

Problematic substances in consumer's hands? Colour developers in thermal paper 2015 – 2024 in Germany Lina Müller & Sarah Enge; Food Chemistry Students 2015-2024; Thomas J. Simat*

Dresden University of Technology, Chair of Food Science and Food Contact Materials, Bergstr. 66, 01062 Dresden Germany, *contact: thomas.simat@tu-dresden.de

Summary

- Sampling annually ≥ 99 thermal paper sampels, period: **2015 – 2024**
- focus on 8 colour developer substances
- in years 2015 2018 → Bisphenol A (BPA) proportionally the **most** commonly used colour developer



- in years $2019 2024 \rightarrow Bisphenol S$ (BPS) and Pergafast 201 proportionally most commonly used
- 2024 → trend towards other colour developers, e.g. UU
- after 2020 ("BPA-ban") \rightarrow BPA probably only on the market due to remaining stocks









- How does printing work? The printed image is created selectively by a heat-induced proton transfer from the colour developer to the leuco dye. By this protonation, the colourless leuco dye is converted to its coloured final product. Sensitisers are used in the functional layer to optimize the thermal conduction.
- **Exposition:** The contamination of the recycling cycle of paper fibers by thermal paper-associated substances is known^[1]. Thus, the colour developers and the sensitizers can be transferred into food via recycled fibres. In addition, the substances can be transferred by touching contact onto the skin ^[2]. Certain colour developers (first BPA and then BPS) have been classified as SVHC (substance of very high concern) by the ECHA (European Chemicals Agency), due to toxicity to reproduction and endocrine disruption ^[3].



Ban: According to Regulation (EU) 2016/2235, thermal paper with BPA in a concentration equal or greater than 0.02 % by weight (= 0.2 mg/g) shall not be placed on the market (valid since 2020). Manufacturers are using other colour developers such as Bisphenol S (BPS) and 'phenol-free' alternatives such as Pergafast[®] 201 (PF201) and urea urethane compound (UU), as well as thermal paper without colour developers (Blue4est[®]).

Aim of the study

 In this study, around 100 thermal papers from the German market have been analysed annually from 2015 to date for the presence of colour developers.





Methodology

After methanolic extraction (60 $^{\circ}$ C, > 12 h), the colour developers, their hydrolysis products and sensitizers were identified and quantified using HPLC-DAD.^[2]

Market overview of colour developers 2015 – 2024

Amount of colour developers in thermal paper in 2024:

Colour developer	Amount in mg/g	Amount in mg/dm ²
Bisphenol S (BPS)	9.4	5.7
	(Median, n = 48)	
Pergafast 201	10.7	5.6
	(Median, $n = 26$)	



The figure shows the **percentage distribution of colour** • developers (BPA, BPS, Pergafast 201, UU and other colour developers) in the analysed samples (with n size of the sample)

The thermal papers were mainly collected in Germany. Included are receipts, tickets and adhesive labels (since 2017) from various retail categories (post office, food, cafés, restaurants, petrol stations, fashion, drugstores, etc.).

References: [1] L. Richter, E. Mehlhorn, T. J. Simat, A. Harling, W. Altkofer, *Poster TU Dresden* 2011 [2] M. Eckardt, T. J. Simat, *Chemosphere* **2017**, 186 [3] ECHA Chem Database, https://echa.europa.eu/de/substance-information, keyword ,Bisphenol A', last updated 18/10/2024 [4] M. Eckardt, M. Kubicova, D. Tong, T. J. Simat, J. Chromatogr. A 2019, 1609



8th International Symposium on Food Packaging 01/04/2025 – 04/04/2025 Dubrovnik, Croatia