National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Prioritizing functional alternatives to bisphenol A

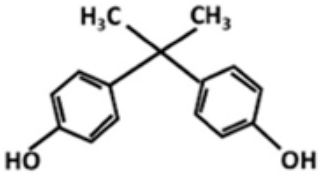
23/10/2024

Annick van den Brand, PhD
Dutch National Institute for Public Health and the Environment
RIVM

annick.van.den.brand@rivm.nl

Bisphenol A

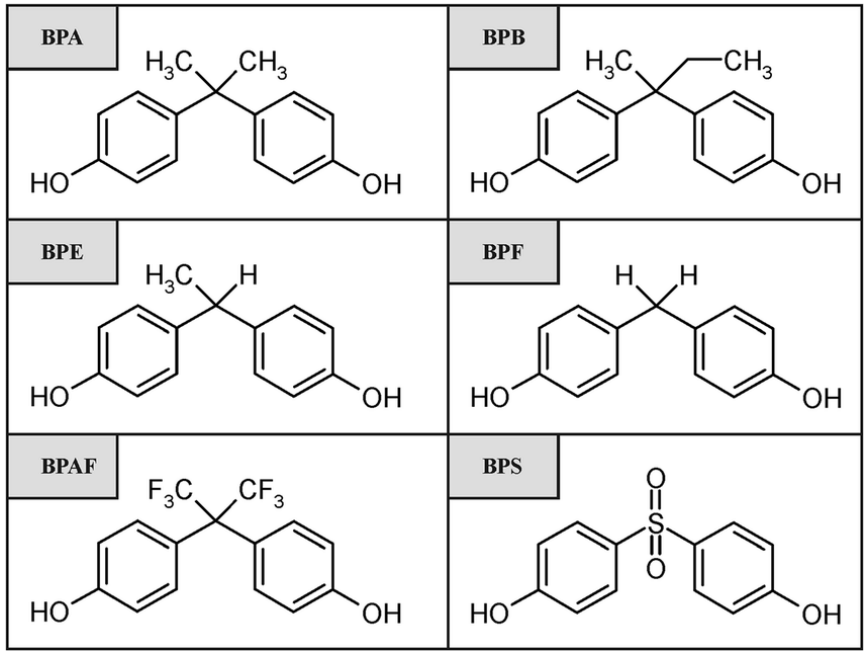
- BPA commonly used in FCM
- Restricted use
- Classified as SVHC
- BPA to be banned in FCM



https://www.chemicalsafetyfacts.org/chemicals/bpa-bisphenol-a/

Bisphenol A alternatives

- Regrettable substitution
- Not one dedicated alternative for all applications



DOI:10.1007/s12010-020-03247-4

Research project

- The Netherlands Food and Consumer Product Safety Authority (NVWA)

- Aim to advise the NVWA in their research to test the migration of BPA alternatives from FCM to obtain occurrence data for risk assessment
  1. What functional BPA alternatives may be applied in FCM and can these be prioritized?
  2. What is known on the toxicity and migration of these alternatives?

Project outline

- Inventory of potential BPA alternatives
  - Substances indicated as BPA alternative
- Functionality
  - Polymerization
- Prioritize
  - Based on five criteria
- Toxicity, migration and (Q)SAR
  - Prioritized substances

Critical Reviews in Toxicology

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/itxc20

A prioritization strategy for functional alternatives to bisphenol A in food contact materials

Annick D. van den Brand, Ellen V.S. Hessel, Rinus Rijk, Bianca van de Ven, Niels M. Leijten, Emiel Rorije & Shalenie P. den Braver-Sewradj

To cite this article: Annick D. van den Brand, Ellen V.S. Hessel, Rinus Rijk, Bianca van de Ven, Niels M. Leijten, Emiel Rorije & Shalenie P. den Braver-Sewradj (10 May 2024): A prioritization strategy for functional alternatives to bisphenol A in food contact materials, Critical Reviews in Toxicology, DOI: 10.1080/10408444.2024.2341020

To link to this article: https://doi.org/10.1080/10408444.2024.2341020

View supplementary material

Van den Brand et al. 2024 - A prioritization strategy for functional alternatives to bisphenol A …. (tandfonline.com)

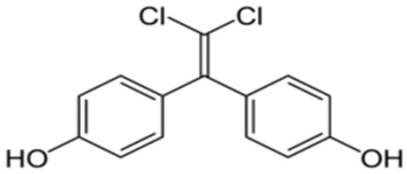
Inventory

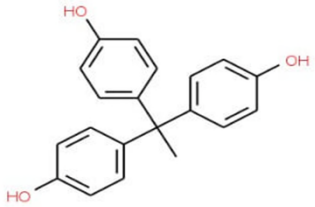
- Inventory of substances (since 2018)
  - Scientific literature
  - ECHA's assessment of regulatory needs for the group of bisphenols
  - The 2017-2018 review cycle of the Identification of Risk Assessment Priorities (IRAP), performed by Environment and Climate Change Canada (ECCC) and Health Canada (HC)
  - The Notice with respect to bisphenol A (BPA) and BPA structural analogues and functional alternatives (Published in the Canada Gazette, Part I on November 13, 2021)
  - Technical Consultation: Proposed Subgrouping of Bisphenol A (BPA) Structural Analogues and Functional Alternatives - Environment and Climate Change Canada Health Canada - An UBA report on substitution candidates for BPA and BPA analogues
  - The dedicated website of the French National Institute for Industrial Environment and Risks (INERIS) that promotes safer alternatives to bisphenols

