Mapping Exposure to hydrocarbons: Intended and unintended uses

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Introduction

What are the requirements for reliable and realistic estimates of dietary exposures to hydrocarbons?

How can we discriminate between intended and unintended including natural occurrence?

- CONCAWE/EWF project, 2000-2003
- EFSA call for scientific data on mineral oil hydrocarbons in food, 2010
- EFSA Opinion on mineral oil hydrocarbons in food, 2012
- Commission Recommendation on monitoring mineral oil hydrocarbons in food, 2017
- Current CONCAWE/EWF project on exposure mapping
- Proposals for future research

CONCAWE/EWF project, 2000-2003*

Approach:

1. Usage survey – consultation with food industry representatives to identify uses of white mineral oils, paraffin waxes, microcrystalline waxes and petrolatum
2. Levels survey – literature survey to determine amounts of hydrocarbons in foods including natural occurrence
3. Intake estimation – UK consumers 95th percentiles for consumers only , pre-school children and adults

MOSH data classified by viscosity to conform to JECFA ADI

No information on aromatics

* Tennant, D.R. (2004). The usage, occurrence and dietary intakes of white mineral oils and waxes in Europe. Food and Chemical Toxicology. Vol 42/3 pp 481-492.

CONCAWE/EWF project, 2000-2003

Results:

		MOSH						Natural occurrence	
		White oils		Waxes		Total			
		Mean	97.5%ile	Mean	97.5%ile	Mean	97.5%ile	Mean	97.5%ile
Adults	Maximum	0.39	0.91	0.08	0.19	0.47	1.06	0.25	0.80
	Adjusted*	0.09	0.20	0.01	0.02	0.09	0.21		
Children	Maximum	0.75	1.77	0.23	0.64	0.98	2.05	0.73	2.59
	Adjusted*	0.17	0.39	0.02	0.58	0.19	0.41		
	Food	Bread		Biscuits/crackers		Bread		Pome fruits	
	Source	Divider oils		Waxed paper					
								mg/kg bw/day	
	* Intakes adjusted for proportion of food category containing hydrocarbons								

- White oil intakes <65 cSt similar to > 65 cSt
- Intakes of paraffin waxes similar to microcrystalline
- MOSH intakes adjusted for usage volumes to represent frequency of occurrence (*)
- Intakes of hydrocarbons from natural sources similar to MOSH conservative estimates

EFSA call for scientific data on mineral oil hydrocarbons in food, 2010

Definitions and classifications:

a) Mineral oil saturated hydrocarbons (MOSH), comprising paraffinic and naphthenic hydrocarbons and

b) Mineral oil aromatic hydrocarbons (MOAH)

or –alternatively-

c) Mineral oil hydrocarbons (MOH) (comprising, without distinction, paraffinic, naphthenic and aromatic hydrocarbons)

Specific requirements for chemical contaminant and food additive occurrence data submission*

- Range of carbon atoms and maximum of the distribution curve
- Standard sample descriptions
- Standard reporting template
- No recommendations on sampling strategy except to exclude “known adulteration”

*EFSA (European Food Safety Authority), 2015. Specific requirements for chemical contaminant and food additive occurrence data submission. EFSA supporting publication 2015:EN-833. 26 pp.

EFSA Opinion on mineral oil hydrocarbons in food, 2012*

- "The majority of data (1117) was provided by the Official Food Control Authority of the Canton of Zürich". Plus vegetable oils (338) data from Germany, France and Italy
- "Since the KLZH is an enforcement laboratory, the selection of many samples was targeted and this may lead to an overestimation of occurrence and exposure estimates".
- Are data sufficiently representative of European usage?
- Most of the data was from the years 1997-2000 and 2008-2010. Practices could be obsolete.
- Analytical data included Left Censored data and incorporated in means. Assumes sampling representative.
- Many skewed datasets – mean > median. Mean used in exposure estimates.
- No distinction between 'intentional' and 'unintentional' sources

* EFSA Panel on Contaminants in the Food Chain (CONTAM); Scientific Opinion on Mineral Oil Hydrocarbons in Food. EFSA Journal 2012;10(6):2704. [185 pp.] doi:10.2903/j.efsa.2012.2704.

