

# Environmental contamination of beeswax in contact with food

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# What has beeswax to do with food?

=> Beeswax is regulated as food additive (E901) by regulation 1333/2008

E 901	Beeswax, white and yellow	<i>quantum satis</i>	only for the surface treatment of fruit: citrus fruit, melons, apples, pears, peaches, pineapples, bananas, mangoes, avocados and pomegranates and as glazing agent on nuts	Period of application as regards bananas, mangoes, avocados and pomegranates: From 25 December 2012.
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Beeswax has a positive effect on the moisture loss, appearance, texture and firmness of the fruit and thus contributes to a prolonged shelf life of the fruit

=> **We eat beeswax**

# What has beeswax to do with food?

Beeswax is also used as coating agent for cheese

The wax coating is not intended to be eaten and thus is considered being a **Food Contact Material (FCM)**

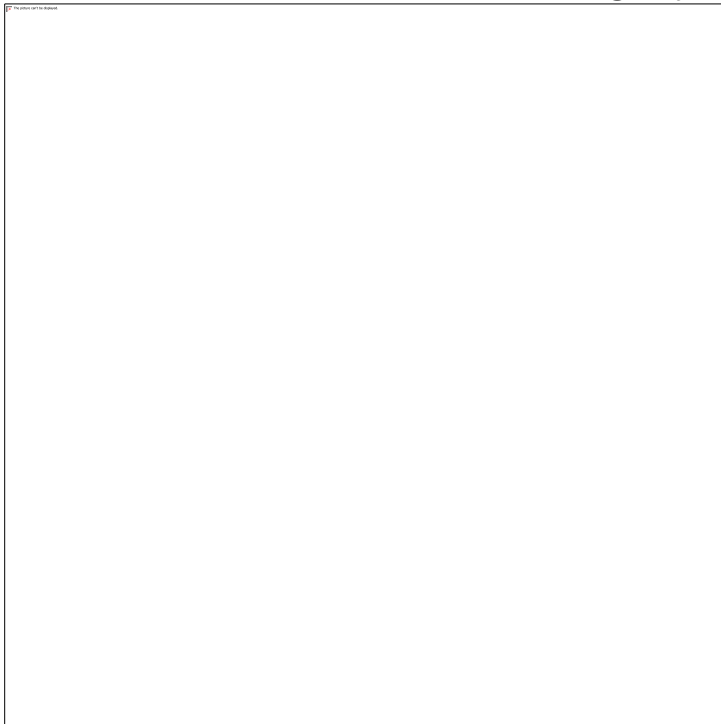


There is no material-specific legislation for food contact materials made from beeswax, but the manufacturer must be able to demonstrate that the material complies with the requirements and **does not contain any harmful substances** or substances prohibited in FCMs

# What has beeswax to do with food?

Beeswax has also become very popular in the production of beeswax wraps:

Beeswax is melted onto fabric (usually cotton or linen), which after cooling and hardening is used as reusable packaging for food. In this case, beeswax also falls into the category of food contact material.



# What is beeswax ?

Beeswax is a secretion of bees used to make honeycombs.

Originally beeswax is white and odourless but the bees mix it with propolis giving it the golden color and the characteristic smell.