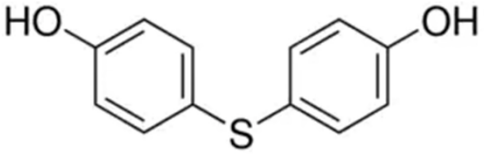
- **376 substances** named as BPA alternatives

Functionality

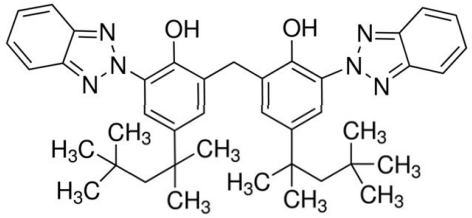
- Yes (n=152)

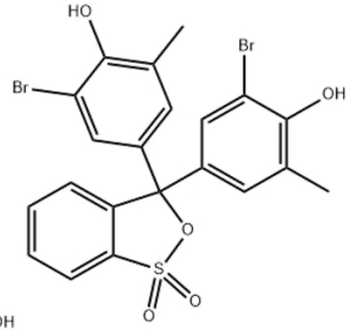


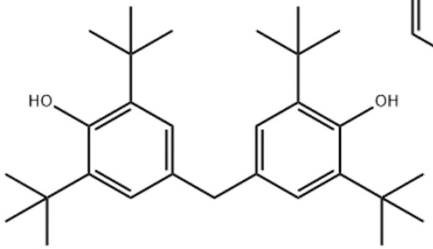




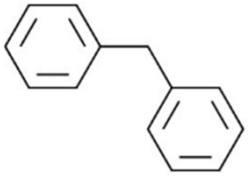
- Questionable (n=69)

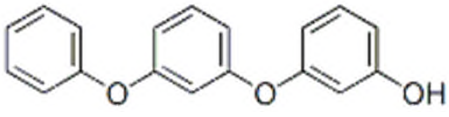


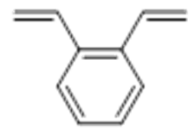




- No (n=155)







Prioritization

Exclude based on:

1. Additional structural characteristics
2. No authorization in FCM
3. No classification as SVHC
4. Migration/occurrence measurable (FCCmigex database)
5. No risk management proposed (ECHA)

