Dietary exposure for risk assessment of GM foods

Ad hoc meeting with industry representatives

Parma, 24.10.2018

efsa
European Food Safety Authority

- **Dietary exposure in the risk assessment of GM foods**
- **How to estimate dietary exposure**
- **Human dietary exposure: current situation**
- **Future**

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DIETARY EXPOSURE AS PART OF THE RA OF GM FOOD

LEGAL

IR 503/2013

2. EXPOSURE ASSESSMENT — ANTICIPATED INTAKE/EXTENT OF USE

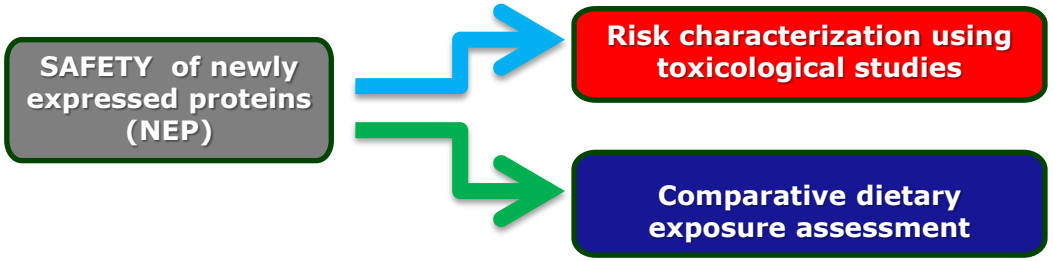
An estimate of the expected intake shall be an essential element in the risk assessment of genetically modified food and feed and shall also be required for the nutritional evaluation. Information shall be provided by the applicant on the intended function, the dietary role, and the expected level of use of the genetically modified food and feed in the EU. In addition, the expected range of concentrations of newly produced proteins or existing plant proteins deliberately modified in the genetically modified food(s) and feed(s) to be placed on the market shall be provided.

GMO DIETARY EXPOSURE ASSESSMENT

The applicant shall determine by appropriate methods the concentrations of the newly expressed proteins, other new constituents and endogenous food and feed constituents, of which the levels have been altered as a result of the genetic modification (for example, due to changes in metabolic pathways) in those parts of the genetically modified plant intended for food or feed use. Expected intake of these constituents shall be estimated taking into account the influences of processing, storage and expected treatment of the food and feed in question, for example, potential accumulation or reduction. In cases where the genetic modification has resulted in an altered level of a natural constituent, or if a new constituent occurs naturally in other food and feed products, the anticipated change in total intake of this constituent shall be assessed considering realistic as well as worst case intake scenarios.

DIETARY EXPOSURE AS PART OF THE RA OF GM FOOD

SCIENCE



- **Comparative dietary exposure frame**: dietary exposure of similar/identical proteins in different foods & dietary exposure to NEPs.
  - e.g. **XXXX** protein in GM-crop & **XXXX** present in different conventional foods (oat, maize, wheat, rice, barley).
- **Absolute dietary exposure frame**: dietary exposure to NEPs & health based guidance values (risk characterization).

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GMO DIETARY EXPOSURE ASSESSEMENT

Field trials – DOSSIER -

Food Terminology FOODEX

EFSA Comprehensive European food consumption database

Concentration values*

Dietary exposure (EXTERNAL)

Food consumption

Scenario 100% replacement

CONCENTRATION DATA

- Substances are analysed in raw primary commodities and consumption data refers to blended (processed) commodities.

