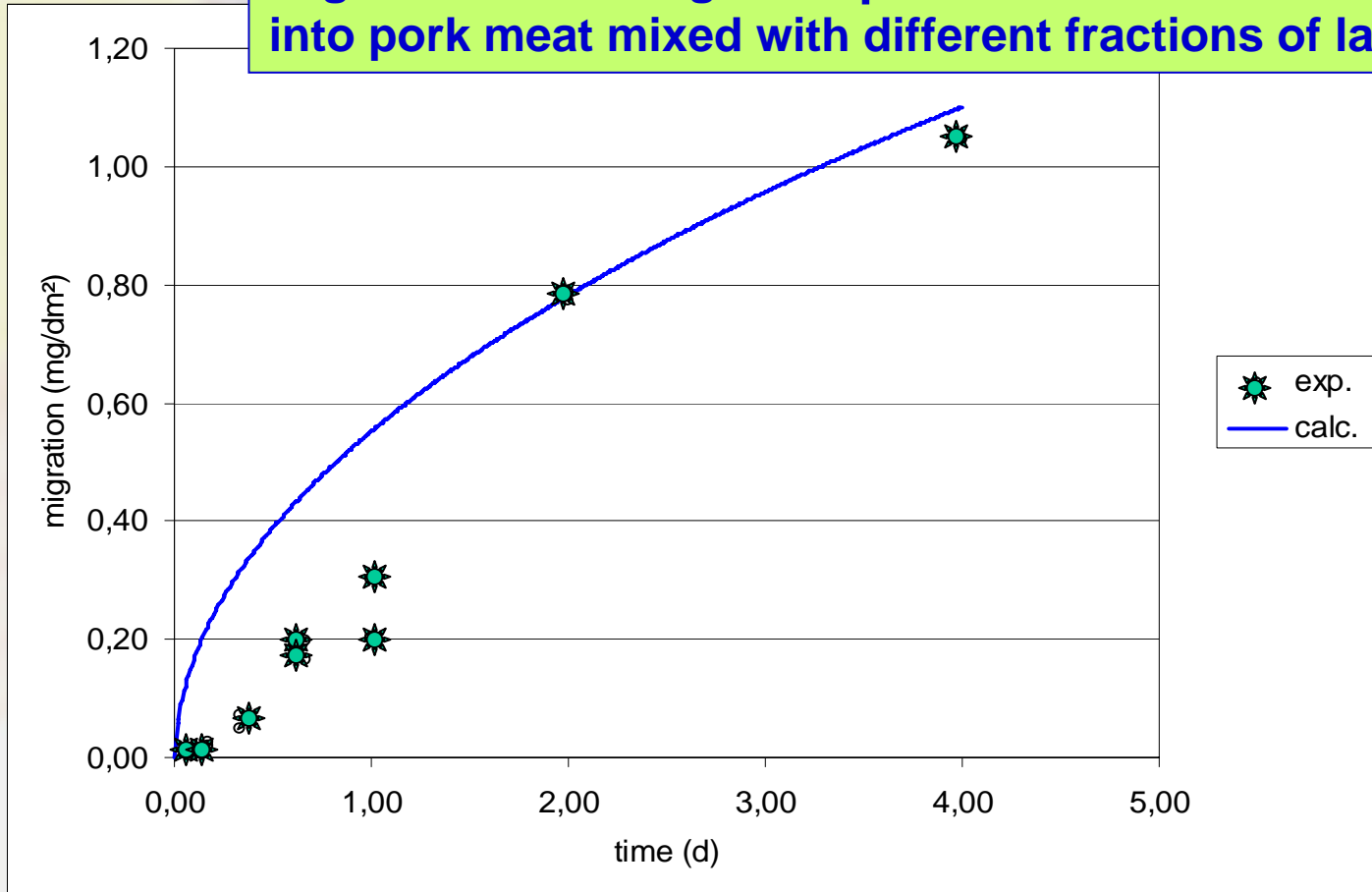
Migration of caprolactam from PA6 into
pork meat mixed with different fractions of lard



migration kinetics - examples



Migration modelling of caprolactam from PA6 into pork meat mixed with different fractions of lard



Overview conc. profile experiments



- ▶ **11 model substances, incorporated**
- ▶ **in LDPE films or PE wax (as high diffusivity release systems) in contact**
- ▶ **with 27 different foodstuffs using**
- ▶ **single side exposure at conditions**
- ▶ **$T = 5^{\circ}\text{C}$ to 70°C and $t = 1$ to 30 days**
- ▶ **175 conc. profiles**

