# Impact of new diet formulations on food safety

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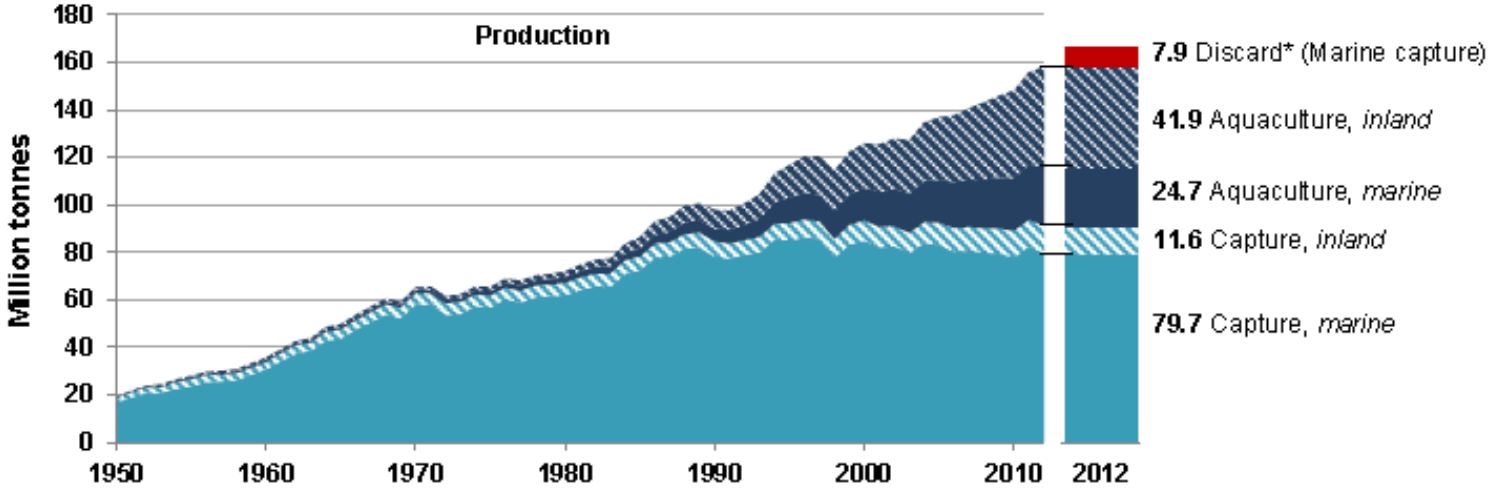
# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## Aquaculture

**At a global level, aquaculture is increasing while fisheries remains stable**




**Sustainable fisheries and aquaculture for food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome 2014.**

**Marine origin sources for aquaculture are limited**

**The validation of new alternatives are advisable**

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## Low fish meal & low fish oil availability

