

# An updated status about the color developers currently used in thermal papers and available on the French market

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# An updated status about the color developers currently used in thermal papers and available on the French market

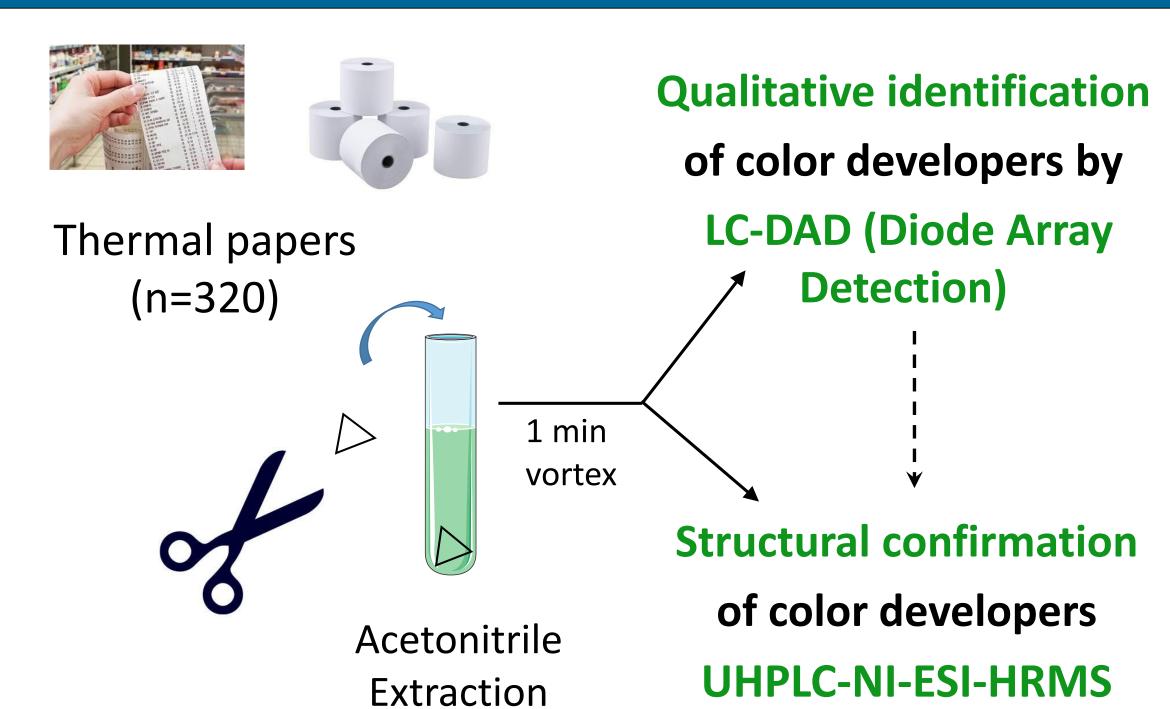


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### Context of the study

- Thermal printing (TP) solutions are increasingly used, with a worldwide market of TP papers estimated over 4 billion \$ in 2021, and expected to exceed 6 billion \$ by 2028.
- Due to their capability to act as proton donors, bisphenols such as Bisphenol A (BPA) are commonly used as color developers in TP, including point-of sale solutions, but also self-adhesive labels (parcels, foods) and several other types of TP solutions.
- BPA is a xeno-estrogen. Following demonstration that dermal exposure to this endocrine disrupting substance (EDC) can occur as a result of TP handling, the EU drastically limited the use of BPA in TP by January 2020 (<0.02% w/w). Alternative substances used for similar purposes are not regulated. These include BPA analogues such as Bisphenol S (BPS, a suspected EDC), but also D-8 and other color developers such as Pergafast-201 (PF-201), which toxicity and potential to penetrate skin are barely documented so far.
- We collected over 300 TP papers between April 2020 and May 2022 in France, from supermarkets, small stores, but also internet sellers. These included receipts, adhesive tags, self-service food scale stickers and even children toys. The objective was to reach a comprehensive overview of the substances in use, before proceeding to the examination of their fate, related hazards and potential to cross the human skin barrier.

