COMMITTEE ON TOXICITY OF CHEMICALS IN FOOD, CONSUMER PRODUCTS AND THE ENVIRONMENT

Scoping paper on the potential risks from polycyclic aromatic hydrocarbons (PAHs) in the diet of infants aged 0 to 12 months and children aged 1 to 5 years

Introduction

1. The Scientific Advisory Committee on Nutrition (SACN) is undertaking a review of scientific evidence that will inform the Government's dietary recommendations for infants and young children. The SACN is examining the nutritional basis of the advice. The Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) was asked to review the risks of toxicity from chemicals in the diet of infants, most of which has been completed, and young children. The reviews will identify new evidence that has emerged since the Government's recommendations were formulated and will appraise that evidence to determine whether the advice should be revised. The recommendations cover diet from birth to age five years.

2. PAHs (polycyclic aromatic hydrocarbons) are organic compounds characterised by the presence of 2 or more fused aromatic rings, many of which are known carcinogens. Although naphthalene, with 2 fused rings, would technically be part of this group of compounds it is usually not regarded as a member. PAHs are common products of combustion and are widely distributed in the environment as the result of vehicle exhaust and industrial processes and in the diet in cooked food and cooking by-products such as oils vaporised from frying pans and smoke from barbecues. Production of PAHs by cooking is greater when fat expressed from the food drips directly onto the heating element or hot coals.

3. The diet is a significant source of PAHs for non-smokers, but cigarette smoke makes the major contribution to the intake for smokers. Second-hand or "side-stream" smoke is known to contain a higher concentration of PAHs than mainstream smoke and thus may contribute to the intake of non-smokers (EFSA 2008).

4. Breast milk is the major source of PAH exposure to young infants. Maternal intake and hence milk concentration varies with location (urban or rural), season (Summer or Winter) (Pulkrabova *et al*, 2016) and smoking status (Zanieri *et al,* 2007)

5. EFSA (2008) addressed PAHs in food. Considering the enormous number of possible members in the group, they reviewed the possibility of using the levels of a smaller number of compounds to indicate PAH exposure in general. EFSA considered BaP alone, BaP and chrysene(ChR) (PAH2), BaP, benz[a]anthracene (BaA), benzo[b]fluoranthene (BbF) and ChR (PAH4) and BaP, BaA, BbF, benzo[k]fluoranthene, benzo[ghi]peryene, dibenz[a,h]anthracene, indeno[123-cd]pyrene and ChR (PHA8).

Absorption, distribution, metabolism and excretion

6. PAHs may be absorbed via ingestion in food, inhalation and by dermal contact. Lao *et al* (2018, from abstract), in a study on consumers of barbecued meat in China, found that the excretion of hydroxylated metabolites of naphthalene, fluorene, phenanthrene and pyrene after dietary exposure to PAHs was about an order of magnitude greater than from a combination of dermal absorption and inhalation. The latter combination was similar to that from dermal absorption alone, indicating that dermal absorption constituted the greater of the latter two routes.

7. Absorption in the digestive tract depends upon bioaccessibility , the proportion of the PAH content of food that is released when the food is eaten and the amount and type of PAH in question. PAH uptake in the gut depends upon fat absorption, which in turn depends upon the presence of bile to produce mycelles. Lipid composed of short-chain (2 – 10 carbons) fatty acids, is absorbed largely into the portal system whereas longer chain (>10 carbons) fatty acids enter the lymph. PAHs appear to follow the lymphatic route (Harris *et al*, 2013)

8. Murphy *et al* (2008) exposed human bronchoepithelial cells to PAHs in soot from combusted butadiene and found that fluorescent material localised in fat droplets and lysosomes in the cells. Exposure was concomitant with upregulation of AhR-induced phase 1 metabolic enzymes and oxidative stress mechanisms.

9. The PAHs are not intrinsically genotoxic but require oxidation to various diols, quinines and epoxides to become compounds able to form DNA adducts. Oxidation takes place by the activity of CYP enzymes 1A1, 1A2, 1B1 and 3A4, which can be induced by PAHs binding to and activating the aryl hydrocarbon receptor (AhR). (EFSA 2008) Xue and Warshawsky (2005) reviewed the chemistry that leads to the generation of the electrophilic species that go on to form DNA adducts that can lead to mutagenesis and carcinogenesis. However, CYP1A1, 1A2 and 1B1 appear also to be involved in detoxification of BaP (Shi *et al* , 2010, Nebert *et al* 2013).

10. Li *et al* (2012) found that urinary excretion of naphthol and hydroxylated metabolites of pyrene, phenanthrene and fluorene followed similar temporal patterns following the ingestion of grilled chicken meat by adults. Levels peaked within the first hour and then slowly declined, reaching pre-ingestion levels by about 24 hours.

Toxicity

11. The PAHs appear to be of low acute toxicity. Short term effects of PAH exposure include eye and skin irritation, nausea and vomiting and local inflammation but since PAHs occur as mixtures that may also include other non-PAH components, it is difficult to ascertain the causative agents of these effects (Kim *et al* , 2013).

Carcinogenicity

12. Exposure to PAHs has been associated with increased risk of cancer of various tissues including the breast (White *et* al, 2016), oesophagus (Roshandel *et al*, 2012), gastrointestinal tract (Diggs *et al*, 2011) and lung (Moorthy *et al* (2015).

13. Not all PAHs are equally carcinogenic and although benzo[a]pyrene (BaP) is often regarded as representative of the group as a whole, it is not always present or prevalent in carcinogenic mixtures of PAHs. For the compounds included in the EFSA (2008) PAH4 group, IARC has classified BaP as in Group1 (carcinogenic to humans, 2012), and BaA, BbF and ChR as in Group 2B (possible human carcinogens, 2010). https://monographs.iarc.fr/wp-content/uploads/2018/09/ClassificationsAlphaOrder.pdf

14. Deziel *et al* (2014) sampled Californian residential surface dust (n = 185) and vacuum cleaner dust (n = 66) from houses where a child in the family had been diagnosed with acute lymphoblastic leukaemia (ALL) and compared these with respect to PAH content with surface (n = 212) and vacuum cleaner dust (n = 94) from households with children not diagnosed with ALL. The children were matched for sex, age, and ethnicity and data were obtained on house age and type, pesticide use and the smoking behaviour of other household members. Positive associations with ALL diagnosis were found for benzo[b]fluoranthene, benzo[k]fluoranthene and indeno[1,2,3-*cd*]pyrene.