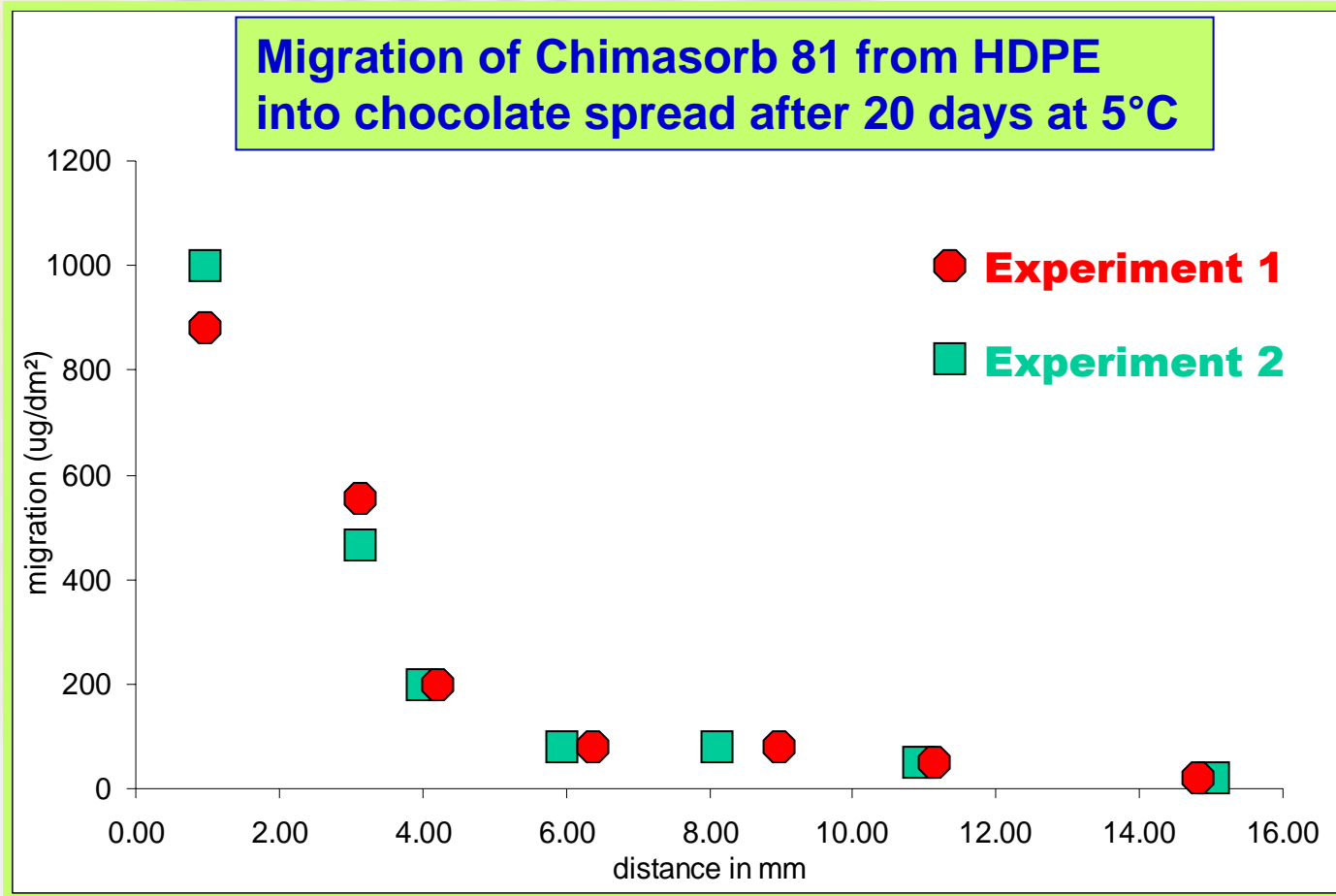


Overview conc. profile experiments

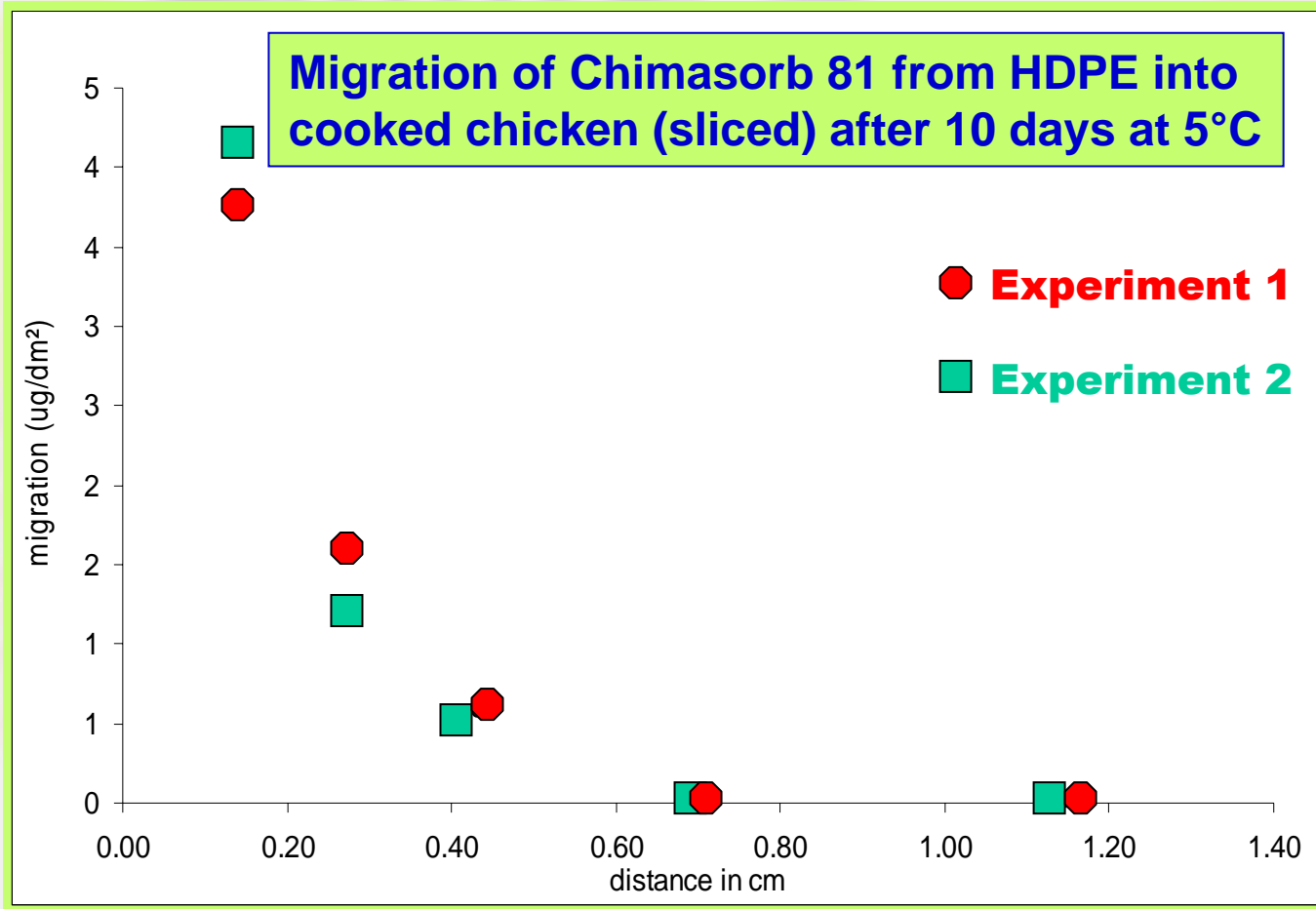
for example: schedule for Chimasorb 81 (in LDPE)

Foodstuffs	Temp (°C)	Time (days)	Chimasorb 81
Cheese Gouda	5	30	done
	25	8	done
Soft cheese	5	20	done
Chocolate spread	20	5	done
Margarine	5	30	done
Mayonnaise	5	30	done
	20	20	done
Pork neck	5	5	canc.
Fish (salmon)	5	10	done
Milk powder	40	10	done
Wheat flour	40	10	done
Bacon	5	10	done
Cooked chicken	5	10	done
Mature cheddar cheese	20	10	done
	5	20	done
Salami 30% fat	5	10	done

