Process contaminants

In this guide

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Acrylamide and furans

103. Acrylamide, furan and methyl furans (2-methyl furan, 3-methyl furan, 2,5-dimethyl furan) are organic compounds produced when some foods are subjected to high temperatures (greater than 120ºC) during cooking (including home-cooking) and processing (FSA, 2014d).

104. Tea is typically processed in four stages: withering, rolling, oxidation and drying. The aim of these steps is to reduce the moisture content of the fresh tea leaves. The drying stage involves heating at various temperatures and for different times. The typical industrial drying parameters of black tea is 100 - 140°C (Aaqil et al., 2023), whilst higher temperatures are utilised for green tea at 130 - 150°C (Zhou et al., 2024). The formation of acrylamide and furans in tea are

therefore possible at the higher temperature range.

105. Regular and prolonged exposures over a lifetime to foods containing high levels of acrylamide and furan has the potential to increase the risk of developing cancer. The FSA concluded that exposure to acrylamide and furan should be as low as reasonably achievable (ALARA) (FSA, 2022).

106. There is no specific maximum limit for acrylamide in tea (green or black). However, assimilated Regulation (EU) 2017/2158 – for England and Wales and Regulation (EU) 2017/2158 for Northern Ireland) requires food business operators to put in place practical steps to manage acrylamide within their food safety management systems, including sourcing of ingredients, and appropriate storage (FSA, 2024). There is no specific regulation for maximum levels of furans in tea (green or black). The FSA monitors the levels of acrylamide and furans in food surveys.

107. The FSA has not conducted any food survey specifically focused on tea with regard to acrylamide or furans. However, previous broad, multi-product contaminant surveys did not identify tea as major sources of acrylamide and furans (FSA, 2014; 2018; 2024). Furans will also evaporate from hot drinks in an open container, thus minimising exposure.

108. Hinojosa-Nogueira et al., (2025) evaluated exposure to 11 food processing contaminants and their effects on maternal and foetal health in a group of women from Northern Spain. This included 5-Hydroxymethyl-2-Furfural (HMF5), furosine, acrylamide, and furan. The study analysed the characteristics of 84 pregnant women and their newborns. The average age of participants was ~35 years. Dietary intake during pregnancy was assessed using a food frequency questionnaire once in the first trimester and again in the third trimester.

109. Analysis showed that for the dietary intake of HMF5, coffee, cocoa, tea and infusions were responsible for 86% of the total exposure, with mean exposures being 0.81 ± 0.91 mg/kg bw per day. Exposure to acrylamide and furans from this food group contributed 14% (0.15 ± 0.10 µg/kg bw per day) and 30% (0.66 ± 0.03 µg/kg bw per day) of the total exposure, respectively. The study did not provide a breakdown on the numbers of samples for each of the hot drinks. Therefore, it is not possible to establish the contribution of tea consumption alone to the exposure of these compounds.

110. It is anticipated that the COT will be undertaking work on acrylamide later in the year and this will be reflected in the maternal diet programme of

work.

Polyaromatic hydrocarbons

111. Polyaromatic hydrocarbons (PAHs) are compounds that have at least two condensed aromatic rings. They can be formed during food processing procedures such as grilling, roasting, frying, smoking and drying. PAHs are also common environmental pollutants generated from the incomplete combustion of fossil fuels or biomass (Ma et al., 2023).

112. At present in the UK, there are no established maximum permitted levels of PAHs in tea.

113. In 2015, the FSA published a report on the occurrence of PAHs in herbs, spices, supplements and tea (FSA, 2015). PAHs were measured in 92 of the 95 teas tested (n= 68 herbal teas, n=27 teas). Teas that had concentrations either at the LOD or very low PAH4 (sum of benzo[a]pyrene, benz[a]anthracene, benzo[b]fluoranthene, and chrysene) concentrations (n=3; ranging from LOD – 21.04 µg/kg) and were intended for consumption by infants. Of the remaining samples, the majority showed PAHs with lower molecular weight to occur at elevated levels. Benzo(a)pyrene (BaP) concentrations ranged from <0.13 µg/kg to 80.54 µg/kg with a mean of 6.00 µg/kg. PAH4 concentrations ranged from 0.40 µg/kg to 385.93 µg/kg with a mean of 32.73 µg/kg. Approximately a third of the samples showed BaP and PAH4 concentrations above 2 µg/kg and 20 µg/kg, respectively.

114. In 2008, the EFSA CONTAM Panel published their scientific opinion on PAHs in food (EFSA, 2008). This included dried tea samples (n=30). The lower and upper bound means concentrations are shown in Table 4.

Table SEQ Table * ARABIC 3 - Lower and upper bounds for the mean of the concentration of BaP, PAH4 and PAH8 (µg/kg) (adapted from EFSA, 2008).

Mean levels (µg/kg)	**BaP**	**PAH2**	**PAH4**	**PAH8**
Lower bound	8.37	24.85	42.66	61.02
Upper bound	8.38	24.87	42.69	61.14

BaP = benzo[a]pyrene.

PAH2 = benzo[a]pyrene and chrysene.

PAH4 = benzo[a]pyrene, chrysene, benz[a]anthracene and benzo[b]fluoranthene.

PAH8 = PAH4 plus benzo[k]fluoranthene, benzo[ghi]perylene, dibenz[a,h]antracene, indeno[1,2,3-cd]pyrene.

115. In general, it was observed that tea was noted to exceed 10 µg/kg of PAH8. The concentrations of PAHs in the 30 tea leaf samples varied between 1 and 173 µg/kg with 20% exceeding 100 µg/kg. EFSA however noted that the preparation of the tea will dilute the level found in the beverage before consumption. The average total dietary exposure (whole population) for the UK to BaP, PAH2, PAH4 and PAH8 was 188, 499, 936 and 1,415 ng/day, respectively. Based on their corresponding BMDL10 values, the MOEs for PAHs indicate a low concern for consumer health at the average estimated dietary exposures across EU Member States (average exposures 3.1-4.3 ng/kg bw per day, MOEs: 16,300-22,600 for benzo[a]pyrene alone and 23.6-35.6 ng/kg bw per day, MOEs: 13,800-20,800 for PAH8).