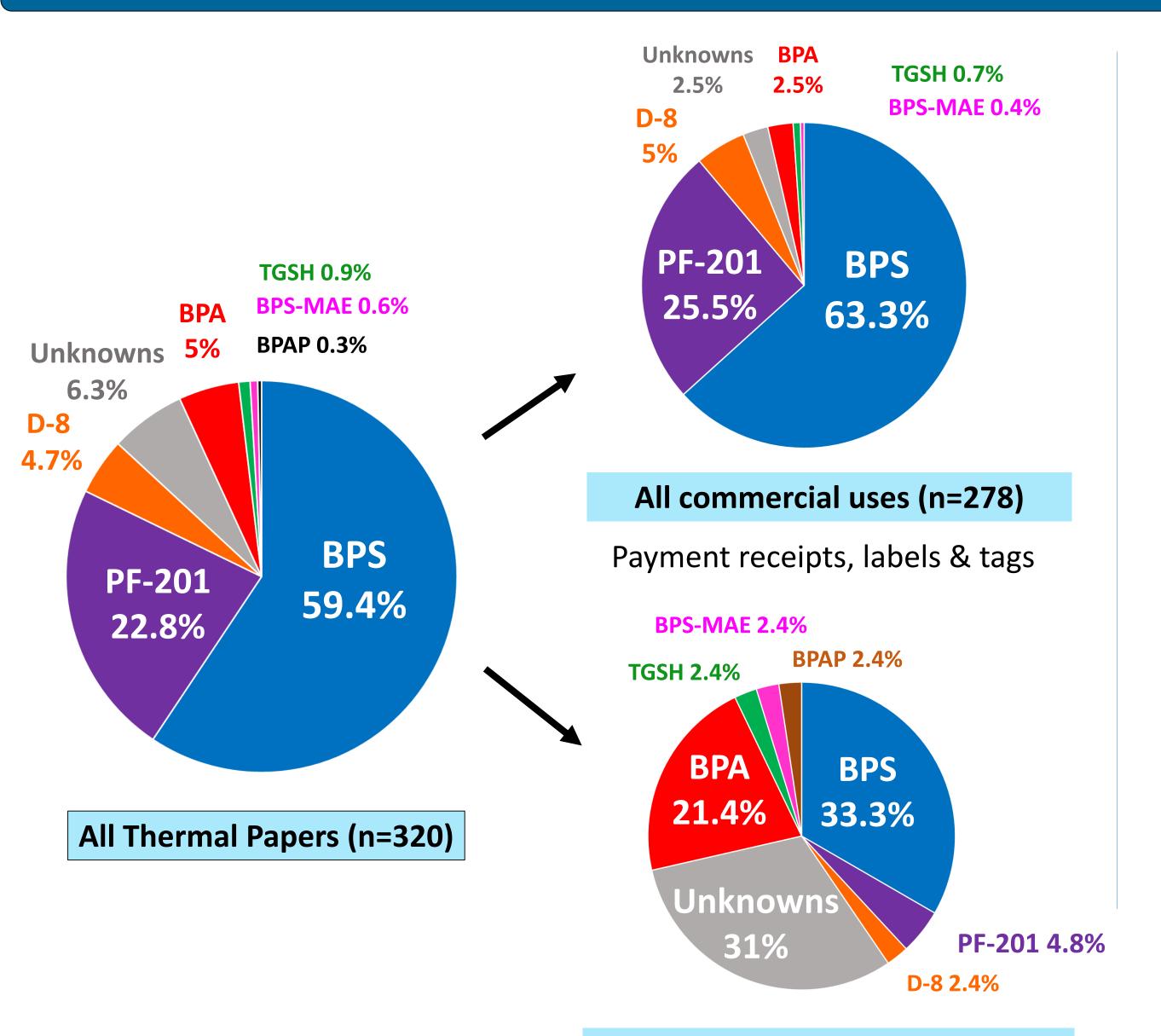
## Methodology



Comparison of DAD and MS spectra with available color developers analytical standards (n=19)

(BPA, BPS, Bisphenol-AP, Bisphenol Z, Bisphenol F, Bisphenol S-MAE, D-8, Pergafast-201, TGSH....)