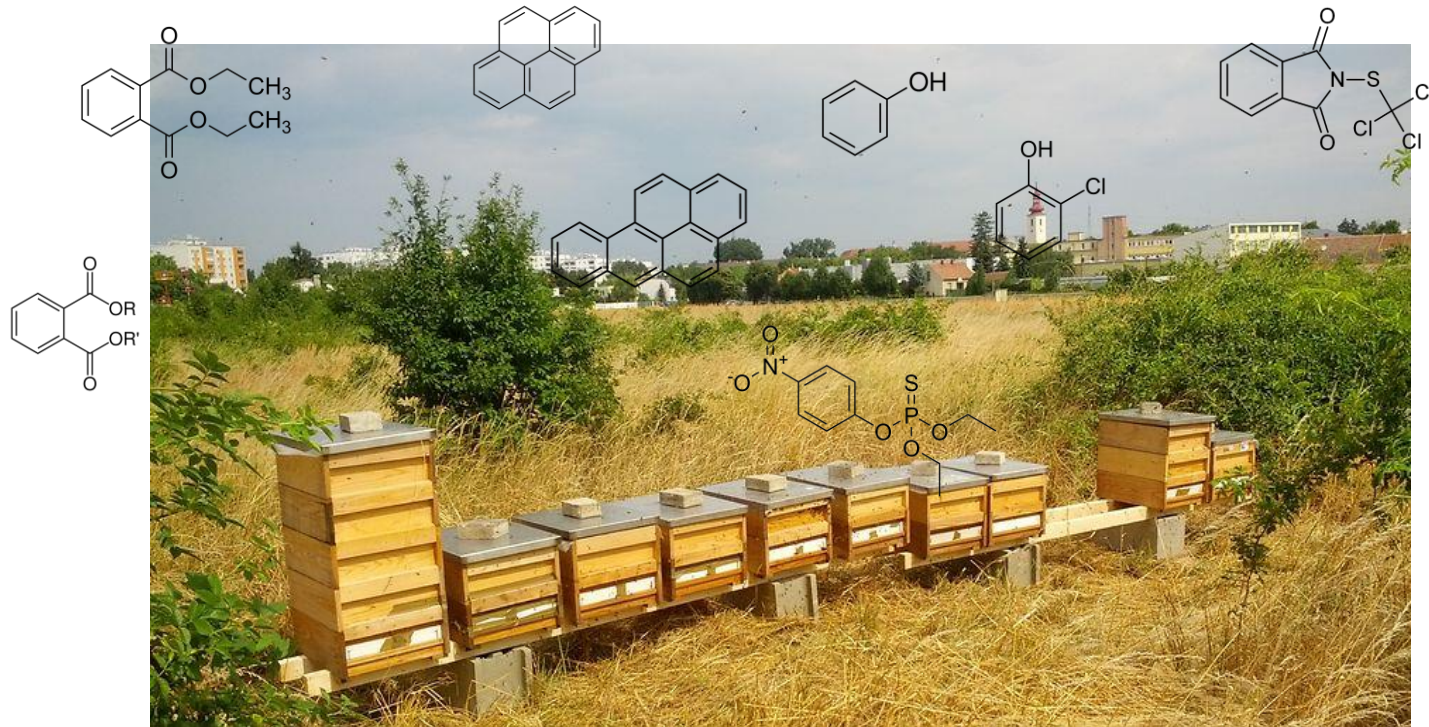
**100 % natural !**





# Beeswax in the environment

As natural product, beeswax is exposed to environmental pollution.



- ⇒ Evidence for pesticides, concentrations of up to 250 ng/g have been detected
- ⇒ What about other pesticides? Other ubiquitous pollutants ?

# Is beeswax a health risk ?

## **PAHs**

Associated with several types of cancer (e.g. skin, lung or bladder); Diseases of the lungs, kidneys or digestive tract

## **Phthalates**

Associated with reproductive capacity or developmental disorders in humans