conc. profiles - examples



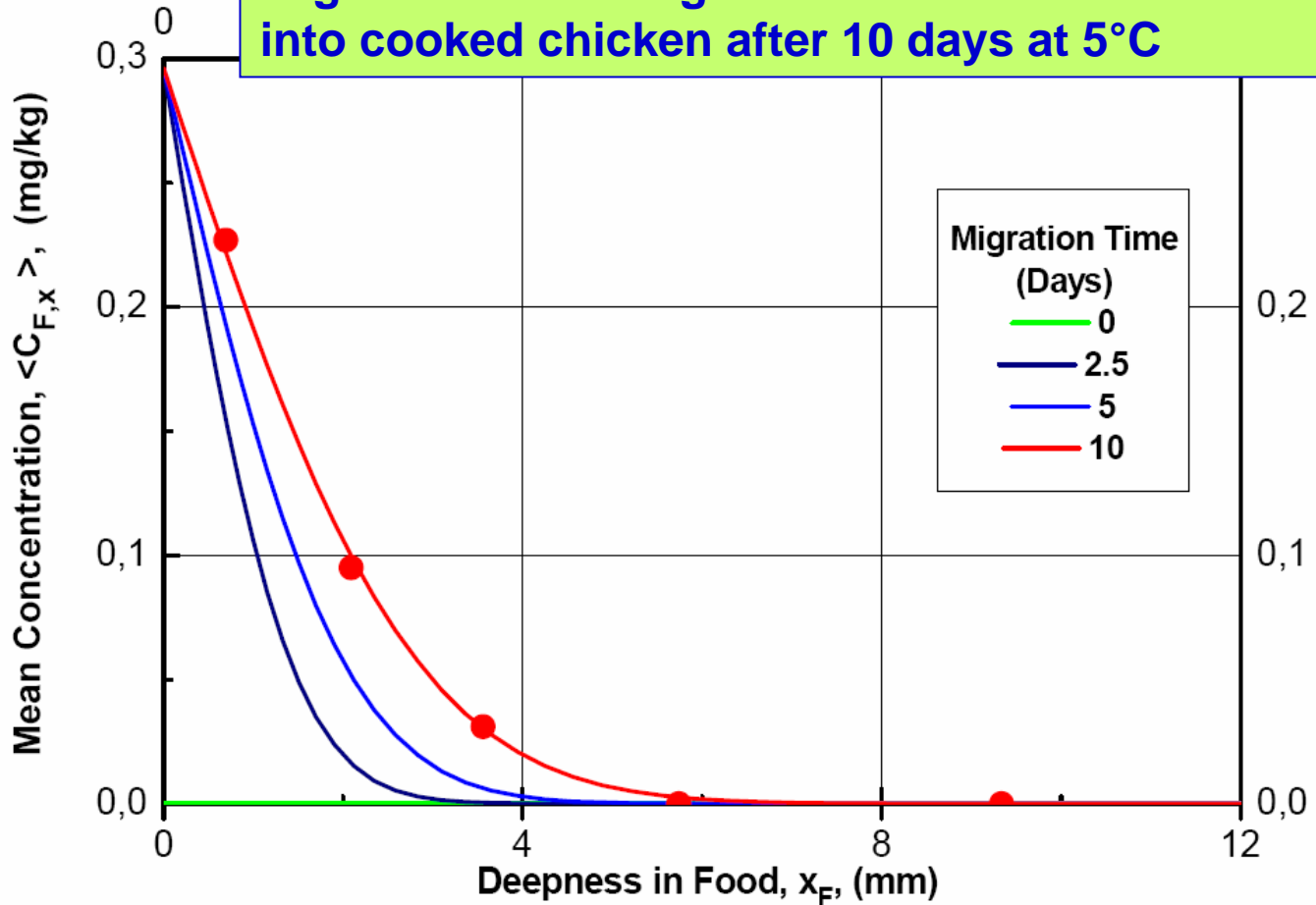
conc. profiles - examples



conc. profiles - examples



Migration modelling of Chimasorb 81 from HDPE into cooked chicken after 10 days at 5°C



Conclusion



An extensive and unique collection of data sets were elaborated within WPs 3b & 3c for into-food migration modelling in WP5. This was only possible by the excellent cooperation of all partners and due to the creativeness of partners with respect to the experimental design in measuring migration kinetics and concentration profiles.





www.foodmigrosure.com

Thank you,
also on behalf of the
FOODMIGROSURE
project team



Fraunhofer
Institut
Verfahrenstechnik
und Verpackung