Health-based Guidance values (HBGVs)

15. EFSA (2008) used the US EPA BMD software (BMDS) to derive HBGVs for BaP, PAH2, PAH4 and PAH8 and decided that although PAH4 and PAH8 were better indicators of the occurrence and toxicity of PAHs in food than BaP or PAH2, use of the $BMDL_{10}$ for PAH8 did not provide much added value in comparison with PAH4. In this paper, where the available data allow, intakes of both BaP and PAH4 will be compared with their EFSA $BMDL_{10}$ values but in some cases where either only BaP data are given, or where the PAHs are not given individual values but regarded as a group of > 4, BaP will be considered alone. EFSA (2008) derived a $BMDL_{10}$ of 0.070 mg/kg bodyweight (bw)/day (70 μg/kg bw/day) for BaP and 0.340 mg/kg bw/day (340 μg/kg bw/day) for PAH4.

Occurrence

PAHs in breast milk

16. Data on the concentration of BaP and PAH4 in breast milk are given in Table 1. No data on UK milk were found.

Table 1. Literature values for BaP and PAH4 in breast milk

Country	Concentration (μg/kg fat)		
	B[a]P mean	PAH4 mean	Ref
Italy	0.81	2.77	Santonicola *et al* 2017
Italy	ND	0.868	Zanieri *et al*2007
China	1.77	33.66	Yu *et al* 2011
Hong Kong	ND	192*	Tsang *et al* 2011
USA	<0.04	17.5	Kim *et al* 2008
USA	0.1	39.0	Acharya *et al* 2019
Turkey	0.243	2.664	Çok *et al* 2012

ND Not detected
*Approximate – includes BkF measured with BaF

Infant formula

A FSA survey performed in 2003 – 4 (White *et al*, 2004) is the latest UK data source on PAHs in infant formula, and gave mean values of BaP and PAH4 in 96 samples of infant formulae of 0.047 and 0.358 μg/kg respectively.

Food

17. The food groups through which infants are exposed to BaP and PAH4 via the diet are listed in Appendices 1and 2. The foods leading to the highest BaP exposure are: miscellaneous cereals and dairy products for the 4 - < 6-month age group and miscellaneous cereals and "other veg" for the older age groups The foods leading to the highest PAH4 exposure are: miscellaneous cereals and dairy products for the 4 - < 6-month age group and miscellaneous cereals and "other veg" for the older age groups.

Environmental

18. Levels of PAHs in the environment are subject to local conditions (industrial/ urban or rural) and seasonal variations. In the air, PAHs with 2 – 3 rings exist predominantly in the vapour phase, those with 4 rings in both vapour and particulate

phases and those with 5 or more rings predominantly in the particulate phase. Many PAHs such as BaP are rapidly degraded by ultraviolet light (EFSA 2008)

Air

19. The Environment UK Soil and Herbage Pollutant Survey https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291164/scho0607bmtc-e-e.pdf states: “The lower molecular weight PAHs such as acenapthylene, acenapthene and fluorene are volatile with vapour pressures around 10^{-1} Pa; in contrast, higher molecular weight PAHs such as benzo(a)pyrene and perylene have vapour pressures around 10^{-8} Pa. “

20. Data from DEFRA for BaP in UK air show that levels have fallen substantially across the country since 2008, especially around Sheffield and Scunthorpe. The interactive map of the UK shows that most of the country is exposed to <0.1 ng BaP/m^3, with urban areas reaching a range of 0.2 – 0.4 ng BaP/m^3. The only exception to this was an area near Port Talbot in Wales, where there was a measurement of > 1.0 ng BaP/m^3.

https://uk-air.defra.gov.uk/data/gis-mapping

Soil

21. Soil can become contaminated by airborne and waterborne deposition. Kibblewhite (2018) highlighted the role of both vehicles and road building materials as sources for PAHs and other pollutants in agricultural soils adjacent to urban and peri-urban roads.

22. Vane *et al* (2014) assayed 76 urban soils from a 19 km^2 area within the Western boundary of greater London in locations that had eleven different land-use types, including residential, domestic garden, playground, school, industrial and commercial uses. The upper confidence limit of the 95th percentile of the normal background concentration of 16 PAHs were calculated. BaP in an urban setting had a concentration of 6.9 mg/kg and PAH4 25.6 mg/kg.

23. The Environment UK Soil and Herbage Pollutant Survey gives values for PAHs in rural and urban soils in England, Scotland, Wales and Northern Ireland. In rural soils, the mean concentration of BaP was 215 μg/kg and that for urban soils 878 μg/kg. For PAH4, the mean concentrations in rural and urban soils were 614 and 3395 μg/kg respectively. These values will be used in this assessment since the survey covers the whole country.

Dust

24. Lorenzi *et al* (2011) determined the concentrations of PAHs in urban street dust in various locations in Newcastle-upon-Tyne, UK. Intake depended upon both

the concentration of PAHs and the size distribution of particles. The authors calculated intake of PAHs from ingestion of 100 mg per day of each of 6 particle ranges covering 0 – 2000 μm in diameter.

25. Particles <63 μm in diameter gave the highest intake /100 mg, leading to 0.91 μg/day for BaP and 4.07 μg/day for PAH4

26. Ma and Harrad (2015) reviewed the data on PAHs in indoor air, settled house dust and diet. Only one paper on UK house dust was reported, giving a concentration in particles <62 μm in diameter of 345 μg/kg for BaP and 5095 μg/kg for ΣPAH (excluding naphthalene)

Exposure

Breast milk

Exposure to BaP and PAH4 from exclusive breastfeeding was estimated for average and high-level consumption of breast milk, using data from Santonicola *et al* (2017). Breast milk is estimated to consist of 4,1% fat (Finglas *et al* 2015). Bodyweights are taken to be published average estimates, as shown in Table 2.