## **Phenols**

Associated with cancer (soft tissue sarcomas, Hodgkin's disease and leukemia) and liver and kidney damage, Parkinson's disease , reproductive disorders and congenital abnormalities

## **Pesticides**

Associated with cancer and other tumors; brain and nervous system damage; birth defects; infertility and other reproductive problems; and damage to the liver, kidneys, lungs and other body organs.

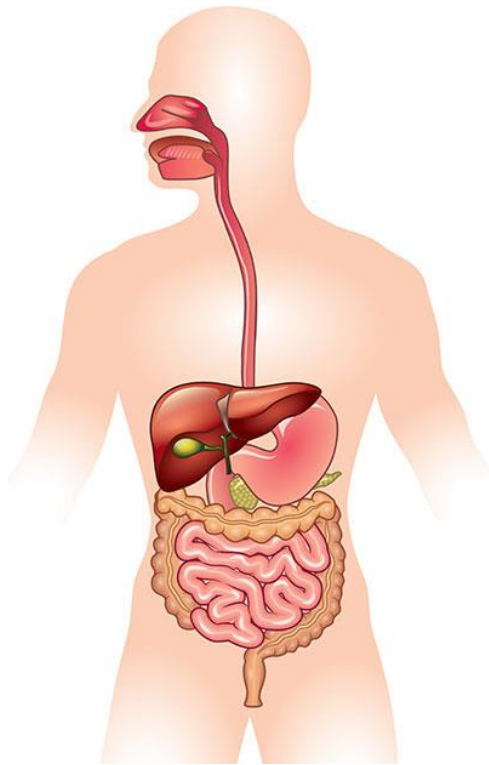
# Is beeswax a health risk ?

Beeswax is an inert natural product and therefore « *food grade* »

-> excreted by the human organism without being digested

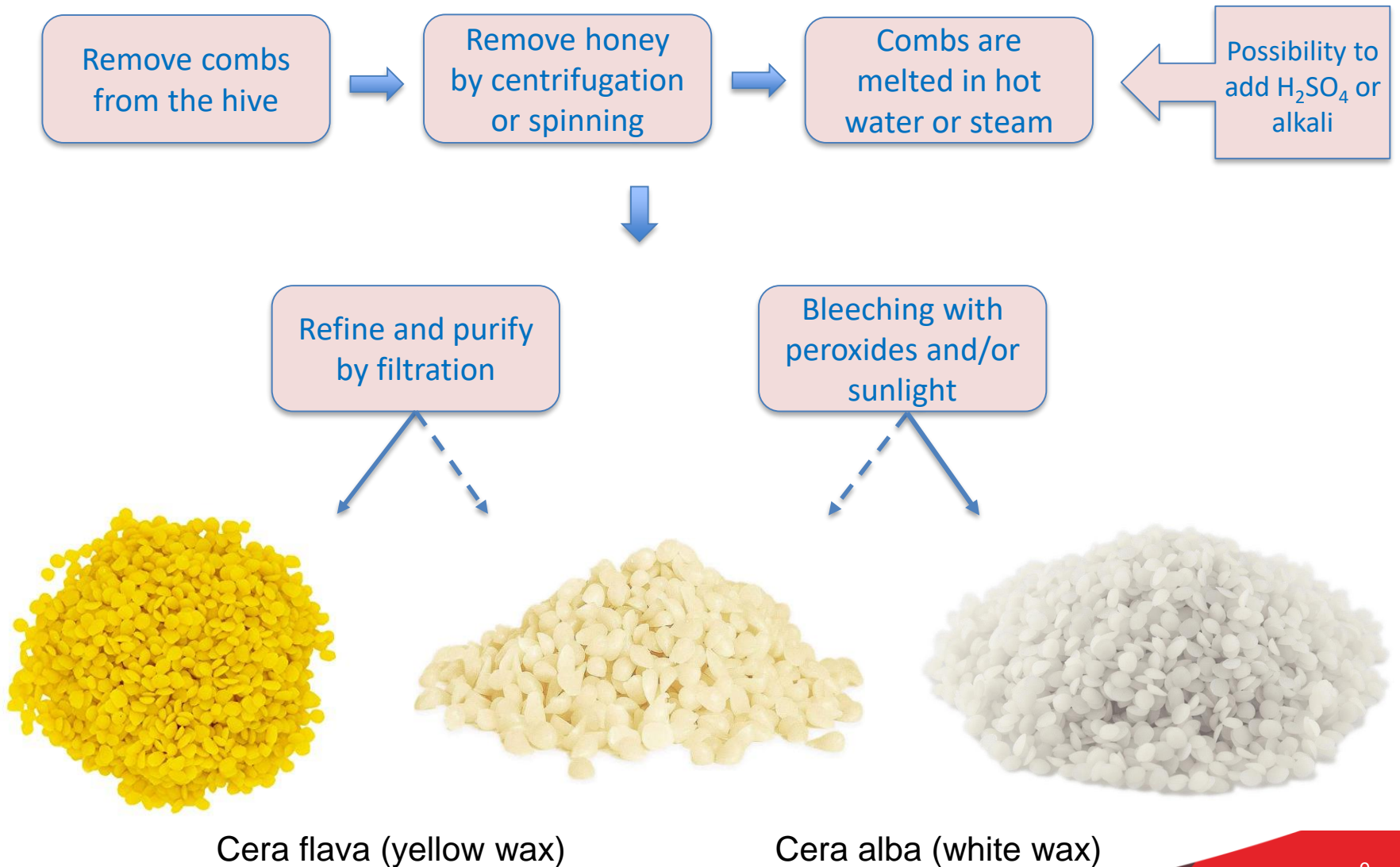
-> it must not contain any harmful substances because they can interact with the human metabolism