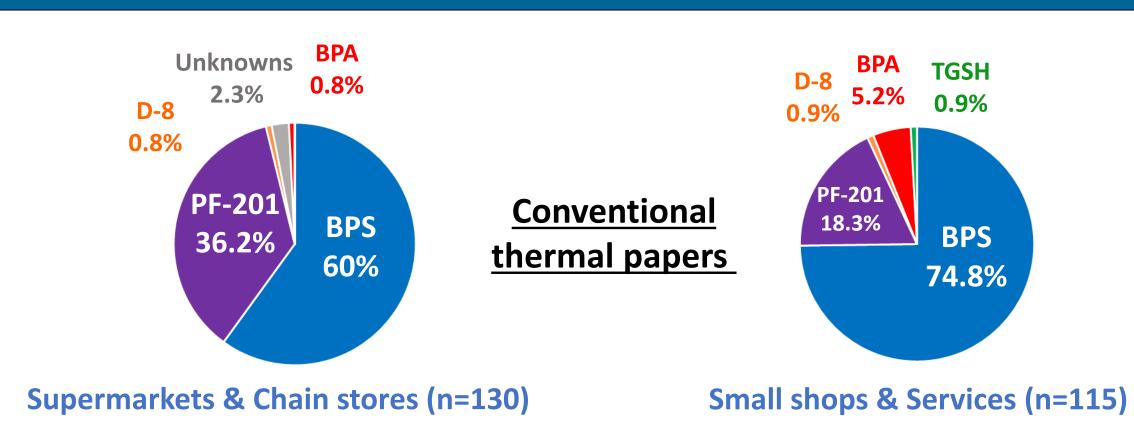
#### Results





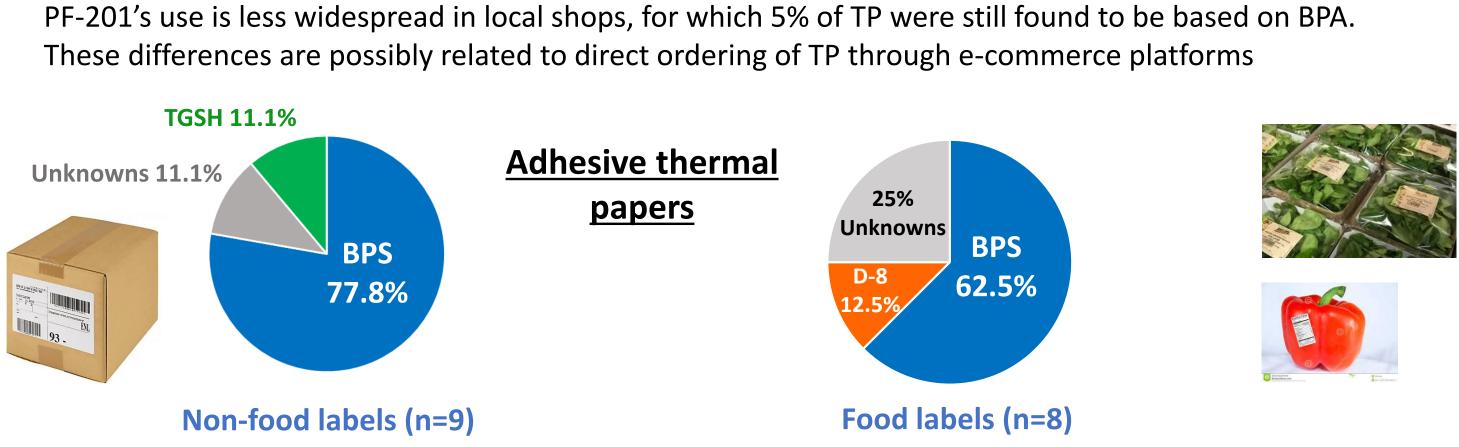
Blank papers (rolls, adhesives), toys<sup>(1)</sup>

- BPA-based blank rolls of TP are still available for purchase from e-commerce platforms; many of it are based on yet structurally unknown color developers.

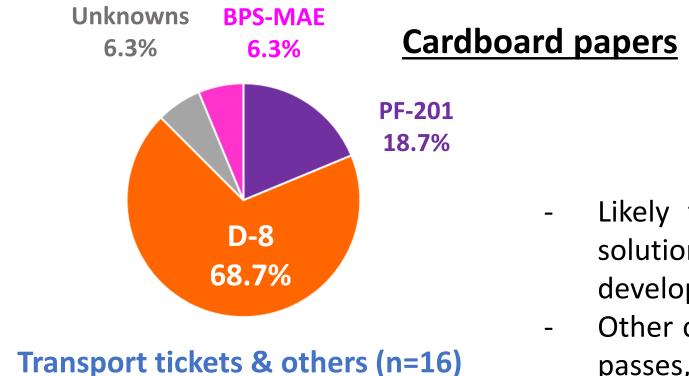


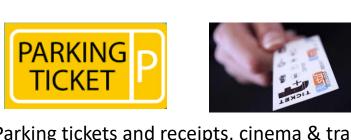


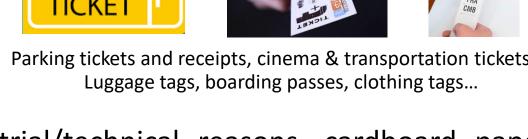
- BPS & PF-201 are the main color developers currently used in conventional TP in France (ca. 95% of the market).



- Adhesive TP are mostly based on BPS, sometimes other color developers (TGSH, D-8, unknowns), but not PF-201.
- Professional as well as consumer exposure (dermal and oral route) can be expected.