Summary

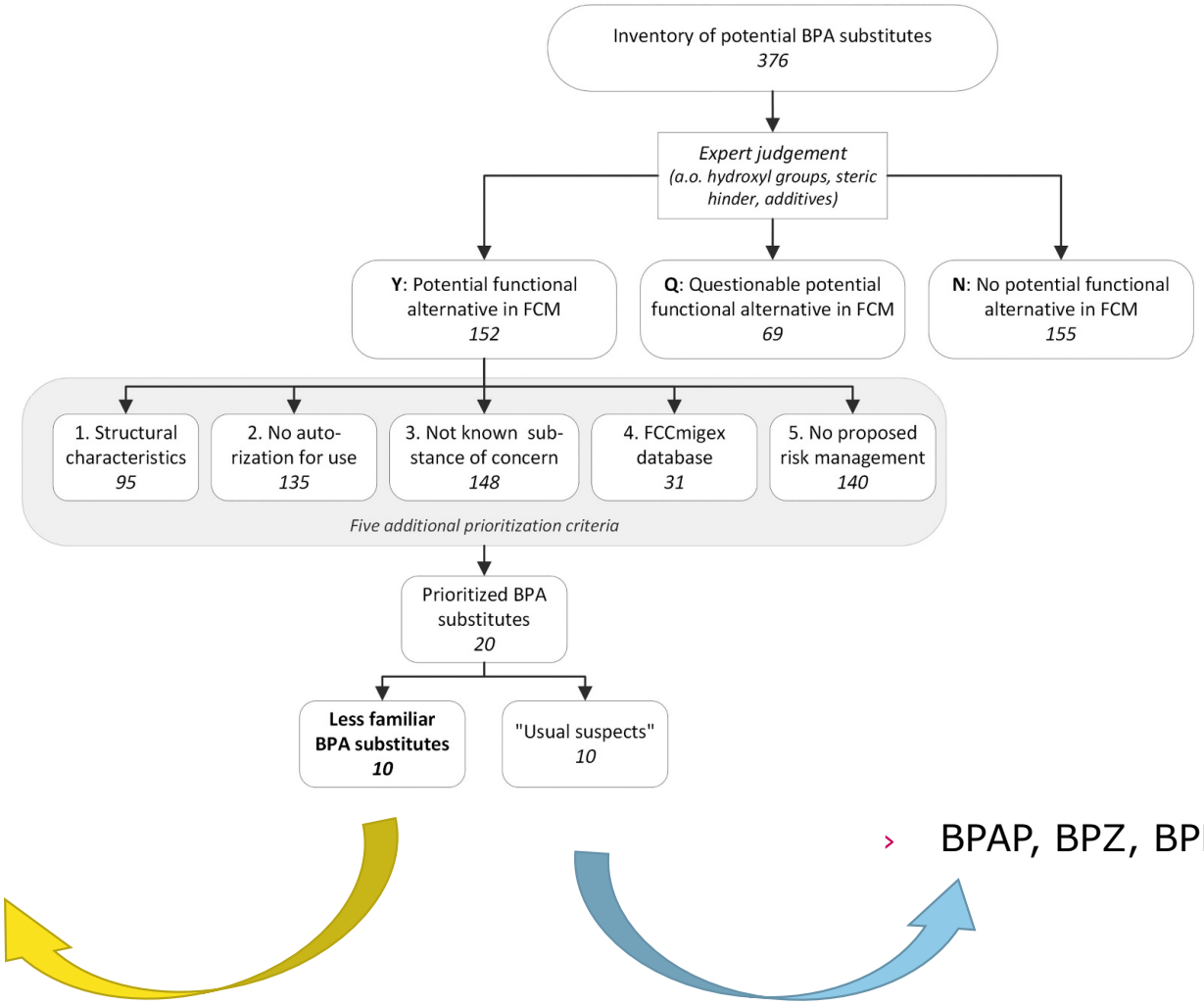


Table 1. Overview of the selected potential BPA alternatives in the current study and their CAS numbers.

Substance	CAS
Bisphenol TMC	129188-99-4
4,4′-Dihydroxydiphenyl ether	1965-09-9
2,2′-Bisphenol F	2467-02-9
2,4′-Bisphenol F	2467-03-0
4,4-Dihydroxybenzophenone	611-99-4
2,2′-Bisphenol A	7559-72-0
Tetrachlorobisphenol A	79-95-8
3,3′-Dichlorobisphenol A	79-98-1
BPA 2EO	901-44-0
Benzophenone-6	131-54-4

- BPAP, BPZ, BPH …

Toxicity, migration and QSAR

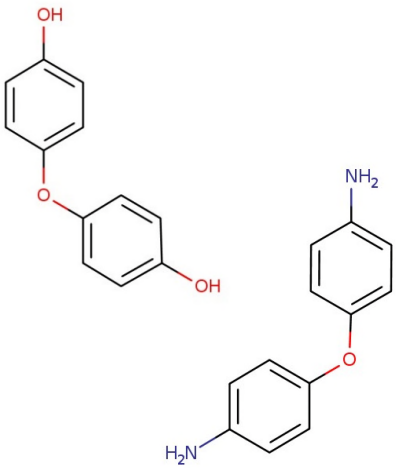
- Toxicity
  - REACH
  - 26 individual research papers
  - Rarely *in vivo* rodent studies
  - Ecotoxicology

- Migration
  - 18 individual studies
  - Few positive analyses
  - Sensitivity of the methods differ

Structure-activity en structural similarity

- Structure-activity
  - Derek Nexus software tool (LHASA)
  - Link structure to possible effects
    - TCBPA structural alert for carcinogenicity (polyaromatic hydrocarbon)
    - BPTMC structural alert for estrogenicity/carcinogenicity (BPA)

- Structural similarity tool (RIVM)
  - Structural similarity to SVHCs
  - 5/11 substances similar (above threshold) to BPA
  - Other SVHC substances with R/ED/CM properties
    - P,p-oxybisphenol - 4,4'-oxydianiline (CM)



Stakeholder consultation

- Dutch trade organizations
- Short chats, written reply or survey

- Coatings IP protected
- BPA will be used as long as it is allowed
- Alternatives are available – costs are the limiting factor
  - Not one substitute for all applications of BPA
  - Although more complicated for heavy duty coatings

In conclusion

- Prioritization strategy to identify alternatives to BPA
  - Can also be applied to similar cases
  - Can be modified based on relevant criteria

- Data gaps for lesser-known alternatives
  - Even though similarity with BPA or other SVHCs
  - Migration potential

Acknowledgements

- Shalenie den Braver-Sewradj
- Ellen Hessel
- Bianca van de Ven
- Niels Leijten
- Emiel Rorije
- Rinus Rijk (consultant)

Taylor & Francis

Critical Reviews in Toxicology

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/itxc20

A prioritization strategy for functional alternatives to bisphenol A in food contact materials

Annick D. van den Brand, Ellen V.S. Hessel, Rinus Rijk, Bianca van de Ven, Niels M. Leijten, Emiel Rorije & Shalenie P. den Braver-Sewradj

To cite this article: Annick D. van den Brand, Ellen V.S. Hessel, Rinus Rijk, Bianca van de Ven, Niels M. Leijten, Emiel Rorije & Shalenie P. den Braver-Sewradj (10 May 2024): A prioritization strategy for functional alternatives to bisphenol A in food contact materials, Critical Reviews in Toxicology, DOI: 10.1080/10408444.2024.2341020

To link to this article: https://doi.org/10.1080/10408444.2024.2341020

View supplementary material

Thank you!