-> also valid for FCM as substances can migrate into food during the contact period





# How is beeswax used ?



# The analysis



Hot Soxhlet (90°C) extraction for 4 hours with acetonitrile



Cool (4°C) extract overnight, filter on Büchner



Reduce extraction volume to 5 ml by evaporation under N<sub>2</sub>



Cool (4°C) for 2 hours, filter on 0,2 µm PTFE syringe filter



## GC-MS:

- Phthalates
- Phenols (after derivatization with MtBSTFA)

## GC-MS/MS:

- PAHs
- Pesticides (part I)

## LC-MS/MS:

- Pesticides (part II)

# Beeswax samples

**Cera alba  
(white)**

4 samples in pellets. Origin: Germany, China

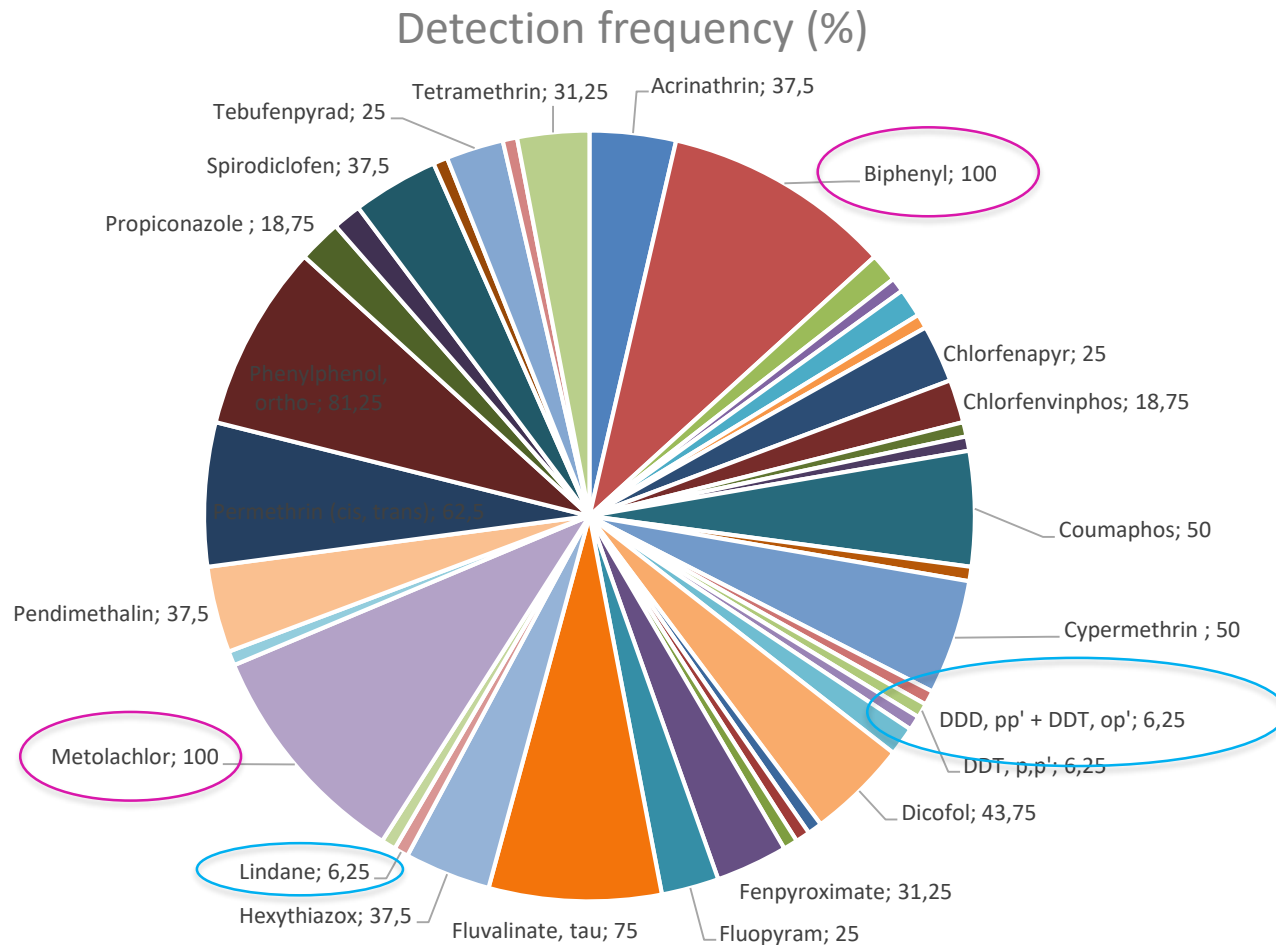
**Cera flava  
(yellow)**

5 samples in pellets and block. Origin: Germany, China

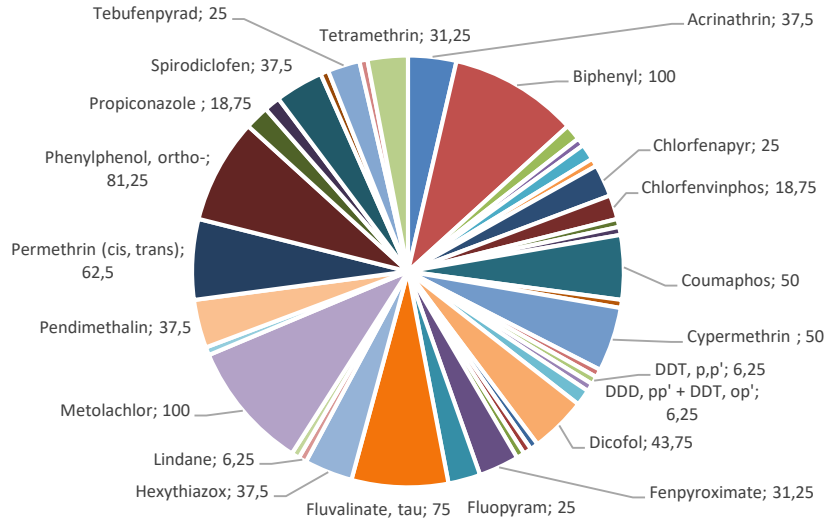
**Non-treated  
honeycombs**

7 samples collected from local beekeepers. Origin:  
Luxembourg, France, Portugal

# Results: pesticides



# Results: pesticides



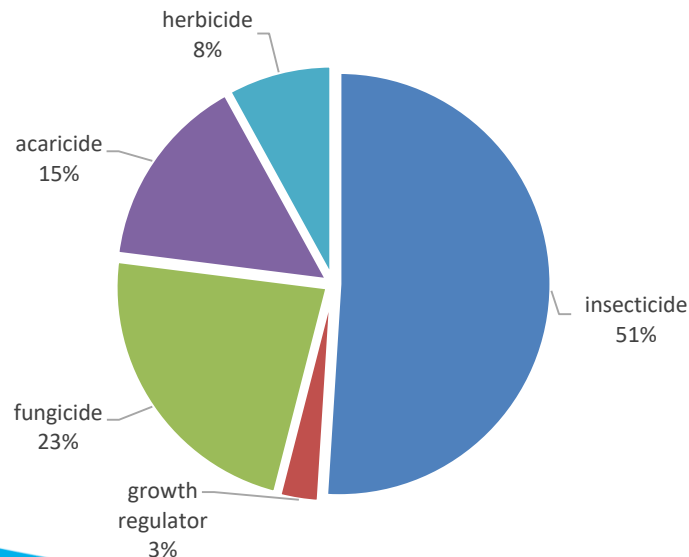
- All wax samples contained at least one pesticide >LOQ

- 39 Different pesticides (out of 248 monitored) were detected

- 7 pesticides were detected in  $\geq 50\%$  of the samples)

