



# ADULTERATION OF BEE PRODUCTS: CURRENT SITUATION AND PERSPECTIVES

5th Apiquality Roma 22 November 2016  
Etienne BRUNEAU

# Definitions



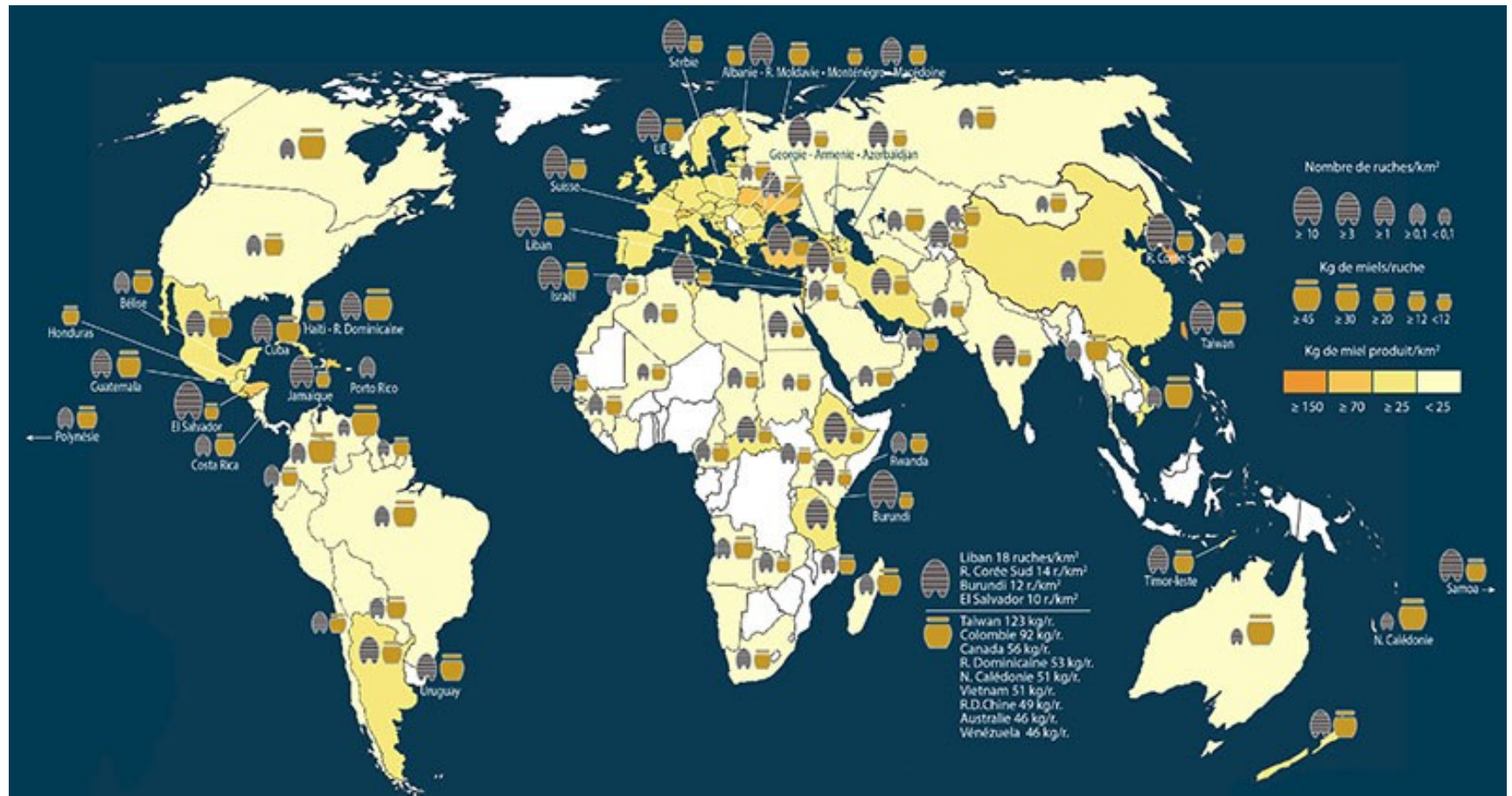
- ▣ The official definition of a product provides an essential framework for commercial transactions
- ▣ Bring acceptable limits to give a name to a product
- ▣ Today, only the honey has an international definition.
- ▣ Notes:
  - Product definition should correspond to consumer expectations: in this case, pure and natural products.
  - The composition must take into account natural and geographical diversity.