EFSA Opinion on mineral oil hydrocarbons in food, 2012

Results

Table 9: Summary statistics of the chronic dietary exposure scenarios for MOSH (mg/kg b.w. per day) in the general population across European dietary surveys. Where a difference is observed between UB and LB, the range is provided.

Mean chronic exposure (mg/kg b.w. per day) across national dietary surveys			
	min (LB-UB)	**median (LB-UB)**	**max (LB-UB)**
Infants [(a)]	0.038 - 0.041	0.10 - 0.11	0.16 - 0.18
Toddlers	0.083 - 0.087	0.11	0.19
Other children	0.066 - 0.068	0.11	0.16 - 0.17
Adolescents	0.028	0.064 - 0.066	0.091 - 0.096
Adults	0.031 - 0.032	0.038 - 0.039	0.064 - 0.068
Elderly	0.031 - 0.032	0.040 - 0.042	0.056 - 0.059
Very elderly	0.032 - 0.033	0.037 - 0.039	0.051 - 0.054

P95 chronic exposure (mg/kg b.w. per day) across national dietary surveys[(b)]			
	min (LB-UB)	**median (LB-UB)**	**max (LB-UB)**
Infants [(a)]		0.12 - 0.13	
Toddlers	0.18	0.22	0.25 - 0.26
Other children	0.14	0.21 - 0.22	0.31 - 0.32
Adolescents	0.063 - 0.065	0.12 - 0.13	0.19 - 0.20
Adults	0.059 - 0.061	0.082 - 0.085	0.11 - 0.12
Elderly	0.058 - 0.060	0.074 - 0.078	0.093 - 0.096
Very elderly	0.069 - 0.070	0.076 - 0.079	0.081 - 0.084

b.w.: body weight; LB: lower-bound; UB: upper-bound;
(a): estimates available only from two dietary surveys for the mean and only one for the 95th percentile;
(b): The 95th percentile estimates obtained on dietary surveys/age classes with less than 60 observations may not be statistically robust (EFSA, 2011b) and therefore they should not be considered in the risk characterisation. Those estimates were not included in this table.

- Chronic results similar to 'adjusted' intakes from 2004 CONCAWE/EWF study (≤ c.a. 0.5 mg/kg bw/day).
- Main sources of intake: breast milk, ices and desserts, vegetable oils/fats, fine bakery wares, bread and rolls.
- Scenarios for sustained high 'bread and rolls' or 'grains for human consumption' higher than 'maximum' intakes from 2004 CONCAWE/EWF study (≤ 6 mg/kg bw/day).
- Source of hydrocarbons unclear for many food categories.
- Natural occurrence of hydrocarbons not included in exposure assessment

Commission Recommendation on monitoring mineral oil hydrocarbons in food, 2017*

- Member States should monitor the presence of MOH in food during 2017 and 2018. The monitoring should cover [wide range of foods], as well as food contact materials used for those products.
- A guidance document on monitoring and testing for MOHs does not currently exist (January 2017).
- They should preferably provide the monitoring data by 1 October 2017 and subsequently by 1 October 2018. The last results should be provided by 28 February 2019.
- Member States should collaborate with European Union Reference Laboratories (EU-RL) to identify how the monitoring should be conducted, in order to generate reliable and comparable results.
- Where MOH are detected in food, Member States should carry out further investigations in the food business establishments in order to determine the possible source or sources.

* Commission Recommendation (EU) 2017/84 of 16 January 2017 on the monitoring of mineral oil hydrocarbons in food and in materials and articles intended to come into contact with food. OJ L 12/95, 17.1.2017.