Table 2. Average bodyweights used in the estimation of PAH exposures, where individual bodyweight data were not available

Age group (months)	Bodyweight (kg)
0 to <4	5.9[a]
>4 to <6	7.8[b]
>6 to <9	8.7[b]
>9 to <12	9.6[b]
>12 to <15	10.6[b]
>15 to <18	11.2[b]
>18 to <24	12.0[c]
>24 to <60	16.1[c]

[a] DH, 1994
[b] DH, 2013
[c] Bates *et al*., 2014

27. Table 3 shows the exposure to PAHs of infants consuming breast milk exclusively. The most exposed group is the 0 - <4-month-old high level consumers.

Table 3 Exposure of average and high-level consuming exclusively breast-fed infants to PAHs via breast milk

PAH	Concentration (μg/kg fat)	Exposure (μg/kg bw/ day)	
		Average consumer (800 mL/day)	High consumer (1200 mL/day)

		0 to < 4 Months	4 to < 6 months	0 to < 4 Months	4 to < 6 months
BaP	0.81	0.0045	0.0034	0.0068	0.0051
PAH4	2.77	0.015	0.012	0.023	0.017

Infant exposure is based on consumption of 800 mL or 1200 mL per day and expressed on a bodyweight (5.9 kg for infants aged 0-4 months and 7.8 kg for infants aged 4 to < 6 months) basis. Values rounded to 2 significant figures (SF)

Infant formula

28. The most recent UK data for infant formula date from 2003 – 4. Table 4 shows the upper bound mean values for BaP and PAH4 in infant formula. As for breast milk, the most exposed group is the 0 - <4-month-old high level consumers.

Table 4. Exposure for BaP and PAH4 from infant formula estimated for average and high-level consumption.

PAH	Concentration (μg/kg)	Exposure (μg/kg bw/ day)			
		Average consumer (800 mL/day)		High consumer (1200 mL/day)	
		0 to < 4 Months	4 to < 6 months	0 to < 4 Months	4 to < 6 months
BaP	0.049	0.0066	0.0050	0.010	0.0075
PAH4	0.358	0.049	0.037	0.073	0.055

Infant exposure is based on consumption of 800 mL or 1200 mL per day and expressed on a bodyweight (5.9 kg for infants aged 0-4 months and 7.8 kg for infants aged 4 to < 6 months) basis. Values rounded to 2 significant figures (SF)

Food

29. Our Exposure Assessment Team has provided data on the exposure of children aged 4 months to 5 years to BaP and PAH4 in the diet (Table 5). There are 19 Total diet Survey (TDS) food groups covered (Tables in Appendices 1 and 2). These are based on the general population and a few infant foods (liquid as well as solid).

Polycyclic Aromatic Hydrocarbons (PAHs)	**4 to <6-month-olds**		**6 to <9-month-olds**		**9 to <12-month-olds**		**12 to <15-month-olds**		**15 to <18-month-olds**		**18 to <24-month-olds**		**24 to <60-month olds**	
	ng/kg bw/d		**ng/kg bw/d**		**ng/kg bw/d**		**ng/kg bw/d**		**ng/kg bw/d**		**ng/kg bw/d**		**ng/kg bw/d**	
	Mean LB-UB	**97.5 percentile LB-UB**	**Mean LB-UB**	**97.5 percentile LB-UB**	**Mean LB-UB**	**97.5 percentile LB-UB**	**Mean LB-UB**	**97.5 percentile LB-UB**	**Mean LB-UB**	**97.5 percentile LB-UB**	**Mean LB-UB**	**97.5 percentile LB-UB**	**Mean LB-UB**	**97.5 percentile LB-UB**
BAP	0.25-2.3	1.1-8.8	0.74-2.3	2.4-8.4	1.1-2.5	2.6-6.6	1.4-3.6	3.0-6.5	1.7-3.0	3.0-6.2	1.5-3.6	2.9-6.2	1.6-3.2	2.8-5.2
PAH4	2.0-2.6	7.4-10	4.5-6.4	14- 20	6.2-8.8	16-22	7.7-11	16-23	8.3-12	17-24	8.4-12	16-23	8.9-13	16-23

Table 5. Exposure of infants and young children to BaP and PAH4 in food

Air

29 Air exposures were calculated using published estimated ventilation rates for different age groups, as shown in Table 6. Table 7 shows the calculated exposures to the different exposures, using the air values for the UK from DEFRA.

Table 6 Mean ventilation rates used in the estimation of PAH exposures from air (derived from US EPA, 2011b)

Age group (months)	Ventilation rate (m^3/day)
0 to <4	3.5
4 to <6	4.1
6 to <9	5.4
9 to <12	5.4
12 to <15	8.0
15 to <18	8.0
18 to <24	8.0
24 to <60	10.1

Table 7: Possible BaP exposures from air in infants and young children aged 6 months to 5 years.

BaP concentration (ng/m^3)	Exposure (ng/kg bw/day)							
	Age(months)							
	0 to <4	4 to <6	6 to <9	9 to <12	12 to <15	15 to <18	18 to <24	24 to <60
0.2	0.12	0.11	0.12	0.11	0.15	0.14	0.13	0.13
0.4	0.24	0.22	0.24	0.23	0.30	0.29	0.27	0.25
1.0	**0.60**	**0.55**	**0.60**	**0.56**	**0.75**	**0.71**	**0.67**	**0.63**

Values rounded to 2 SF

Soil

30 Potential exposures of UK infants aged 6 to 12 months and young children aged 1 to 5 years to BaP and PAH4 in soil were calculated assuming ingestion of 30 or 50 mg/day, respectively (US EPA, 2011a). Younger infants, who are less able to move around and come into contact with soil, are likely to consume less soil than children of these age groups.