# Honey

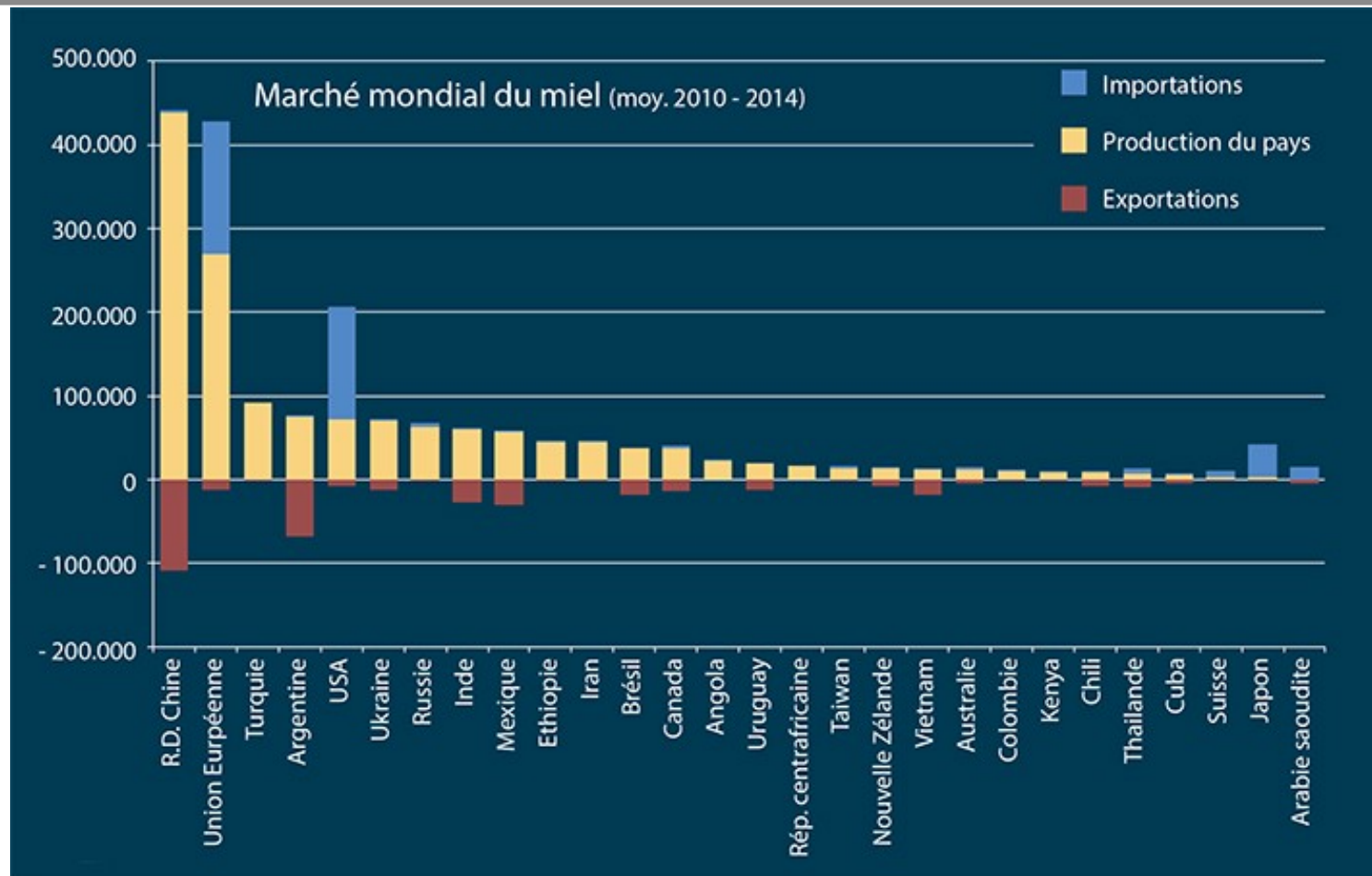


- Honey is the natural sweet substance produced by bees of the species *Apis mellifera* from
  - ▣ the nectar of plants or
  - ▣ secretions of living parts of plants or excretions thereon sucking insects
  
- Any external input or withdrawal is prohibited (ultrafiltration in specific cases)...