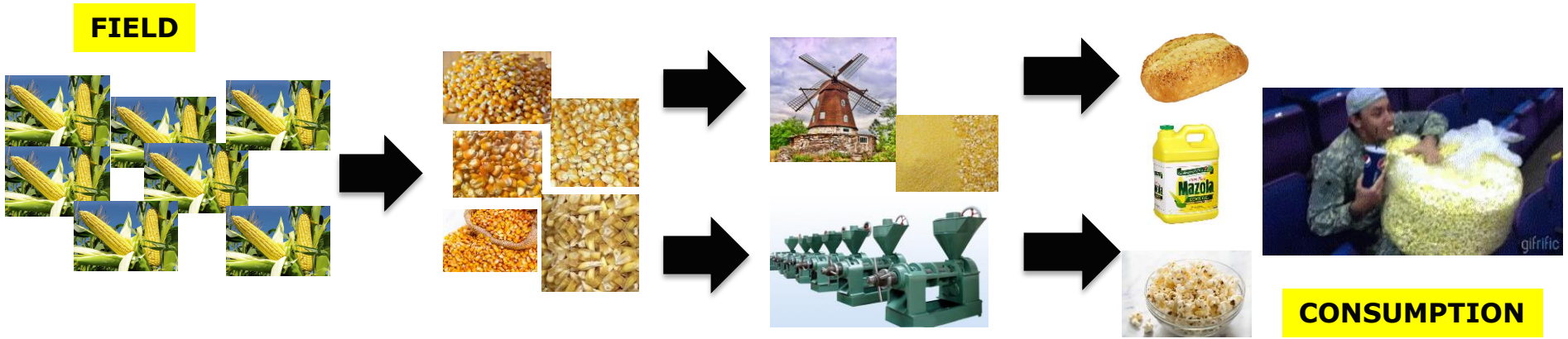
- In most of the cases, very (very) small number of samples available….**representative**??

Which values should be used for dietary exposure estimations ?

Chronic dietary exposure and **acute** dietary exposure

CONCENTRATION DATA

Which values to estimate dietary exposure to GMO components ?



When using **NEP concentrations from RPC** the most realistic scenario is to always* use **MEAN CONCENTRATIONS** for both ACUTE and CHRONIC EXPOSURE

WHICH CONCENTRATION DATA TO BE USED (FROM THE RPC)

- Appropriate material at the representative **growth stage (e.g. maize:** grains **R6/senescence)**

- **Representative of cultivation conditions** (crops treated with the intended herbicide).

- **Mean values** (acute and chronic dietary exposure). *Possibility of differentiating among areas (sites) if significant differences reported

- Values expressed **in fresh weight**

- **LOD/LOQ** to be used for left-censored data (undetected/unquantified) when estimating mean values.

FROM RPC DATA TO PROCESSED COMMODITIES

- **Factors and recipes** linked to processed commodities are also considered.
  - **Recipes** = dilution effect
  - **Reverse yield factors**: conservative approach*
    - no NEP losses (e.g. due to fermentation)
    - No effect of processing (pH, temperature) as related to the potential hazard of the NEP

- **Protein content**

FROM RPC DATA TO PROCESSED COMMODITIES

USDA

MINTEL

Factors and recipes & Protein content

- **More accurate when covering processed commodities made of different foods.**

- **<u>On-going</u> work on recipes & factors (RPC model)**

- **Harmonised approach across EFSA**

FROM RPC DATA TO PROCESSED COMMODITIES

Identify relevant commodities that may contain our compound of interest (e.g. NEP)

Bread	Maize, popped	Popcorn
Corn flour	Corn syrup	Rosehip soup
Corn semolina	Corn oil	Blueberries soup
Corn starch	Whisky	
Cornmeal	Gin	
Corn flakes	Grain soup	

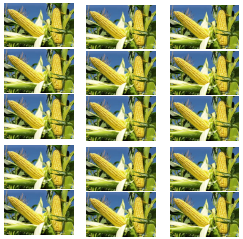
Maize grain

Sweet corn	Prepared pasta salad
Mashed vegetables	Mixed vegetables fried, Mexican
Mixed vegetables, grilled	Mixed vegetables boiled, Mexican
Prepared mixed vegetable salad	

Sweet corn
(*Zea mays var. saccharata*)

FROM RPC DATA TO PROCESSED COMMODITIES

MAIZE



Mean value (n=15)

10 µg NEP/kg fresh weigh

CONSUMPTION

Standard recipe for maize bread (**Mintel database**)

Maize flour (74%), sunflower oil (3%), tap water (20%), salt (2%) and yeast (1%)