Table 8 Exposure of children aged 6 months to 5 years to PAHs on rural soils

PAH concentration (μg/kg)	Exposure (μg/kg bw)					
	Age (months)					
	6 to <9	9 to <12	12 to <15	15 to <18	18 to <24	24 to <60
BaP 215	0.00074	0.00067	0.0010	0.00096.	0.00090	0.00067
PAH4 614	0.0021	0.0019	0.0029	0.0028	0.0026	0.0019

Table 9. Exposure of children age 6 months to 5 years to PAHs in urban soils

PAH concentration (μg/kg)	Exposure (μg/kg bw)					
	Age (months)					
	6 to <9	9 to <12	12 to <15	15 to <18	18 to <24	24 to <60
BaP 878	0.0030	0.0027	0.0041	0.0039	0.0037	0.0027
PAH4 3395	0.010	0.011	0.016	0.015	0.014	0.011

Dust

31 Potential exposures of UK infants aged 6 to 12 months and young children aged 1 to 5 years to PAHs in dust were calculated assuming ingestion of 30 or 60 mg/day, respectively (US EPA, 2011a). Younger infants, who are less able to move around and come into contact with dust, are likely to consume less dust than children of these age groups.

32 Using the value for BaP in the single UK study quoted by Ma and Harrad (2015), the exposure of children aged 6 months to 5 years to BaP ranges from 0.0011 to 0.0016 μg/kg bw/day.

Risk characterisation

Intake of PAHs in breast milk

33 Table 10 shows the margins of exposure (MOEs) for BaP and PAH4 exposure from exclusive breastfeeding estimated for average and high-level consumption of breast milk. All the MOEs are greater than 10,000, indicating that they are of low concern for genotoxic carcinogens

Table 10. MOE for BaP and PAH4 intake by medium and high-level-consuming exclusively breast-fed infants aged 0 - <6 months relative to the EFSA $BMDL_{10}$ values of 0.07 and 0.340 mg/kg bw/day.

PAH		Margin of exposure (MOE)

	Concentration (µg/kg)	Average consumer (800 mL/day)		High consumer (1200 mL/day)	
		0 to < 4 Months	4 to < 6 months	0 to < 4 Months	4 to < 6 months
BaP	0.81	16,000	21,000	11,000	14,000
PAH4	2.77	22,000	29,000	15,000	19,000

Infant formula

34 Table 11 shows MOEs for BaP and PAH4 exposure for infants consuming exclusively infant formula estimated for average and high-level consumption. For BaP the MOEs for the average consumer are greater than 10,000, indicating that they are of low concern for genotoxic carcinogens. However, BaP in the high-level consumers and all the intakes of PAH4 are lower than the 10,000 and on face value may represent a risk to human health. Since the low MOE values cover only a short period of an individual's lifetime and the values for food (see below) are calculated to be much higher, these values are unlikely to contribute in a major way to overall dietary intake.

Table11 MOE for BaP and PAH4 intake by medium and high-level-consuming infant formula-fed infants aged 0 - <6 months relative to the EFSA $BMDL_{10}$ values of 0.07 and 0.340 mg/kg bw/day.

PAH	Concentration (µg/kg)	Exposure (µg/kg bw/ day)			
		Average consumer (800 mL/day)		High consumer (1200 mL/day)	
		0 to < 4 Months	4 to < 6 months	0 to < 4 Months	4 to < 6 months
BaP	0.047	11,000	14,000	7,100	9,300
PAH4	0.358	7,000	9,000	4,700	6,200

Food

35 Table 12 shows the estimated margins of exposure of infants to BaP and PAH4 from food. Except for the upper bounds of the 97.5^{th} percentile exposures of 0 – 4 and 4 – 6-month-old infants, all MOEs are greater than 10,000, indicating a low concern for health. For the group in question, although this level of intake is undesirable, the MOEs are still fairly high (8000), the numbers of infants involved will be small and exposure at this level only takes place for a short period of life, not the lifetime exposure upon which the MOEs are based.

Polycyclic Aromatic Hydrocarbons (PAHs)	MOE													
	4 to <6-month-olds		6 to <9-month-olds		9 to <12-month-olds		12 to <15-month-olds		15 to <18-month-olds		18 to :24-month-olds		24 to <60-month olds	
	Mean LB-UB	97.5 percentile LB-UB	Mean LB-UB	97.5 percentile LB-UB	Mean LB-UB	97.5 percentile LB-UB	Mean LB-UB	97.5 percentile LB-UB	Mean LB-UB	97.5 percentile LB-UB	Mean LB-UB	97.5 percentile LB-UB	Mean LB-UB	97.5 percentile LB-UB
BAP	280,000-30,000	64,000 - 8,000	96,000-30,000	29,000-8,300	64,000-28,000	27,000-11,000	50,000-18,000	47,000-19,000	47,000-23,000	23,000-11,000	47,000-19,000	24,000-11,000	44,000-22,000	25,000-13,000
PAH4	170,000-130,000	46,000-34,000	76,000-53,000	24,000-17,000	55,000-39,000	21,000-15,000	44,000-31,000	21,000-15,000	41,000-28,000	20,000-14,000	40,000-28,000	21,000-15,000	38,000-26,000	21,000-15,000

Table 12. MOEs for the intake of BaP and PAH4 in food.

Air

36 Table 13 shows that the MOEs for BaP in air are very much in excess of 10,000 and as such would not represent a risk to health.

Table 13: Possible BaP margins of exposure from air in infants and young children aged 6 months to 5 years.

BaP concentration (ng/m^3)	MOE							
	Age(months)							
	0 to <4	4 to <6	6 to <9	9 to <12	12 to <15	15 to <18	18 to <24	24 to <60
0.2	590,000	670,000	560,000	620,000	460,000	490,000	530,000	560,000
0.4	300,000	330,000	280,000	310,000	230,000	250,000	260,000	280,000
1.0	120,000	130,000	110,000	120,000	93,000	98,000	110,000	110,000

Dust

37 Using the value for UK indoor dust given by Ma and Harrad (2015), daily MOEs for intake of BaP by infants aged 6 months to 5 years ranged from 43,000 to 65,000. Intake of PAHs via ingestion of house dust would not be expected to be a risk to the health in these age groups.

Soil.