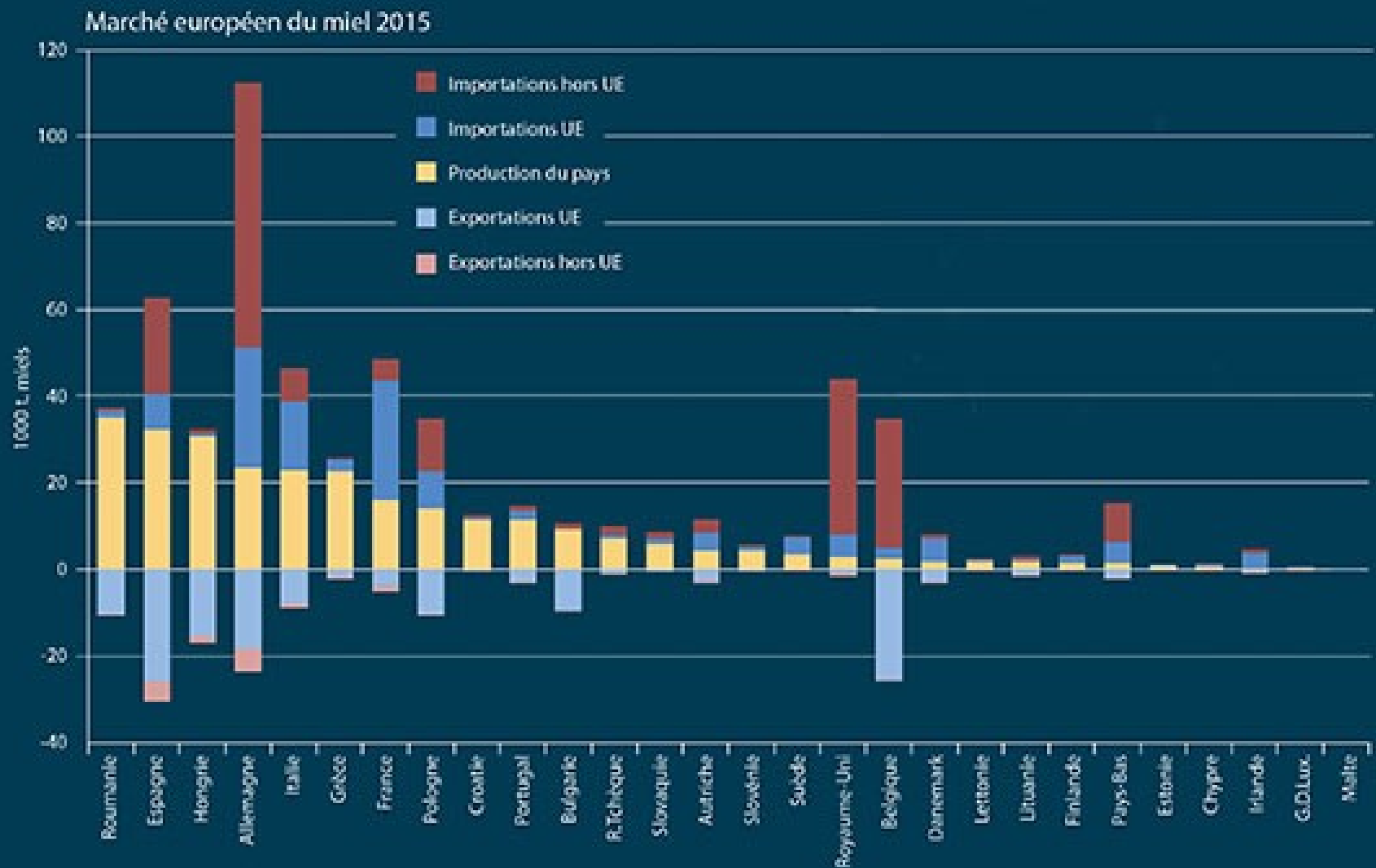
# The international beekeeping



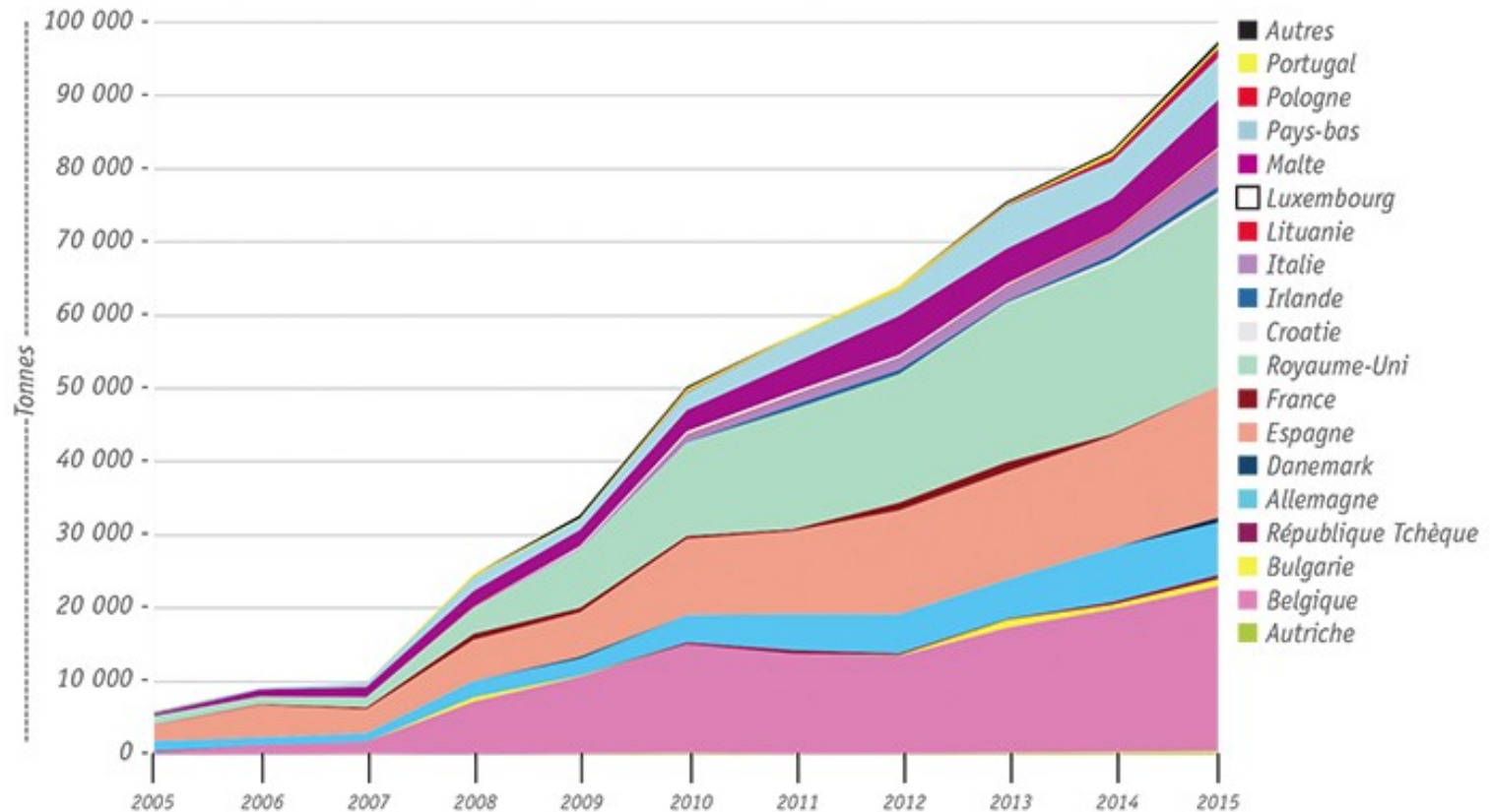
# The international market for honey