122 grams

Milling= 1,22

100 grams

74 grams

100 grams

0,74 **X** 1.22

Factor$_{BREAD}$ = 0.92

FROM RPC DATA TO PROCESSED COMMODITIES

FOODEX LEVEL	FOODEX CODE	FOOD	Amount of raw agricultural commodity to produce 100 grams of processed food (grams)		Comments
4	6220	**Corn grain**	100		100% grain
3	8074	**Popcorn**	100	Puffing=1,08	92,9% grain
4	6268	**Corn flour**	122	Milling= 1,22	100% Corn flour
4	6383	**Corn flakes**	260		100% Corn flakes
4	6384	**Corn flakes and nuts**	190		73% Corn flakes
4	6385	**Corn flakes with honey and nuts**	156	Flaking = 2,6	60% Corn flakes
4	6386	**Corn flakes with honey and sugar**	190		73% Corn flakes
4	6387	**Corn flakes with sugar**	161		62% Corn flakes
4	6445	**Cornmeal porridge**	18		15% corn grain (cornmeal)
4	6271	**Cornmeal**	122	Milling= 1,22	
4	6269	**Corn semolina**	122	Milling= 1,22	
4	6352	**Corn bread**	91	Milling= 1,22	Corn flour 74,3%
3	6336	**Multigrain bread and rolls**	3	Milling= 1,22	Corn flour 2,4 %
3	6407	**Muesli bars**	26	Flaking = 2,6	10% cornflakes
4	6422	**Maize, popped**	108	Puffing=1,08	100% grain
4	6423	**Maize, popped, with sugar**	100		67% corn flour + 33% sugar

CONSUMPTION DATA

- Two main sources of consumption data used in the past in GM applications:
  - **Pesticide Residues Intake MOdel (PriMo) model**
  - **FAO's Food Balance Sheets (FBSs)**

- It allowed a direct link of the levels of particular constituents measured in RPCs with the consumption data of RPCs

CONSUMPTION DATA

- Some drawbacks associated to the use of PriMo model and/or FBS:
  - FBSs are not appropriate for acute exposure
  - Primo model

    - different methodology to disaggregate the consumption data

    - no possibility to exclude particular foods

EFSA statement in 2015 on the use of the EFSA Comprehensive Consumption database in GMO area

EFSA COMPREHENSIVE CONSUMPTION DATABASE

The EFSA Comprehensive European food consumption database contains data:

- 24-hour recall or dietary record method
- data collected at individual level
- most recent data within each country
- random sample at national level
  - different age classes, from infants to elderly
  - special population groups

EFSA COMPREHENSIVE CONSUMPTION DATABASE

Number of	
Member States	**25**
Dietary surveys	**60**
Population groups	**132**
Subjects	**119,458**
Consumption records	**12,076,637**

Last update in Aprile 2018

EFSA COMPREHENSIVE CONSUMPTION DATABASE -AGE CLASSES-

Age class	Age range (years)	Number of surveys*		Number of countries*	
		Before April 2018	After April 2018	Before April 2018	After April 2018
Infants	0 – 1	6	11 (11)	6	11 (11)
Toddlers	1 – 3	11 (10)	15 (14)	10 (9)	14 (13)
Children	3 - 10	20 (18)	21 (19)	17 (15)	19 (17)
Adolescents	10 - 18	20 (17)	21 (18)	17 (14)	19 (16)
Adults	18 - 65	22 (17)	23 (19)	21 (16)	23 (19)
Elderly	65 - 75	16 (14)	20 (18)	15 (13)	19 (17)
Very elderly	> 75	14 (12)	17 (15)	14 (12)	17 (15)
Special population group		2 (2)	4 (4)	2 (2)	4 (4)

* In parenthesis only surveys with more than one day per subject

CONSUMPTION DATA –SUMMARY-

- Chronic/acute dietary exposure

- Average population and high consumers
- Estimated in different age classes across Europe

- Special population groups: vegetarians, lactating women and pregnant women.

- Dietary exposure in the risk assessment of GM foods
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CURRENT SITUATION

- Dietary exposure to NEP thoroughly addressed and reported in SO from AP-121 onwards.*

- Information reported in the SO: acute and chronic dietary exposure, only high consumers.

- Information provided by the applicants: **very diverse**

  - Inconsistency between scope and assessment; indistinct use of **expression of results** (fresh weight/dry weight); chronic exposure/acute **dietary exposure** not provided; missing information on **high consumers;** inadequate use of **summary statistics on consumption…**

- Preparation of a document providing guidance to harmonise data needed on exposure estimations.