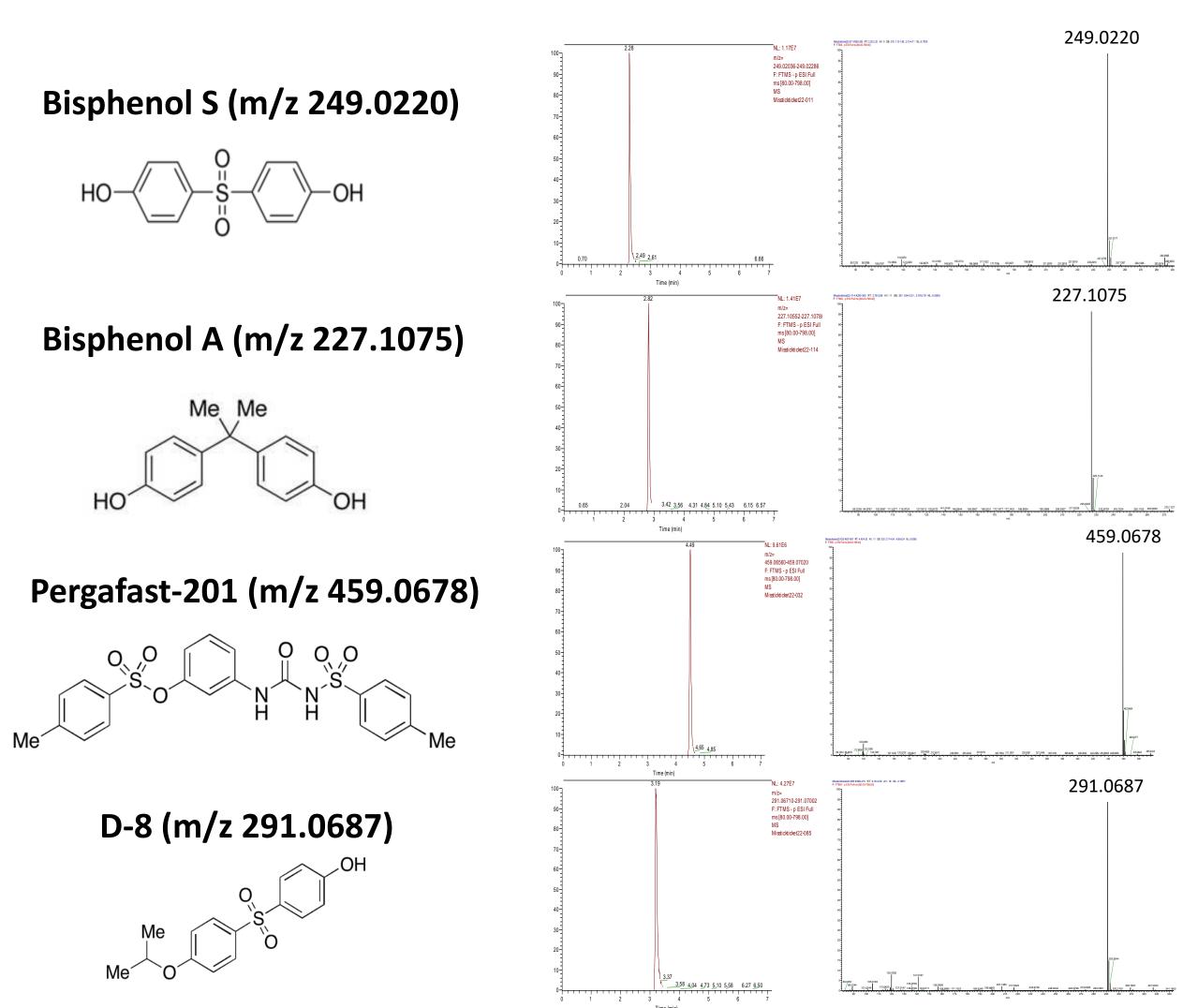




Likely for industrial/technical reasons, cardboard paper printing solutions such as parking tickets often rely on D-8 as the color developer, and, sometimes, on PF-201.

Other color developers can be found in adhesive tags and boarding passes, for which market screening is currently being extended.

#### **UHPLC-NI-ESI-HRMS** confirmation



(1) Toys: Children toy cameras deserve special attention. They either rely on the use BPA, or of yet structurally unidentified color developers. This may lead to kids early exposure to EDCs, therefore raising a major toxicological concern.



Toys (instant print cameras)

## Conclusions

Our results show that ca. 60% of the French market of thermal papers nowadays consists of BPS. PF-201's use (ca. 23%) is on the rise, as in many other countries.

D-8 was mostly detected in parking and public transport receipts. It appears to be the most common color developer used in cardboard papers.

- Despite current EU regulations, 5% of thermal papers were found to contain BPA, mainly as a result of the availability of BPA-based TP solutions from e-commerce platforms (>20%).
- Other color developers such as D-8, TGSH, BPS-MAE and Bisphenol AP were occasionally identified. Unknown color developers were observed in 6.3% of analyzed thermal papers.
- Quantification of major color developers, investigation of related hazards and of expected trans-dermal human exposure to these substances are further being explored in this project.

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