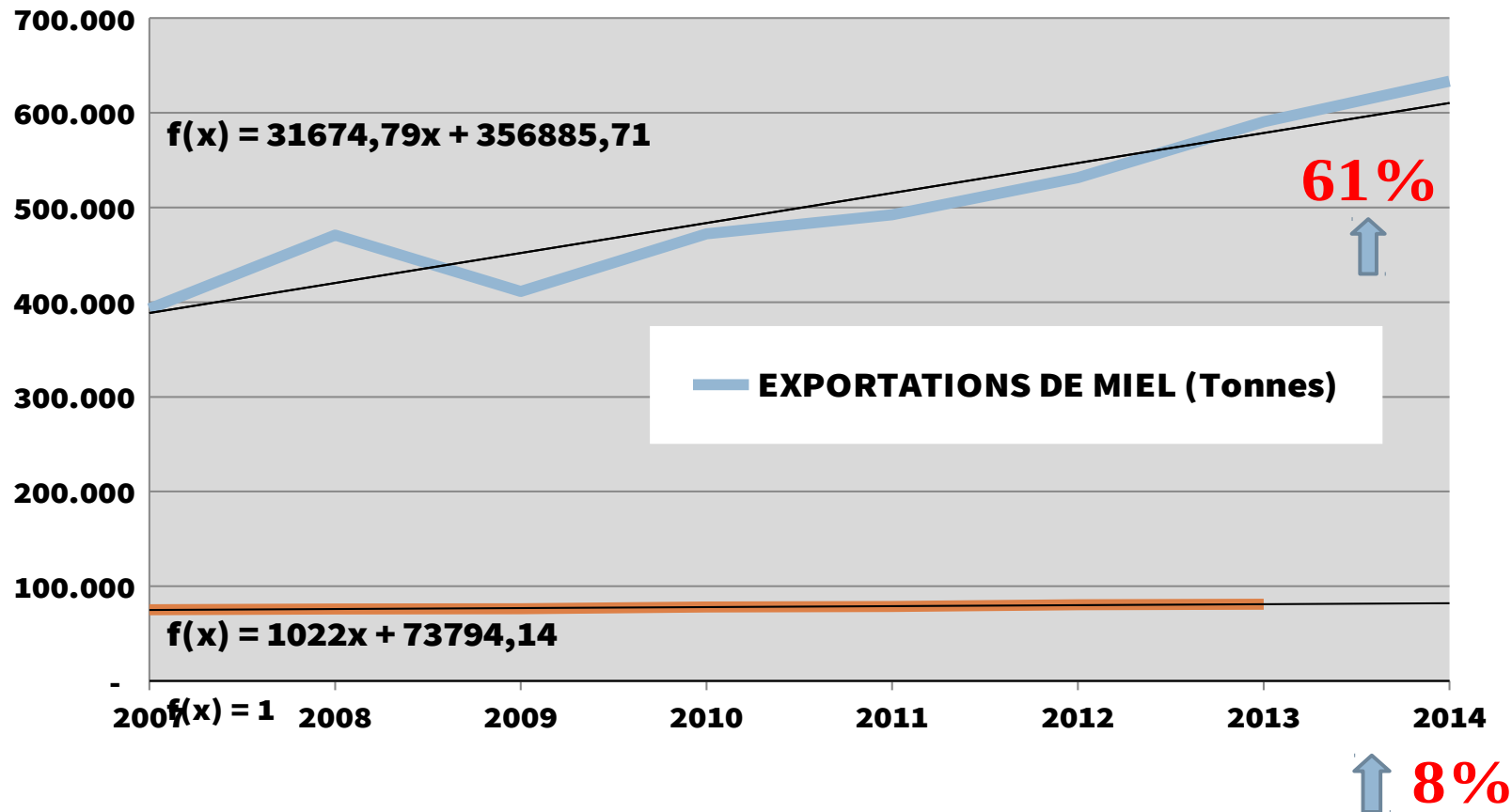
# The European honey market



Graphique 1 : Evolution des importations de miels chinois dans les différents pays européens de 2005 à 2015.