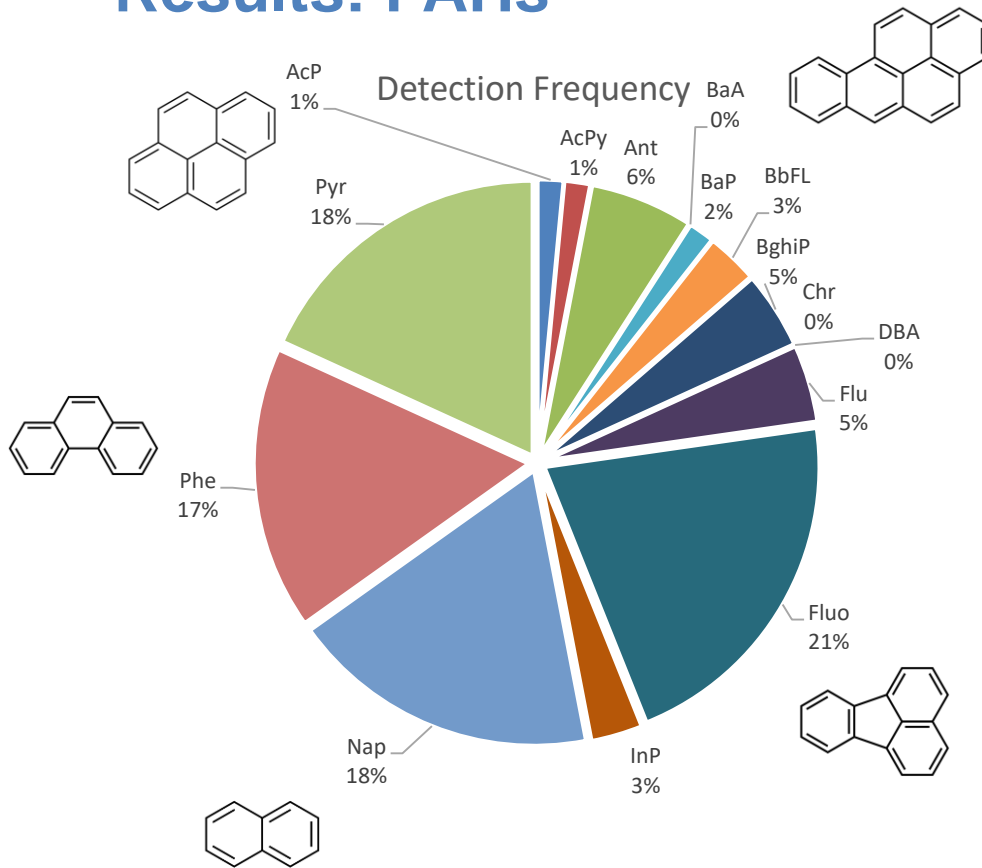
- similar results in literature (e.g. Daniele et al., 2018)

- +/- 50 % of the detected pesticides are insecticides

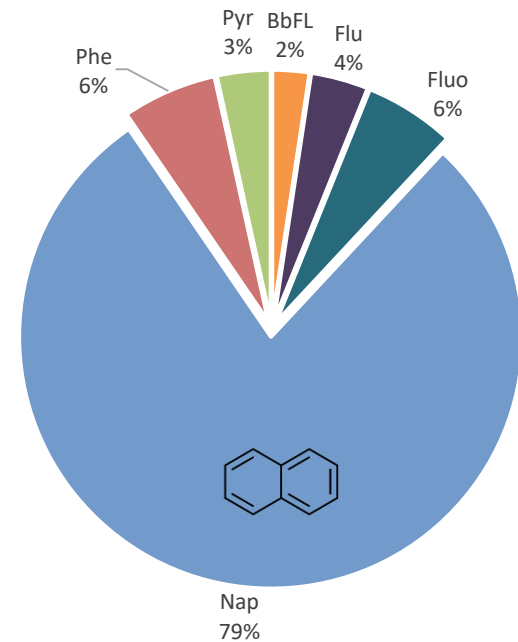




# Results: PAHs



Contribution to total PAH concentration



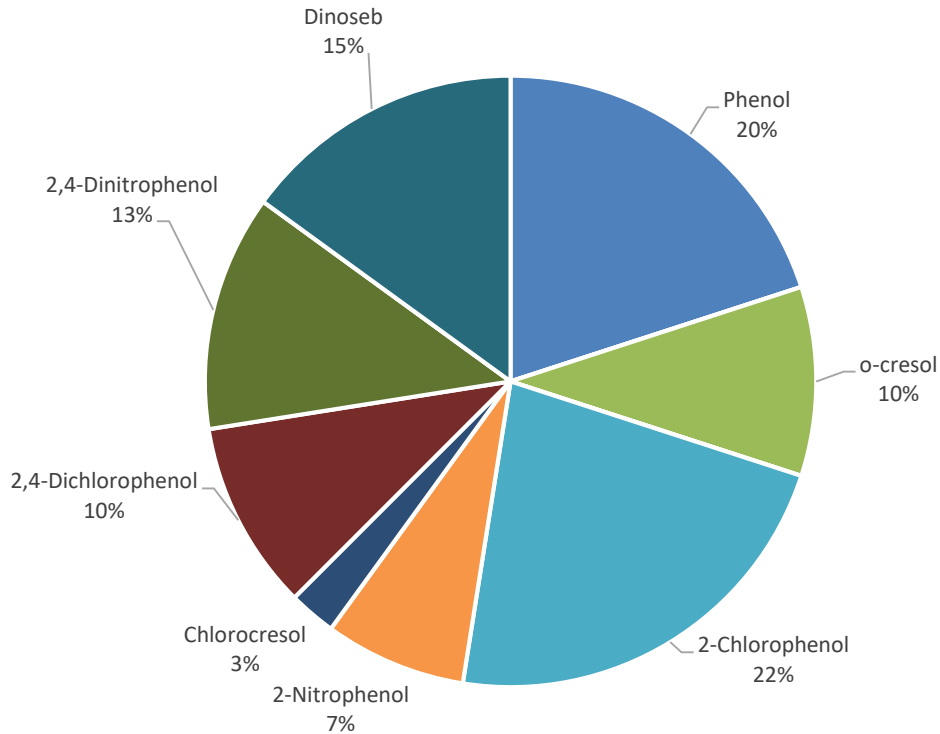
- At least one PAH in 14 out of 16 samples (*only two samples without PAHs*)

- Mostly « light » PAHs were found ( $\leq 4$  aromatic rings) -> suggesting that basically PAHs in the gas phase migrate into beeswax, and not PAHs in the particle phase of the atmosphere