FOOD CONSUMPTION

EFSA Comprehensive European food consumption database

SUMMARY STATISTICS

Summary food consumption statistics (chronic and acute) available per

- country,
- survey,
- age group (from infants to elderly)
- codified in FoodEx
- in g/day and g/kg bw per day.

- Use of the most recent dietary surveys per country and age class
- Use of appropriate FoodEx levels

USE OF SUMMARY STATISTICS

EFSA Comprehensive European food consumption database

Chronic dietary exposure in the average population

Sum the exposure of all relevant foods obtained by multiplying the average consumption of each food in the whole population by the mean value reported in the GM crop for the compound of interest (e.g. NEP).

Chronic dietary exposure of high consumers

Sum the high percentile (e.g. 95th) of the most consumed food among consumers only and the average consumption of all the other foods in the whole population, using the mean value reported in the GM crop for the compound.

"Overview of the procedures currently used at EFSA for the assessment of dietary exposure to different chemical substances" (EFSA, 2011)

Food additives intake model (FAIM) Template (2012)

David R. Tennant (2016) Comprehensive European dietary exposure model (CEDEM) for food additives, Food Additives & Contaminants: Part A, 33:5, 772-781, DOI: 10.1080/19440049.2016.1166898

USE OF SUMMARY STATISTICS

EFSA Comprehensive European food consumption database

Acute dietary exposure for the average population and high consumers.

As we talk about acute exposure, the consumption refers to the amount of food commodity consumed in only one day so the summary statistics for acute consumption should be used. For the rest, same approach as for chronic exposure.

CONSUMPTION DATA

- **Use of EFSA Comprehensive Consumption database (summary statistics) allows…**
  - Assessment **chronic** and **acute** dietary exposure (screening tool)
  - **Average** and **high consumers**
  - **Extensive coverage** of European population
  - Selection of **food commodities relevant for exposure**
  - Possibility of looking at **vulnerable** population groups (based on age, consumption habits, life status)

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DOCUMENT ON HUMAN DIETARY EXPOSURE

- **AIM**: To provide guidance on how human dietary exposure to GM constituents should be estimated making the best use of the available information. Description of the information needed for the RA (standardisation)

- **Presentation based on the on-going document; your feedback is very welcome!**
- **Publication first quarter of 2019**

DOCUMENT ON HUMAN DIETARY EXPOSURE

- **Concentration data to be used (mean values, fresh weight, use LOD/LOQ, etc.)**
- **How to best use summary statistics on consumption data**
- **Recipes and factors provided in EFSA website**
- **Information to be provided as part of the submission dossier**

RAW PRIMARY COMMODITY MODEL (RPC MODEL)

Raw Primary Commodities (RPCs)

Reverse yield factors

Individual ingredients

Food as consumed

List of ingredients and proportions

GMO DIETARY EXPOSURE ASSESSEMENT

Field trials – DOSSIER -

Food Terminology FOODEX

EFSA Comprehensive European food database

Raw Primary Commodities (RPC MODEL)

Concentration values*

Dietary exposure (EXTERNAL)

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TAKE HOME MESSAGES ON DIETARY EXPOSURE

- Dietary exposure to be used on concluding on the safety of the endogenous/new constituents = **representative and accurate levels needed** !!

- Dietary exposure estimations today could be different tomorrow: need of **monitoring** → **different outcome of the RA** → **still SAFE** ?

TAKE HOME MESSAGES ON DIETARY EXPOSURE

- There are **uncertainties** surrounding dietary exposure estimations

Assumptions introduce uncertainty → Overall: **conservative estimations** → **Realistic and representative**

Where can the uncertainty be reduced?

- **Consumption: 100% replacement** ☹
- **Improve representativity of samples ??** 😐
- **Accuracy of the measurements??** 🙂
- **Appropriate use of the available data (mean, fresh weight, etc.)** 🙂
- **Concentration data on processed foods ??** 😐
- **Processing studies…at the moment only DILUTION due to recipes…** 😐

THANKS!!

QUESTIONS ?