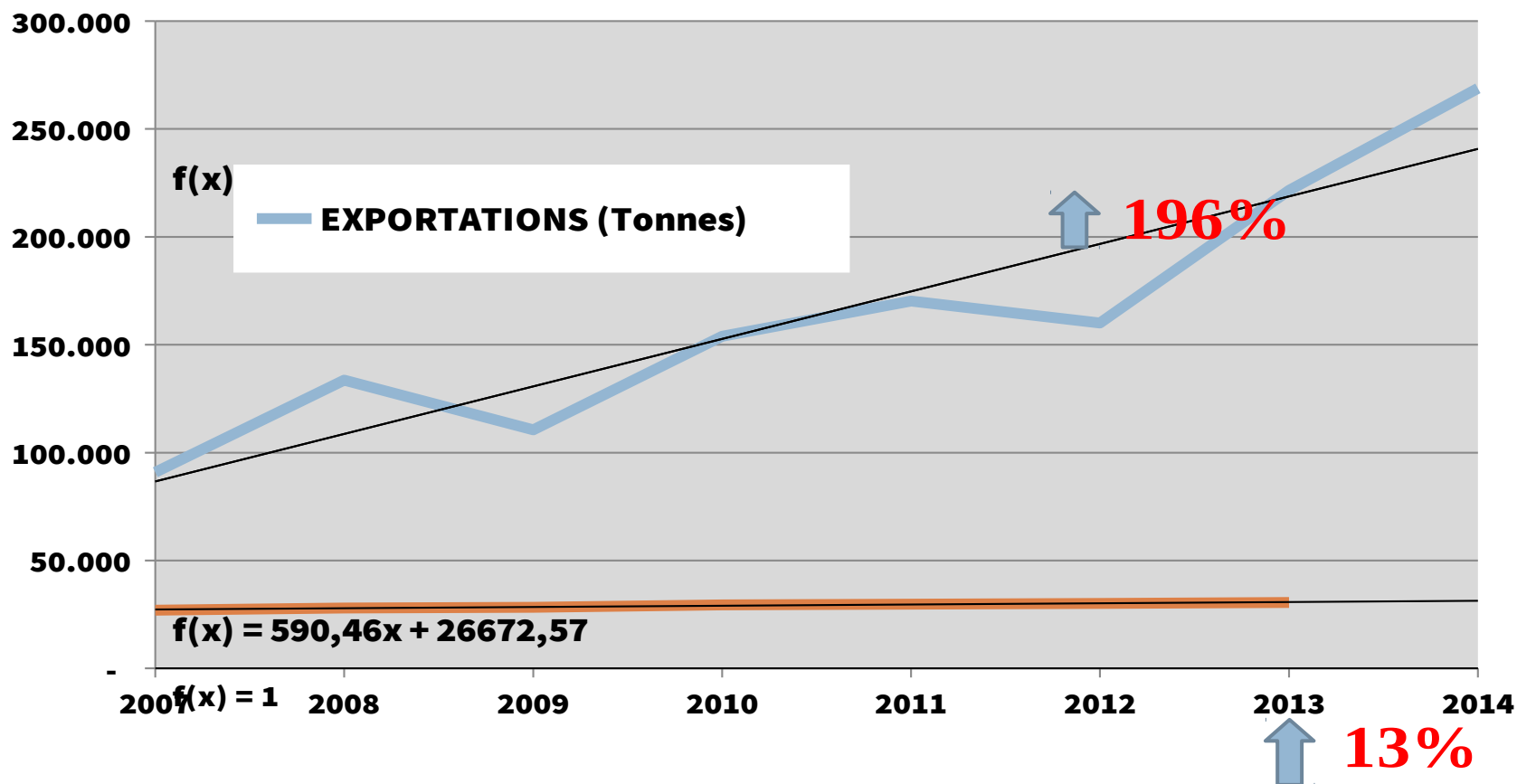


# Honey production

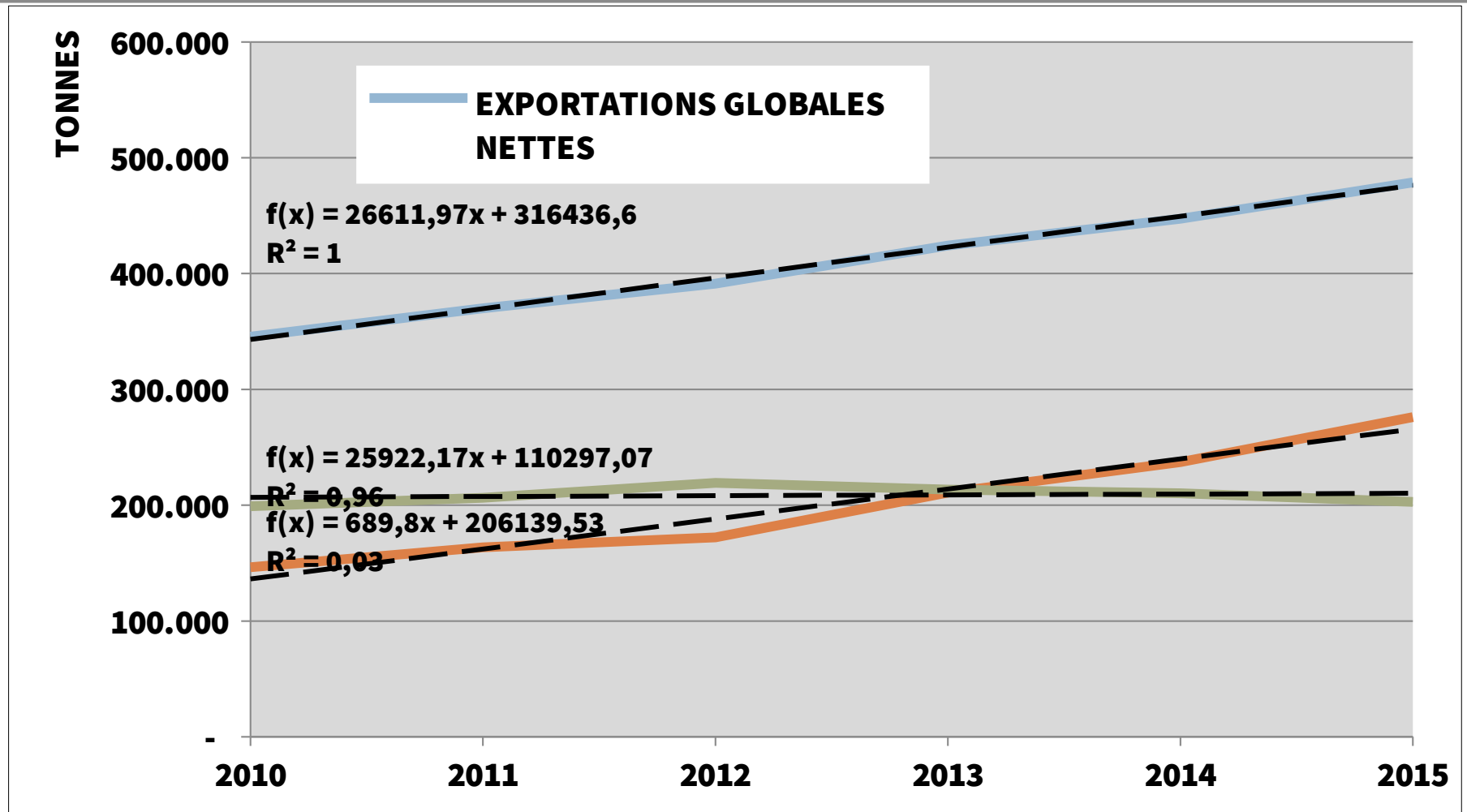




# Asian honey production

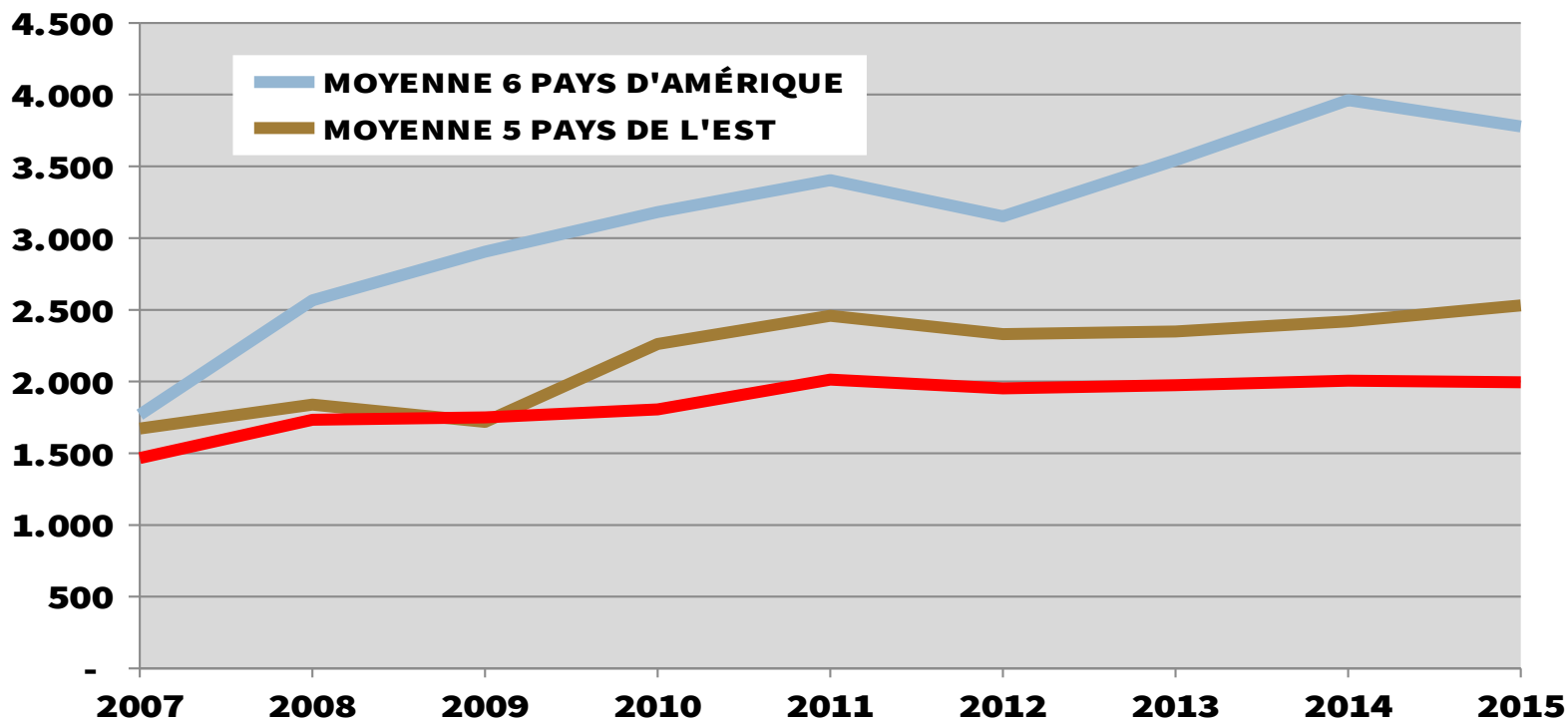


# Honey exports



# Evolution of the price of honey

DOLLARS PAR TONNE





# Quality Control

---

# Controls: goals



- The aim is to check:
  - ▣ The correspondence of the product to its name based on its definition
  - ▣ Compliance with hygiene standards in the country that performs controls (drug residues, pathogens ...)
  - ▣ Compliance with other laws (GMOs ...)
  - ▣ Verification of compliance with quality criteria announced in case of a controlled quality labeling