38 The MOE values for BaP and PAH4 intake in young children aged 6 months to 5 years from rural and urban soils are shown in Tables 14 and 15. All the values are greater than 10,000, indicating that ingestion of soil particles containing PAHs at the concentrations found in British soils does not constitute a risk to health in these age groups.

Table 14: Possible BaP and PAH4 intakes from rural soil in infants and young children aged 6 months to 5 years. relative to the EFSA $BMDL_{10}$ values of 0.07 and 0.340 mg/kg bw/day.

PAH concentration (ng/m^3)	MOE					
	Age (months)					
	6 to <9	9 to <12	12 to <15	15 to <18	18 to <24	24 to <60
BaP 215	94,000	100,000	69,000	73,000	78,000	100,000
PAH4 614	160,000	180,000	120,000	120,000	130,000	180,000

Values rounded to 2 SF

Table 15: Possible BaP and PAH4 intakes from urban soil in infants and young children aged 6 months to 5 years, relative to the EFSA $BMDL_{10}$ values of 0.07 and 0.340 mg/kg bw/day.

PAHconcentration (ng/m^3)	MOE					
	Age (months)					
	6 to <9	9 to <12	12 to <15	15 to <18	18 to <24	24 to <60
BaP 878	23,000	26,000	17,000	18,000	19,000	24,000
PAH4 3395	29,000	32,000	21,000	22,000	24,000	32,000

Conclusions

39 The concentrations of BaP and PAH4 in human breast milk and food in general give rise to intakes that have margins of exposure when compared with the respective $BMDL_{10}$ values of greater than 10,000 which, for a genotoxic carcinogen represents a low level of concern.

40 Where MOEs are below 10,000, they are mostly in infant formula, which would be a major constituent of the diet for only a short period of an individual's life and would not be expected to contribute significantly to overall lifetime exposure.

41 Levels estimated to be ingested in soil and dust and inhaled in air are also > 10,000 and thus do not represent a concern for health.

Questions for the Committee

1 Are Members happy with the use of PAH4 as a measure of PAHs as presented in this paper?

2 Does the Committee agree with the conclusions drawn above?

3 Does the Committee think that PAHs in the infant diet can be included in the addendum to the1-5 feeding review overarching statement?

4 Do Members have any further comments?

References

Acharya N, Gautam B, Subhiah S, Rogge MM, Anderson TA, Gao W. polycyclic aromatic hydrocarbons in breast milk of obese vs normal women: infant exposure and risk assessment. Science of the Total Environment 2019 **668**: 658 – 667.

Bates, B.; Lennox, A.; Prentice, A.; Bates, C.; Page, P.; Nicholson, S.; Swan, G. (2014) National Diet and Nutrition Survey Results from Years 1, 2, 3 and 4 (combined) of the Rolling Programme (2008/2009 – 2011/2012) Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/310995/NDNS_Y1_to_4_UK_report.pdf

Cok I, Mazmanci B, Mazmanci MA, Torgut C, Henkelmann B, Schramm K-W. Analysis of human milk to assess exposure to PAHs, PCBs and organochlorine pesticides in the vicinity Mediterranean city Mersin, Turkey. Environment International 2012 **40**: 63 – 69.

Department of Health (DH) (1994). The COMA report on Weaning and the Weaning Diet. Report on Health and Social Subjects 45. The Stationary Office London

DH (2013). Diet and Nutrition Survey of Infants and Young Children (DNSIYC), 2011. Available at: http://transparency.dh.gov.uk/2013/03/13/dnsiyc-2011/

Deziel NC, Rull RP, Colt JS, Reynolds P, Whitehead TP, Gunier RB, Month SR, Taggart DR, Buffler P, Ward MH, Metayer C. Polycyclic aromatic hydrocarbons in residential dust and risk of childhood acute lymphoblastic leukemia. Environmental Research 2014 **133**: 388 – 395.

Diggs DL, Huderson AC, Harris KL, Myers JN, Banks LD, Rekhadevi PV, Niaz MS, Ramesh A. Polycyclic aromatic hydrocarbons and digestive tract cancers – a perspective. Journal of Environmental Science and Health C. Environmental Carcinogenesis and Ecotoxicological Reviews 2011 **29**94): 324 – 357.

EFSA Scientific opinion of the Panel on Contaminants in the Food Chain. Polycyclic aromatic hydrocarbons in food. The EFSA Journal 2008 **724**: 1 – 114.

Finglas PM, Roe MA, Pimchen HM, Berry R, Church SM, Dodha SK, Farron-Wilson M, Swan G (2015). McCance and Widdowson's The Composition of Foods. Seventh summary edition. Cambridge: Royal Society of Chemistry.

Harris KL, banks LD, Manley JA, Huderson AC, Ramesh A. Bioaccessibility of polycyclic aromatic hydrocarbons: relevance to toxicity and carcinogenesis. Expert Opinion on Dug Metabolism and Toxicology 2013 **9**(11): 1465 – 1480.

IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Some non-heterocyclic polycyclic aromatic hydrocarbons and some related exposures**.** IARC Monograph Evaluating Carcinogenic Risks to Humans. 2010; **92**: 1–853 https://www.ncbi.nlm.nih.gov/books/NBK321710/#p244_s3_102

Kibblewhite MG. Contamination of agricultural soil by urban and peri-urban highways: an overlooked priority? Environmental Pollution 2018 **242**: 1331 – 1336.

Kim K-H, Jahan SA, Kabir E, Brown RJC. A review of airborne polycyclic aromatic hydrocarbons (PAHs) and their human health effects. Environment International 2013 **60**: 71 – 80.

Li Z, Romanoff L, bartell S, Pittman EN, Trinidad DA, McClean M, Webster TF, Sjödin A. Excretion profiles and half-lives of ten urinary polycyclic aromatic hydrocarbon metabolites after dietary exposure. Chemical Research In Toxicology 2012 **26**(7): 1452 – 1461.

Lorenzi D, Entwistle JA, Cave M, Dean JR. Determination of polycyclic aromatic hydrocarbons in urban street dust: implications for human health. Chemosphere 2011 **83**: 970 – 977.