CONCAWE/EWF project on exposure mapping 2017 - 2018

- Review available literature / consult food industry to identify
  - MOH origins (intentional and unintentional sources)
  - Current usage
  - Sources of exposure
  - Characterisation
  - Levels of occurrence
  - Frequency of occurrence
- Upload data into MS Access database
  - Database structure
  - Search capabilities – linked to database structure
  - Potential outputs – reports linked to specific information requirements
  - Publish on-line?

CONCAWE/EWF project on exposure mapping 2017 - 2018

Figure 1. Simple illustration of possible mapping of MOH sources, occurrence and exposure

MOH origin	Exposure source*	Vector	Food category*	Occurrence (% Containing MOH)	Concentrations (mg/kg)	Exposure
	Saturated hydrocarbons naturally occurring in biota					
Natural occurrence	Marine biota	Fish				
	Terrestrial biota	Fruit and vegetables				
	Environmental contamination		Animal Fat	tbc	tbc	tbc
	Mineral oil hydrocarbons from the atmosphere	Fruit and vegetables	Bread and Rolls	tbc	tbc	tbc
Environmental pollution	Mineral oil hydrocarbons in marine & water ecosystems	Fish	Breakfast cereals	tbc	tbc	tbc
	Food processing		Breast milk	tbc	tbc	tbc
	Hydrocarbons formed during food processing	Vegetable oils	Chocolate confectionery	tbc	tbc	tbc
	Release agents	Bread, baked goods, confectionery	Non-chocolate confectionery	tbc	tbc	tbc
Processing products	De-dusting agents	Imported grain and rice	Dried fruits	tbc	tbc	tbc
	Machine oils	Processed foods	Eggs, Fresh	tbc	tbc	tbc
	Coating of foods	Rice, fruit and vegetables	Fine bakery wares	tbc	tbc	tbc
	Mineral oil migrating from food contact materials		Fish meat	tbc	tbc	tbc
Food-grade oils	Jute and sisal bags	Hazelnuts, cocoa beans, coffee, rice	Fish products (canned)	tbc	tbc	tbc
	Waxed packaging materials	Cheese, baked goods, confectionery	Grain milling products	tbc	tbc	tbc
	Wax coatings applied directly on food	Cheese	Grains for human consumption	tbc	tbc	tbc
	Plastic materials	Packaged foods	Herbs, spices & condiments	tbc	tbc	tbc
Food-grade waxes	Lubricating oils for cans	Canned foods	Ices & desserts	tbc	tbc	tbc
	Printing inks	Packaged foods	Legumes, beans, dried	tbc	tbc	tbc
	Recycled board	Packaged dry foods	Livestock meat	tbc	tbc	tbc
	Adhesives	Packaged foods	Oilseeds	tbc	tbc	tbc
Non-food oils	Food additives	Confectionery, fruit and vegetables, frozen meat	Pasta (raw)	tbc	tbc	tbc
	Pesticides	Fruit and vegetables, vegetable oils	Potato flakes	tbc	tbc	tbc
	MOH entering food chain through feed		Sausages	tbc	tbc	tbc
	MOH from edible oil refining	Animal products	Snack food	tbc	tbc	tbc
Multiple sources	Binders for additives	Animal products	Sugars	tbc	tbc	tbc
	Motor oils and other wastes entering feed	Animal products	Treenuts	tbc	tbc	tbc
	Other sources		Vegetable oil	tbc	tbc	tbc
	Unidentified sources in food	Various	Vegetable products	tbc	tbc	tbc
	Breast feeding	Breast milk		tbc	tbc	tbc
	Fat substitute	Weight-loss diet	Diet foods	tbc	tbc	tbc
	Cosmetics, pharmaceuticals and medicinal use	Cosmetics, medicines, adjuvants	Cosmetics, etc.	tbc	tbc	tbc

* As defined in EFSA CONTAM Panel Opinion on MOH in foods (2012)

tbc - to be completed

- Simplified diagram to show how hydrocarbons can move from origin, through exposure sources, and food vectors to result in concentrations in specific food categories
- Information also required about proportion of supply containing the hydrocarbon (% Occurrence)