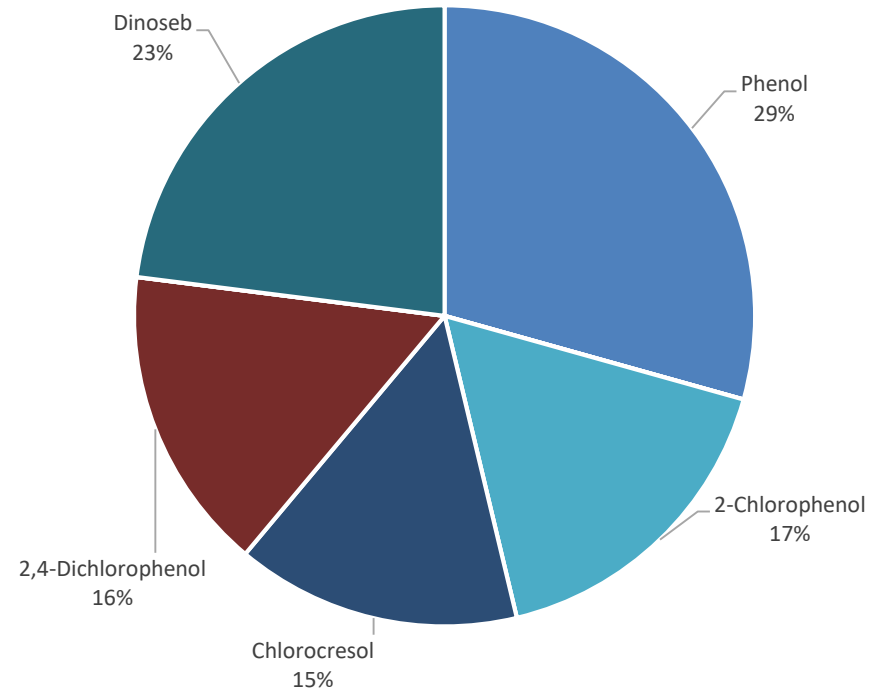
-> This is consistent with most studies about PAHs in the atmosphere / air\*

# Results: Phenols

### Detection Frequency



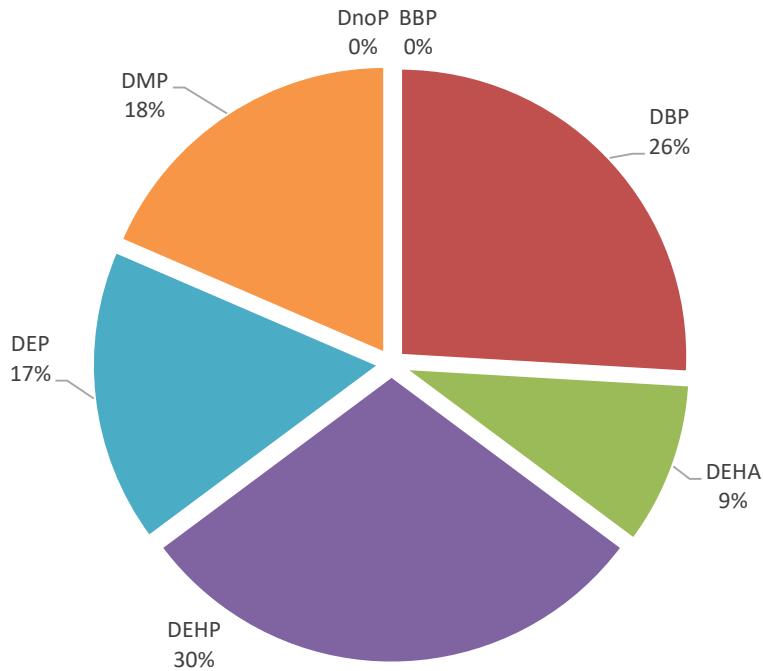
### Contribution to total Phenol concentration



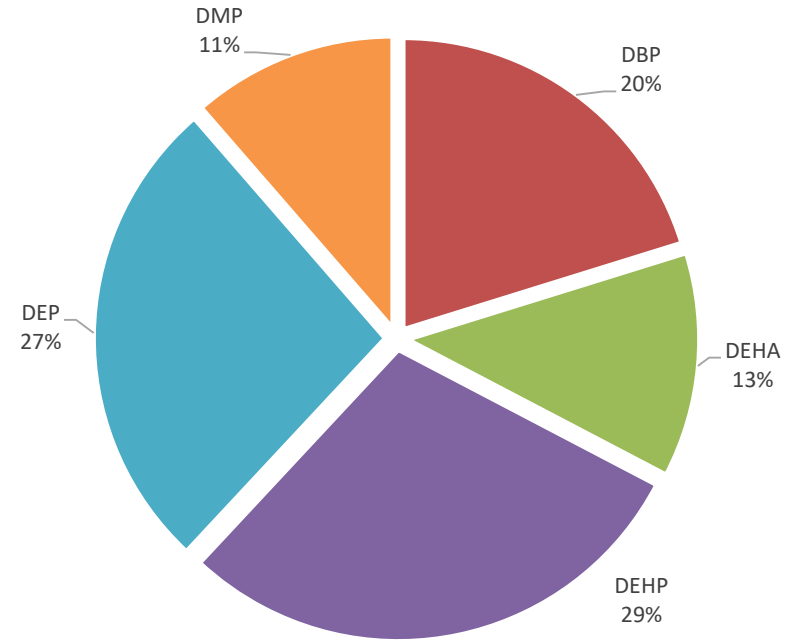
- 8 out of 12 phenols detected
- 5 out of 16 samples with concentrations > LOQ