Ma Y, Harrad S. Spatiotemporal analysis and human exposure assessment on polycyclic aromatic hydrocarbons in indoor air, settled house dust and diet: a review. Environment International 2015 **84**: 7 – 16.

Moorthy B, Chu C, Carlin DJ. Polycyclic aromatic hydrocarbons: from metabolism to lung cancer. Toxicological Sciences 2015 **145**(1): 5 – 15.

Murphy Jr. G, Rouse RL, Polk WW, Henk WG, Barker SA, Boudreaux MJ, Floyd ZE, Penn AL. Combustion-derived hydrocarbons localize to lipid droplets in respiratory cells/ American Journal of Respiratory Cell Molecular Biology 2008 **38**: 532 – 540.

Nebert DW, Shi Z, Galvez-Peralta M, Uno S, Dragin N. Pral benzo[a[pyrene: understanding pharmacokinetics, detoxication, and consequences – *Cyp*1 knockout mouse lines as a paradigm. Molecular Pharmacology **84**: 304 – 313.

Pulkratbova J, Stupak M, Svarcova A, Rossner P, Rossnerova A, Ambroz A, Sram R, Hajslova J. Relationship between atmospheric pollution in the residential area and concentrations of polycyclic aromatic hydrocarbons (PAHs) in human breast milk. Science of the Total Environment 2012 **562**: 640 – 647.

Roshandel G, Semnani S, Malekzadeh R, Dawsey SM. Polycyclic aromatic hydrocarbons and esophageal squamous cell carcinoma – a review. Archives of Iranian Medicine **15**(11: 713 – 722.

Santonicola S, De Felice A, Cobellis L, Passariello N, Peluso A, Murru N, Ferrante MC, Mercogliano R. Comparative study on the occurrence of polycyclic aromatic hydrocarbons in breast milk and infant formula and risk assessment. Chemosphere 2017 **175**: 383 – 390.

Shi Z, Dragin N, Galvez-Peralta M, Jorge-Nebert LF, Miller ML, Wang B, Nebert DW. Organ-specific roles of CYP 1A1 during detoxication of dietary benzo[a]pyrene. Molecular Pharmacology 2010 **78**: 46 – 57.

TsangHL, Wu S, Leung CKM, Tao S, Wong MH. Body burden of Hong Kong residents, based on human milk, maternal and cord serum. Environment International 2011 **37**: 142 – 151.

US EPA (2011a) ‘Exposure Factors Handbook Chapter 5: Soil and Dust Ingestion’ Available at: https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252&CFID=69447188&CFTOKEN=21916199

US EPA (2011b) ‘Exposure Factors Handbook Chapter 6: Inhalation Rates’ Available at: https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252&CFID=69447188&CFTOKEN=21916199

Vane CH, Kim AW, Beriro DJ, Cave MR, Knights K, Moss-hayes V, Nathanail PC. Polycyclic aromatic hydrocarbons (PAH) and polychlorinated biphenyls (PCB) in urban soils of Greater London, UK. Applied geochemistry 2014 **51**: 303 – 314.

White AJ, Bradshaw PT, Herring AH, Teitelbaum SL, Beyea J, Stellman SD, Steck SE, Mordukhovich I, Eng Sm, Engel LS, Conway K, Hatch M, Neugut AI, Santella RM, Gammon MD. Exposure to multiple sources of poltcyclic aromatic hydrocarbons and breast cancer incidence. Environment International 2016 **89 – 90**: 185 – 192

White S, Fernandes A. Rose M. Survey for polycyclic aromatic hydrocarbons (PAHs) in infant formulae and baby foods December 2004. CSL Sand Hutton
York YO41 1LZ

Xue W, Warshawsky D. Metabolic activation of polycyclic aromatic hydrocarbons and DNA damage: a review. Toxicology and Applied Pharmacology 2005 **206**: 73 – 93.

Zanieri L, Galvan P, Checcini L, Cincinelli A, Lepro L, Donzelli GP, Del Bubba M. Polycyclic aromatic hydrocarbons (PAHs) in human milk from Italian women: influence of cigarette smoking and residential area. Chemosphere 2007 **67**: 1265 – 1274.

Appendix1 Exposure of different age groups of infants and children to BaP by consumption of various foodstuffs

		4 to 5.9 m olds				6 to 8.9 m olds			
Group Code	Group Name	Mean LB	Mean UB	P97.5 LB	P97.5 UB	Mean LB	Mean UB	P97.5 LB	P97.5 UB
1	Bread	0.01	0.01	0.11	0.11	0.07	0.07	0.44	0.44
2	Misc cereals	0.04	0.04	0.29	0.29	0.19	0.19	0.90	0.90
3	Carcase meat	0.00	0.00	0.00	0.05	0.00	0.03	0.00	0.20
4	Offals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Meat products	0.00	0.00	0.00	0.00	0.01	0.01	0.10	0.10
6	Poultry	0.00	0.01	0.00	0.13	0.00	0.02	0.00	0.14
7	Fish	0.01	0.01	0.12	0.12	0.04	0.04	0.31	0.31
8	Fats and oils	0.00	0.00	0.02	0.02	0.01	0.01	0.06	0.06
9	Eggs	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.12
10	Sugars	0.00	0.00	0.08	0.08	0.03	0.03	0.23	0.23
11	Green veg	0.00	0.03	0.00	0.21	0.00	0.04	0.00	0.25
12	Potaoes	0.00	0.03	0.00	0.22	0.00	0.07	0.00	0.35
13	Other veg	0.19	0.19	1.06	1.06	0.40	0.40	1.63	1.63
14	Canned veg	0.00	0.00	0.00	0.03	0.00	0.01	0.00	0.13
15	Fresh fruit	0.00	0.05	0.00	0.33	0.00	0.11	0.00	0.52
16	Fruit products	0.00	0.02	0.00	0.22	0.00	0.02	0.00	0.20
18	Milk	0.00	0.02	0.00	0.20	0.00	0.10	0.00	0.55
19	Dairy products	0.00	1.93	0.00	8.80	0.00	1.13	0.00	7.50
20	Nuts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	Total	0.25	2.34	1.07	8.82	0.74	2.30	2.45	8.37