Exposure mapping database tables

Literature references

FIELD	DESCRIPTION	DATA
TY	Publication type	
AU1	Author#1	
AU2	Author#2	
AU3	Author#3	
AU4	Author#4	
AU5	Author#5	
AU6	Author#6	
AU7	Author#7	
AU8	Author#8	
AU9	Author#9	
AU10	Author#10	
TI	Title	
JO	Journal name	
JA	Journal abbreviation	
VL	Volume	
IS	Issue	
SN		
UR	URL	
DO	DOI	
SP	Start page	
EP	End page	
KW1	Keyword#1	
KW2	Keyword#2	
KW3	Keyword#3	
KW4	Keyword#4	
KW5	Keyword#5	
KW6	Keyword#6	
KW7	Keyword#7	
KW8	Keyword#8	
KW9	Keyword#9	
KW10	Keyword#10	
PY	Publication year	
ER		
PU	Publisher	
Copy	Copy held or not	

Hydrocarbon origin

Origin_number	Origin
O1	Natural occurrence
O2	Environmental pollution
O3	Processing products
O4	Food-grade oils (LV)
O5	Food-grade oils (MV)
O6	Food-grade oils (HV)
O7	Food-grade waxes (LM)
O8	Food-grade waxes (HM)
O9	Non-food oils
O10	Multiple sources
O11	Not known

Hydrocarbon source

Source_L1_number	Source_L1	Source_L2_number	Source_L2
SL1_1	Saturated hydrocarbons naturally occurring in biota	SL2_1	Marine biota
SL1_1	Saturated hydrocarbons naturally occurring in biota	SL2_2	Terrestrial biota
SL1_2	Environmental contamination	SL2_3	Mineral oil hydrocarbons from the atmosphere
SL1_2	Environmental contamination	SL2_4	Mineral oil hydrocarbons in marine & water ecosystems
SL1_3	Food processing	SL2_5	Hydrocarbons formed during food processing
SL1_3	Food processing	SL2_6	Release agents
SL1_3	Food processing	SL2_7	De-dusting agents
SL1_3	Food processing	SL2_8	Machine oils
SL1_3	Food processing	SL2_9	Coating of foods
SL1_4	MOH migrating from food contact materials	SL2_10	Jute and sisal bags
SL1_4	MOH migrating from food contact materials	SL2_11	Waxed packaging materials
SL1_4	MOH migrating from food contact materials	SL2_12	Wax coatings applied directly on food
SL1_4	MOH migrating from food contact materials	SL2_13	Plastic materials
SL1_4	MOH migrating from food contact materials	SL2_14	Lubricating oils for cans
SL1_4	MOH migrating from food contact materials	SL2_15	Printing inks
SL1_4	MOH migrating from food contact materials	SL2_16	Recycled board
SL1_4	MOH migrating from food contact materials	SL2_17	Adhesives
SL1_5	Food additives	SL2_18	Food additives
SL1_6	Pesticides	SL2_19	Pesticides
SL1_7	MOH entering food chain through feed	SL2_20	MOH from edible oil refining
SL1_7	MOH entering food chain through feed	SL2_21	Binders for additives
SL1_7	MOH entering food chain through feed	SL2_22	Motor oils and other wastes entering feed
SL1_8	Other sources	SL2_23	Unidentified sources in food
SL1_8	Other sources	SL2_24	Breast feeding
SL1_8	Other sources	SL2_25	Fat substitute
SL1_8	Other sources	SL2_26	Cosmetics, pharmaceuticals and medicinal use
SL1_9	Not known	SL2_27	Not known