# Controls: Application



- ▣ They are mainly made in the health context (single control plan imposed in the EU)
- ▣ research problems of adulteration
  - Methods changing function and laboratories
  - No legal framework determining the limits of an adulterated product
  - No standardized analytical framework with validated techniques
  - No notification system and / or alert except for prohibited substances (hygiene)

# Controls - adulteration

## Avantages et inconvénients des techniques analytiques pour la vérification de l'authenticité du miel

Méthodes	Préparation d'échantillonnage	Vitesse	Investissements coût opérationnel	Probabilité de succès	
NMR				NMR profiling SNIF-NMR	Contrôles
IRMS				EA-IRMS LC-IRMS	Contrôles
Chromatographie GC/MS, LC/MS				LC-ELSD, LC-MS/MS	Marqueurs spécifiques
Spectroscopie infrarouge (NIR, IR, Raman)					Contrôles
Analyses élémentaires traces de métaux et de minéraux (ICP/MS, AAS, ICP)					Marqueurs spécifiques

Défavorable

Médiocre

Efficace

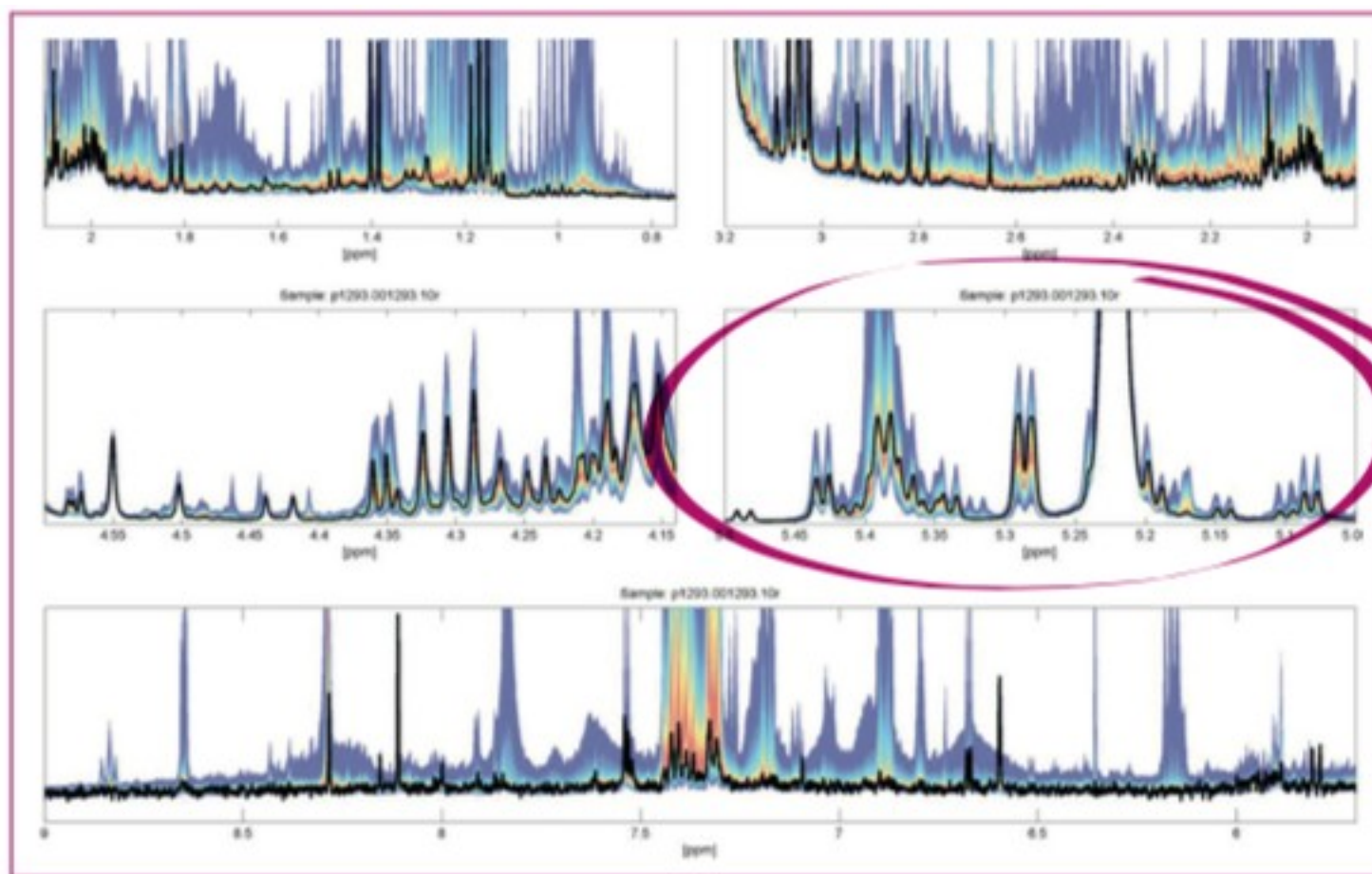
Source : extrait d'une présentation d'Intertek sur les miels adultérés

NMR : résonance magnétique nucléaire  
 IRMS : spectrométrie de masse isotopique  
 MS : spectrophotométrie de masse  
 LC : chromatographie en phase liquide  
 GC : chromatographie en phase gazeuse  
 NIR : proche infrarouge  
 IR : infrarouge  
 Raman : raman  
 ICP : torche à plasma  
 AS : spectrométrie d'absorption atomique  
 SNIF : olfactomètre  
 EA : analyseur d'éléments  
 ELSD : détecteur par diffusion de lumière

# NMR method

- High Resolution Nuclear Magnetic Resonance
  - ▣ Detects the addition of non permitted sugars in honey
  - ▣ Determines the origin of honey (geographical and botanical).
  - ▣ Provides a comprehensive profile of honeys including eg. aromas, sugars, amino and organic acids.
- This method requires a reference collection of 4,000 honey to avoid false positives.