		9 to 11.9 m olds				12 to 14.9 m olds			
Group Code	Group Name	Mean LB	Mean UB	P97.5 LB	P97.5 UB	Mean LB	Mean UB	P97.5 LB	P97.5 UB
1	Bread	0.18	0.18	0.75	0.75	0.29	0.29	0.89	0.89
2	Misc cereals	0.30	0.30	1.09	1.09	0.44	0.44	1.50	1.50
3	Carcase meat	0.00	0.04	0.00	0.25	0.00	0.05	0.00	0.25
4	Offals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Meat products	0.03	0.03	0.18	0.18	0.06	0.06	0.30	0.30
6	Poultry	0.00	0.04	0.00	0.21	0.00	0.05	0.00	0.20
7	Fish	0.08	0.08	0.45	0.45	0.10	0.10	0.47	0.47
8	Fats and oils	0.01	0.01	0.09	0.09	0.02	0.02	0.12	0.12
9	Eggs	0.00	0.03	0.00	0.18	0.00	0.04	0.00	0.21
10	Sugars	0.05	0.05	0.32	0.32	0.09	0.09	0.54	0.54
11	Green veg	0.00	0.05	0.00	0.26	0.00	0.04	0.00	0.21
12	Potaoes	0.00	0.11	0.00	0.43	0.00	0.13	0.00	0.48
13	Other veg	0.43	0.43	1.43	1.43	0.40	0.40	1.41	1.41
14	Canned veg	0.00	0.04	0.00	0.25	0.00	0.05	0.00	0.31
15	Fresh fruit	0.00	0.17	0.00	0.68	0.00	0.23	0.00	0.78
16	Fruit products	0.00	0.03	0.00	0.24	0.00	0.05	0.00	0.44
18	Milk	0.00	0.26	0.00	2.08	0.00	1.05	0.00	2.99
19	Dairy products	0.00	0.70	0.00	4.19	0.00	0.47	0.00	2.96
20	Nuts	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02
TOTAL	Total	1.09	2.54	2.59	6.62	1.40	3.55	2.97	6.53

		15 to 18 m olds				18 to 24 m olds			
Group Code	Group Name	Mean LB	Mean UB	P97.5 LB	P97.5 UB	Mean LB	Mean UB	P97.5 LB	P97.5 UB
1	Bread	0.31	0.31	0.97	0.97	0.32	0.32	0.92	0.92
2	Misc cereals	0.51	0.51	1.46	1.46	0.50	0.50	1.63	1.63
3	Carcase meat	0.00	0.06	0.00	0.30	0.00	0.06	0.00	0.29
4	Offals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Meat products	0.07	0.07	0.32	0.32	0.08	0.08	0.35	0.35
6	Poultry	0.00	0.05	0.00	0.24	0.00	0.06	0.00	0.21
7	Fish	0.10	0.10	0.48	0.48	0.12	0.12	0.52	0.52
8	Fats and oils	0.02	0.02	0.12	0.12	0.03	0.03	0.15	0.15
9	Eggs	0.00	0.04	0.00	0.22	0.00	0.04	0.00	0.19
10	Sugars	0.14	0.14	0.68	0.68	0.17	0.17	0.69	0.69
11	Green veg	0.00	0.04	0.00	0.20	0.00	0.03	0.00	0.17
12	Potaoes	0.00	0.12	0.00	0.39	0.00	0.11	0.00	0.28
13	Other veg	0.39	0.39	1.22	1.22	0.27	0.27	0.87	0.87
14	Canned veg	0.00	0.06	0.00	0.30	0.00	0.07	0.00	0.32
15	Fresh fruit	0.00	0.28	0.00	0.80	0.00	0.29	0.00	0.80
16	Fruit products	0.00	0.07	0.00	0.45	0.00	0.14	0.00	0.70
18	Milk	0.00	1.05	0.00	2.55	0.00	0.97	0.00	2.92
19	Dairy products	0.00	0.38	0.00	1.98	0.00	0.38	0.00	1.95
20	Nuts	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
TOTAL	Total	1.54	3.69	3.03	6.19	1.50	3.63	2.95	6.20

		24 to 60 m olds			
Group Code	Group Name	Mean LB	Mean UB	P97.5 LB	P97.5 UB
1	Bread	0.37	0.37	1.07	1.07
2	Misc cereals	0.45	0.45	1.09	1.09
3	Carcase meat	0.00	0.04	0.00	0.20
4	Offals	0.00	0.00	0.00	0.00
5	Meat products	0.09	0.09	0.33	0.33
6	Poultry	0.00	0.06	0.00	0.21
7	Fish	0.10	0.10	0.40	0.40
8	Fats and oils	0.02	0.02	0.11	0.11
9	Eggs	0.00	0.03	0.00	0.20
10	Sugars	0.23	0.23	0.89	0.89
11	Green veg	0.00	0.03	0.00	0.12
12	Potaoes	0.00	0.10	0.00	0.30
13	Other veg	0.32	0.32	1.05	1.05
14	Canned veg	0.00	0.05	0.00	0.22
15	Fresh fruit	0.00	0.24	0.00	0.65
16	Fruit products	0.00	0.16	0.00	0.88
18	Milk	0.00	0.65	0.00	2.00
19	Dairy products	0.00	0.26	0.00	1.06
20	Nuts	0.00	0.00	0.00	0.05
TOTAL	Total	1.58	3.20	2.81	5.20

Appendix 2: Exposure of different age groups of infants and children to PAH4 by consumption of various foodstuffs