# Results: Phthalates

Detection Frequency



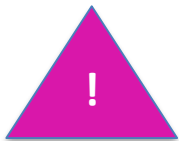
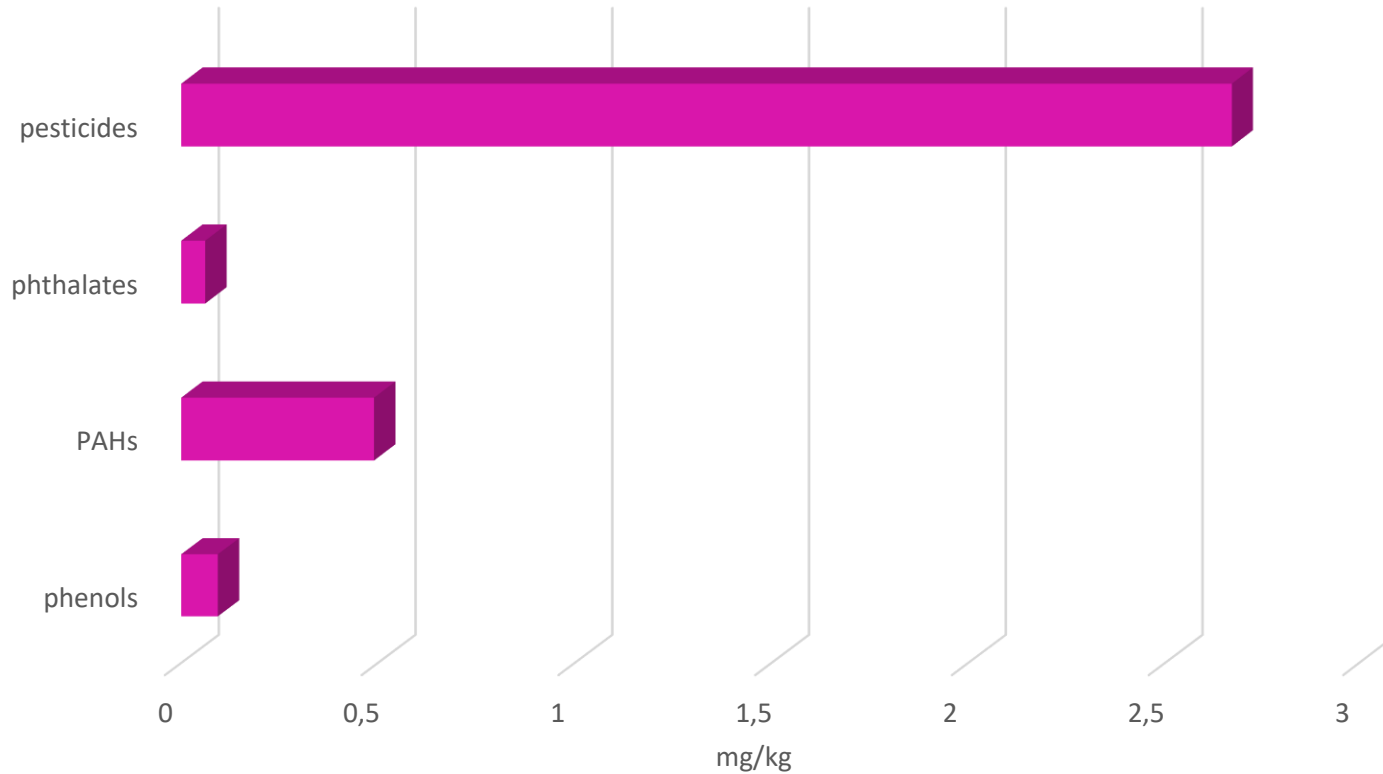
Contribution to total Phthalate concentration



- DEHP found in all samples, with the highest average concentration
- BBP and DnOP were not detected in any sample