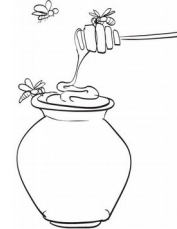


**Figure 2: NMR-spectra of authentic honeys (quantile plot) overlaid with an authentic honey (bold black line). 1st. row: aliphatic region, 2nd. row: sugar region, 3rd. row: aromatic region.**

# Adulteration

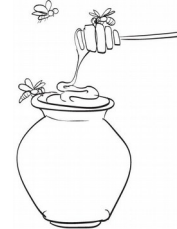


# Adulterated honey



- Adulterated honey on the international market = 9.8% honeys analyzed in 2012, 11.8% in 2013 ...
- Mislabelling =
  - ▣ Botanical origin
  - ▣ Provenance
  - ▣ Addition of foreign sugars
    - Voluntary or not
- Sometimes very difficult to detect (expensive)

# Adulterated honey



- Adulteration: detection methods
  - ▣ Composition: sugar: C<sub>3</sub> (corn, cane), C<sub>4</sub> (beet, rice ...) - d<sup>13</sup> C-IRMS, LC-IRMS, NMR
  - ▣ Enzymes: invertase or artificial amylase - Photometric,
  - ▣ Color: addition of caramel coloring
  - ▣ ...
- The techniques must be adapted frequently (6 months)



**Traceability**



# Adulterated honey



- Wide coordinated control plan at EU level
  - ▣ Objectives: to establish the prevalence of adulteration on the EU market:
    - Mislabelling honey related to its geographical and / or botanical origin
    - "Honey" containing exogenous sugars or sugar products.
  - ▣ 2200 samples in EU+ CH, NW.
- Inspection of honey by the JRC, and analyzes



Coordinated control plane to suit les the prevalence of  
fraudulent practices in the marketing of honey  
Preliminary results

Non-compliance	Physico-chemical parameters	Botanical source	Geographical origin	Sugar	Other labelling	Total
% non-compliant samples	2%	7%	2%	6%	2%	19%

Nature of the suspicion	Pollen content and declared geographical origin	Adulteration with sugar	Total
% suspect samples among the remaining samples	2%	11%	13%

	Border inspection post	Producer	Importer or wholesaler	Packaging or processing establishments	Distribution or retail
n samples taken	52	336	236	306	1307
% of samples taken	2%	15%	11%	14%	58%
% non-compliant samples	2%	15%	19%	17%	10%
% suspect samples among the remaining samples	29%	10%	9%	8%	8%



# Wax and wax foundations



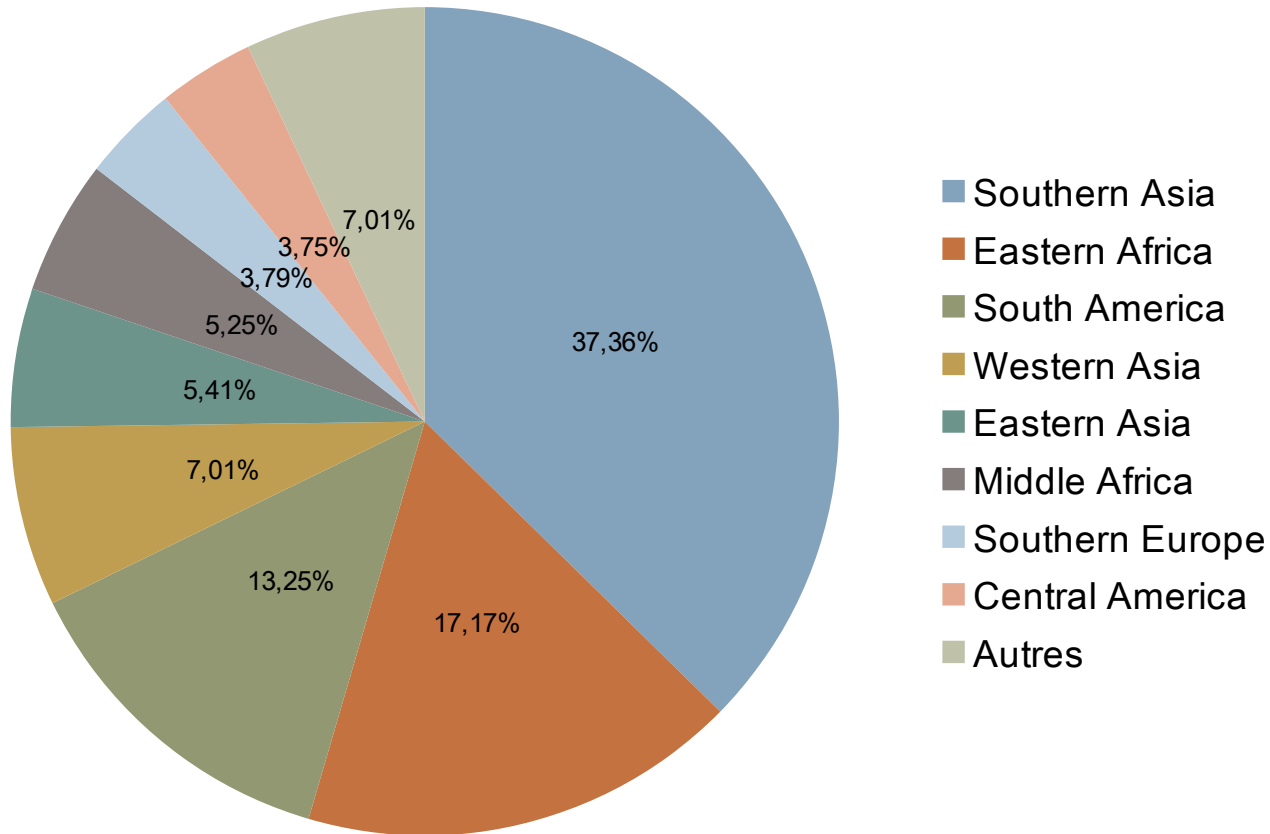
# Beeswax.