Exposure mapping database tables

Food vector

Food_vector_number	Food_vector
FV1	Animal products
FV2	Bread, baked goods, confectionery
FV3	Breast milk
FV4	Canned foods
FV5	Cheese
FV6	Baked goods
FV7	Confectionery, fruit and vegetables, frozen meat,
FV8	Cosmetics, medicines, adjuvants
FV9	Fish
FV10	Frozen foods
FV11	Nuts, cocoa beans, coffee, rice
FV12	Cocoa beans
FV13	Coffee beans
FV14	Rice
FV15	Imported grain and rice
FV16	Packaged dry foods
FV17	Packaged foods
FV18	Processed foods
FV19	Vegetable oils
FV20	Various
FV21	Other
FV22	Not known

Food category

FoodEx code	Food_category
(to be completed)	Animal Fat
	Bread and Rolls
	Breakfast cereals
	Breast milk
	Chocolate confectionery
	Non-chocolate confectionery
	Dried fruits
	Eggs. Fresh
	Fine bakery wares
	Fish meat
	Fish products (canned)
	Grain milling products
	Grains for human consumption
	Herbs, spices & condiments
	Ices & desserts
	Legumes, beans, dried
	Livestock meat
	Oilseeds
	Pasta (raw)
	Potato flakes
	Pulses
	Sausages
	Snack food
	Sugars
	Treenuts
	Vegetable oil
	Vegetable products
	Breast milk
	Diet foods
	Cosmetics, etc.
	Not known

Exposure mapping database tables

Hydrocarbon category

Type-number	Type	HClass_numbe	Class	Carbon number	Remarks*
H1	SH	HC1	n-alkane	<C16	
H2	SH	HC1	n-alkane	C16-C24	
H3	SH	HC1	n-alkane	C24-C35	
H4	SH	HC1	n-alkane	>C35	
H5	SH	HC1	n-alkane	Unspecified/other	
H6	SH	HC2	iso-alkane	<C16	
H7	SH	HC2	iso-alkane	C16-C24	
H8	SH	HC2	iso-alkane	C24-C35	
H9	SH	HC2	iso-alkane	>C35	
H10	SH	HC2	iso-alkane	Unspecified/other	
H11	SH	HC3	cyclo-alkane	<C16	
H12	SH	HC3	cyclo-alkane	C16-C24	
H13	SH	HC3	cyclo-alkane	C24-C35	
H14	SH	HC3	cyclo-alkane	>C35	
H15	SH	HC3	cyclo-alkane	Unspecified/other	
H16	PAO	HC4	PAO	<C16	
H17	PAO	HC4	PAO	C16-C24	
H18	PAO	HC4	PAO	C24-C35	
H19	PAO	HC4	PAO	>C35	
H20	PAO	HC4	PAO	Unspecified/other	
H21	POSH	HC5	POSH	<C16	
H22	POSH	HC5	POSH	C16-C24	
H23	POSH	HC5	POSH	C24-C35	
H24	POSH	HC5	POSH	>C35	
H25	POSH	HC5	POSH	Unspecified/other	
H26	AH	HC6	AH	C16-C24	
H27	AH	HC6	AH	C24-C35	
H28	AH	HC6	AH	>C35	
H29	AH	HC6	AH	Unspecified/other	

Occurrence data

Hydrocarbon origin
Exposure source L1
Exposure source L2
Food Vector
Food matrix
Hydrocarbon typeType
Hydrocarbon class
Carbon _number
Carbon number range
Max of dist curve
N samples
Min_Conc
Ave_Conc
STD
Max_conc
LOD/LOQ
% LC
% Occurrence
Country
Method
Comment

Conclusions and proposals for future research

- Immediate research needs:

  Establish current use patterns – obsolete applications?

  Obtain reliable occurrence data –

  Comprehensive representative survey

  or

  Frequency of occurrence X levels in affected foods

- Link mapping database to exposure modelling software
- Generate estimates of exposure linked to:

  Hydrocarbon source: intended, unintended, natural occurrence, etc.

  Hydrocarbon type: link to toxicological criteria, etc.

  Other parameters: food category, country etc.