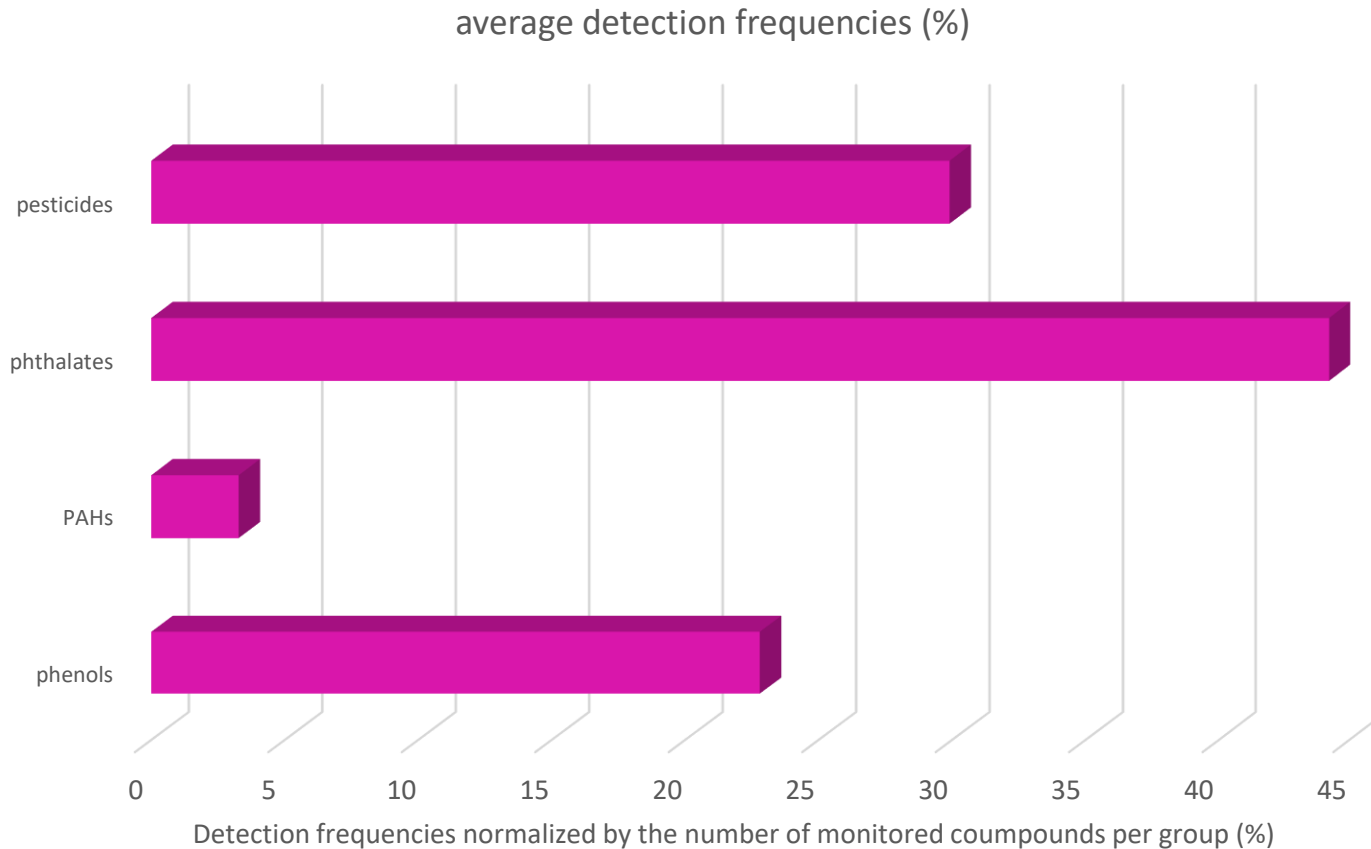
# Results: Comparison of contaminants

average concentrations (on detections > LOQ)



Only considering concentrations, not detection frequencies !

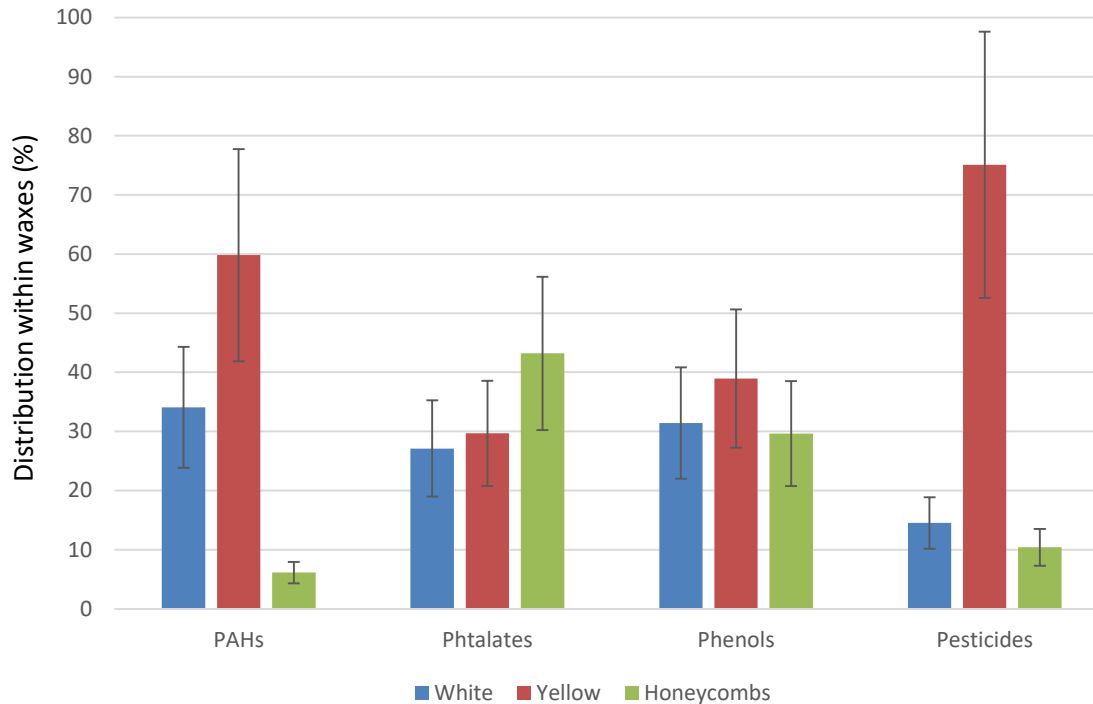
# Results: Comparison of contaminants



Phthalates are omnipresent in our environment



# Results: Comparison of beeswaxes



- No differences for phtalates and phenols
- Pesticides mostly detected in yellow waxes
- PAHs mostly detected in white and yellow waxes, but generally very low detection frequencies



No statistical difference in-between the different kinds of beeswax

# Conclusions

- 1 – Environmental contamination of beeswax is an issue for human health via exposure through food
- 2 – Yellow wax pellets showed the highest concentrations for PAHs and even more for pesticides, but not statistically significant -> increase study population to confirm the preliminary findings of this study
- 3 – The first results suggest that the major source of wax contamination is environmental pollution, but not possible to finally conclude on this.



*Watch out for our publication*

**Thank you for your attention !**