		4 to 5.9 m olds				6 to 8.9 m olds			
Group Code	Group Name	Mean LB	Mean UB	P97.5 LB	P97.5 UB	Mean LB	Mean UB	P97.5 LB	P97.5 UB
1	Bread	0.04	0.06	0.41	0.66	0.27	0.43	1.70	2.78
2	Misc cereals	0.17	0.27	1.20	1.90	0.79	1.24	3.80	6.01
3	Carcase meat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	Offals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Meat products	0.00	0.00	0.00	0.00	0.06	0.07	0.66	0.76
6	Poultry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Fish	0.05	0.06	0.84	1.02	0.31	0.38	2.16	2.62
8	Fats and oils	0.00	0.01	0.07	0.10	0.02	0.03	0.20	0.29
9	Eggs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Sugars	0.02	0.03	0.31	0.48	0.11	0.17	0.93	1.44
11	Green veg	0.08	0.10	0.62	0.77	0.13	0.16	0.74	0.92
12	Potaoes	0.03	0.05	0.22	0.33	0.07	0.11	0.35	0.53
13	Other veg	1.15	1.59	6.48	9.02	2.43	3.38	10.02	13.94
14	Canned veg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	Fresh fruit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	Fruit products	0.14	0.16	1.50	1.73	0.15	0.17	1.36	1.56
18	Milk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	Dairy products	0.32	0.32	1.47	1.47	0.19	0.19	1.25	1.25
20	Nuts	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
TOTAL	Total	2.00	2.65	7.40	10.01	4.54	6.35	14.34	20.25

Appendix 1 (cont.)

		9 to 11.9 m olds				12 to 14.9 m olds			
Group Code	Group Name	Mean LB	Mean UB	P97.5 LB	P97.5 UB	Mean LB	Mean UB	P97.5 LB	P97.5 UB
1	**Bread**	0.71	1.16	2.89	4.71	1.12	1.83	3.43	5.59
2	**Misc cereals**	1.28	2.02	4.59	7.24	1.84	2.91	6.35	10.02
3	**Carcase meat**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	**Offals**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	**Meat products**	0.19	0.22	1.19	1.37	0.37	0.43	2.02	2.32
6	**Poultry**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	**Fish**	0.54	0.66	3.21	3.89	0.73	0.89	3.35	4.05
8	**Fats and oils**	0.04	0.06	0.30	0.43	0.06	0.09	0.42	0.60
9	**Eggs**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	**Sugars**	0.20	0.32	1.33	2.05	0.37	0.58	2.23	3.45
11	**Green veg**	0.14	0.17	0.78	0.97	0.13	0.16	0.62	0.77
12	**Potaoes**	0.11	0.16	0.43	0.65	0.13	0.19	0.48	0.71
13	**Other veg**	2.65	3.69	8.80	12.24	2.47	3.44	8.68	12.07
14	**Canned veg**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	**Fresh fruit**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	**Fruit products**	0.22	0.26	1.65	1.89	0.35	0.40	2.95	3.39
18	**Milk**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	**Dairy products**	0.12	0.12	0.70	0.70	0.08	0.08	0.49	0.49
20	**Nuts**	0.00	0.00	0.03	0.04	0.01	0.01	0.07	0.09
TOTAL	**Total**	**6.21**	**8.83**	**15.94**	**21.67**	**7.66**	**10.99**	**16.44**	**23.14**

Appendix 1 (cont.)

		15 to 18 m olds				18 to 24 m olds			
Group Code	**Group Name**	**Mean LB**	**Mean UB**	**P97.5 LB**	**P97.5 UB**	**Mean LB**	**Mean UB**	**P97.5 LB**	**P97.5 UB**
1	**Bread**	1.20	1.95	3.76	6.13	1.25	2.04	3.54	5.77
2	**Misc cereals**	2.17	3.43	6.18	9.76	2.12	3.35	6.87	10.84
3	**Carcase meat**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	**Offals**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	**Meat products**	0.46	0.53	2.13	2.45	0.54	0.62	2.31	2.65
6	**Poultry**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	**Fish**	0.68	0.82	3.40	4.12	0.85	1.02	3.66	4.44
8	**Fats and oils**	0.07	0.10	0.40	0.58	0.10	0.14	0.50	0.72
9	**Eggs**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	**Sugars**	0.57	0.87	2.81	4.34	0.68	1.05	2.83	4.37
11	**Green veg**	0.13	0.16	0.60	0.75	0.10	0.13	0.50	0.62
12	**Potaoes**	0.12	0.18	0.39	0.58	0.11	0.16	0.28	0.41
13	**Other veg**	2.40	3.34	7.48	10.41	1.68	2.34	5.35	7.44
14	**Canned veg**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	**Fresh fruit**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	**Fruit products**	0.46	0.53	3.04	3.49	0.91	1.05	4.71	5.40
18	**Milk**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	**Dairy products**	0.06	0.06	0.33	0.33	0.06	0.06	0.33	0.33
20	**Nuts**	0.00	0.00	0.05	0.07	0.00	0.01	0.01	0.01
TOTAL	**Total**	**8.31**	**11.97**	**17.00**	**24.18**	**8.41**	**11.97**	**16.43**	**22.81**

Appendix1 (cont

		24 to 60 m olds			
Group Code	Group Name	Mean LB	Mean UB	P97.5 LB	P97.5 UB
1	Bread	1.43	2.33	4.13	6.74
2	Misc cereals	1.90	2.99	4.58	7.24
3	Carcase meat	0.00	0.00	0.00	0.00
4	Offals	0.00	0.00	0.00	0.00
5	Meat products	0.59	0.68	2.17	2.50
6	Poultry	0.00	0.00	0.00	0.00
7	Fish	0.71	0.86	2.82	3.42
8	Fats and oils	0.07	0.10	0.39	0.56
9	Eggs	0.00	0.00	0.00	0.00
10	Sugars	0.94	1.45	3.66	5.65
11	Green veg	0.08	0.10	0.35	0.43
12	Potaoes	0.10	0.15	0.30	0.46
13	Other veg	1.96	2.73	6.45	8.97
14	Canned veg	0.00	0.00	0.00	0.00
15	Fresh fruit	0.00	0.00	0.00	0.00
16	Fruit products	1.10	1.26	5.93	6.81
18	Milk	0.00	0.00	0.00	0.00
19	Dairy products	0.04	0.04	0.18	0.18
20	Nuts	0.02	0.02	0.19	0.25
TOTAL	Total	8.93	12.72	16.48	23.13