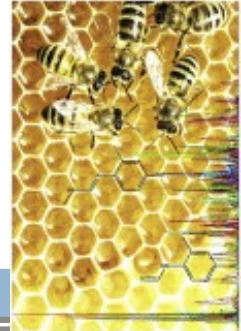
- Defined only in certain countries (Polish standard PN-72 / R-78890, 1996)
- Considered a food additive at an international level :
  - ▣ E901
  - ▣ number EINECS 232-383-7)
- Question N° EFSA-Q-2006-021
  - ▣ Yellow bees wax Chemical Abstracts Service (No. 8012-89-3) wax obtained from the overhaul of frames of bees by hot water by removing the exogenous material there.
  - ▣ Wax white bees (CAS No. 8006-40-4) wax obtained by bleaching yellow wax.



# Beeswax.



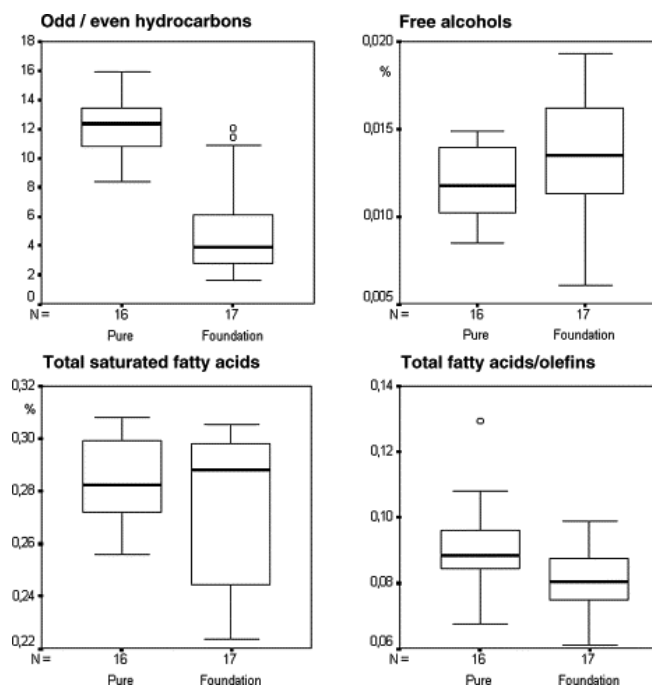
# Controls waxes



- The quality of the wax is related to its purity.
  - ▣ Residues study of 60 samples
    - <http://www.sciencedirect.com/science/article/pii/S004565351630892X>
    - derivatives of amitraz of 5 micrograms to 464  $\mu\text{g kg}^{-1}$
    - organophosphorus insecticides of 1 to 464  $\mu\text{g kg}^{-1}$
    - miticides > 9  $\mu\text{g kg}^{-1}$
    - fungicides 1 to 23  $\mu\text{g kg}^{-1}$
    - herbicides 1 to 5.9  $\mu\text{g kg}^{-1}$

# Controls waxes

- The quality of the wax is related to its purity.
  - ▣ Type of lipid
  - ▣ Significant percentage adulterations
    - > 30 foreign substances
    - Adding paraffin systematic!
  - ▣ IR on 45 samples:
    - 60% contaminated
    - max 30% of paraffin



# Problem waxes 2016

- Problems revealed by the Belgian, Dutch, German and French beekeepers:
  - ▣ Brood mosaic
  - ▣ Difficulty of construction ...
- On line questionnaires for beekeepers
- Replies sent to the authorities
- Ongoing analyzes: chemical residues, waxes composition, wetting products ...



### *Message aux fédérations d'apiculture*

#### **Utilisation de rayons de cire achetés et vente du miel**

Suite à la réunion d'information qui s'est tenu le 14 septembre et vu l'état actuel de l'enquête concernant la mortalité élevée du couvain suite à l'utilisation de nouveaux rayons de cire préfabriqués, le SPF Santé publique demande aux apiculteurs belges de ne pas utiliser provisoirement les surplus ou réserves de rayons de cire qui ont été achetés. Ceci en attente des résultats des recherches en cours.

Cela concerne les rayons de cire (coulés ou laminés) avec les numéros de lot **212225** jusqu'à **213110** qui ont été achetés dans la **période de février 2015 jusqu'à septembre 2016**.

Il est demandé aux apiculteurs de conserver provisoirement ces rayons de cire, y compris les mauvais rayons de cire qui ont été retirés des ruches, et donc de ne pas les refondre (ou les faire refondre) pour réutilisation.

Il a aussi été demandé au fabricant de ces rayons de cire d'arrêter la vente et la distribution de ceux-ci dans l'attente des résultats des recherches en cours.

Dès que le SPF Santé publique aura clarifié la cause exacte des problèmes vous en serez informés.

Information de l'Agence pour la Sécurité de la Chaîne Alimentaire (AFSCA) :

Une évaluation concernant les risques éventuels liés à la consommation du miel a été effectuée. Selon cette première évaluation, il n'y a pas de risque pour le consommateur. L'AFSCA attend toutefois les résultats d'analyses de laboratoire supplémentaires afin de confirmer cette évaluation.

En ce qui concerne le miel, l'AFSCA rappelle que les apiculteurs restent responsables de la sécurité et la qualité du produit qu'ils mettent sur le marché.

# Explanations?

- Use of waxes batches intended for the production of candles
- Wax foundations import from China contaminated with illegal substances
- Poisoning caused by the presence of toxic in waxes or on surface:
  - ▣ Building insecticide treatment (piperonyl butoxide ...)
  - ▣ Wetting used during production of foundations ...
- Presence of artificial waxes with too low melting point
- Others?

# Other bee products

- Royal jelly
  - ▣ It's possible to find on the market product who contain 10HDA who is not real royal jelly
- Pollen
  - ▣ In some countries it's possible to find artificial pollen
- Propolis
  - ▣ This product can be adulterated by the adding of vegetal resins. Techniques exist allowing the detection of certain frauds.

A close-up photograph of a bee in flight, positioned in the lower right quadrant. The bee is angled towards the left, with its wings spread and its body showing distinct black and yellow stripes. In the upper left, a large, spherical flower head is in focus, composed of numerous small, bright yellow stamens. Below it, another similar flower head is visible but out of focus. The background is a soft, out-of-focus grey, which makes the bee and the flower heads stand out. The text 'THANK YOU FOR YOUR ATTENTION' is overlaid in the upper right area in a light yellow, sans-serif font.

THANK YOU  
FOR YOUR  
ATTENTION

As bees, chose quality  
products