**Necessity of knowledge on new alternatives**

⇩

**New feed formulations**

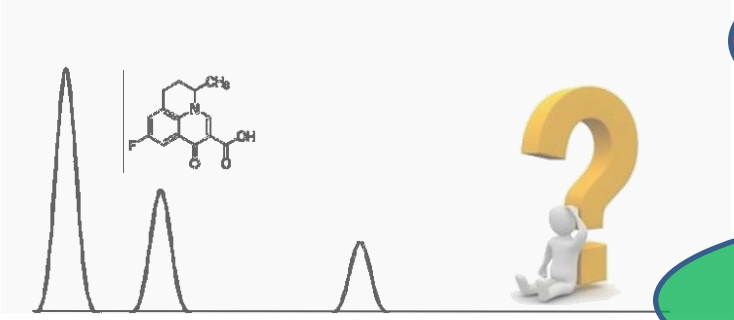
⇩

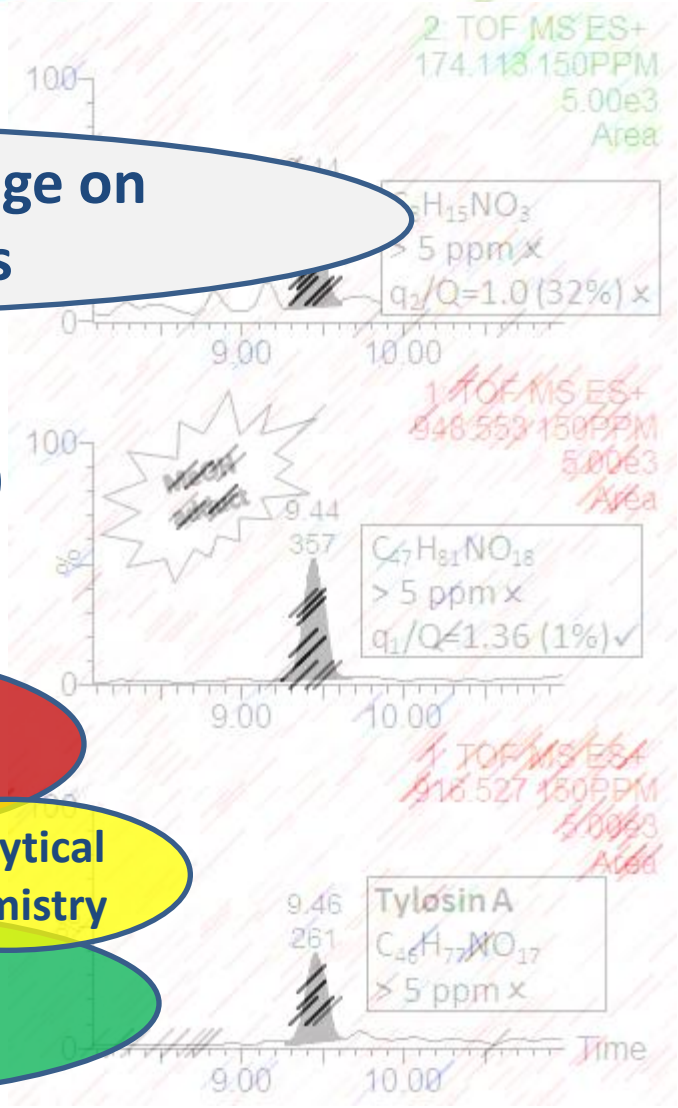
**Contaminants**
**Ingredient-feed-fillet**

⇩

**Analytical Chemistry**

**Feed safety & Public health Implications**





# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## Why this research is essential?

**EU-legislation on maximum residue levels (MRL) throughout food production chain**

**Legislation goals on feed ingredients and feed are directed towards:**


**Protect consumer safety**

**Protect animal welfare**

**Protect the enviroment**

Commission Regulation. № 37/2010. Off. J. Eur. Union L15, 1-72
EU Pesticides Database, http://ec.europa.eu

Directive № 2002/32/EC. Off. J. Eur. Union L140, 10-21
Commission Regulation. № 1881/2006. Off. J. Eur. Union L364, 5-24

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## Why the need of feed-to-fillet transfer assessment?

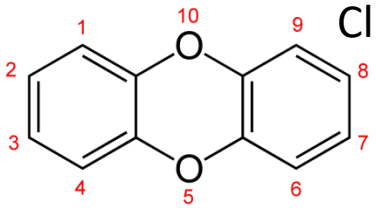
**There are some differences between contaminant groups and chemicals in the group**

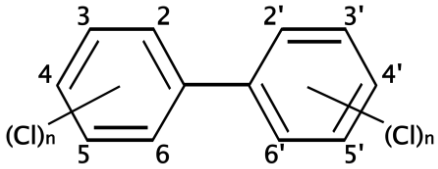
**Contaminant groups:**

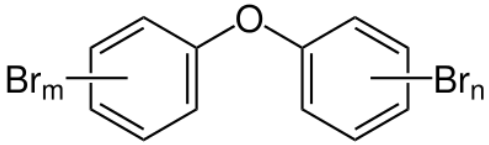
- Dioxins
- Polychlorinated biphenyls - PCBs
- Brominated flame retardants - PBDEs
- Polyaromatic hydrocarbons - PAHs
- Organophosphate pesticides
- Polar pesticides

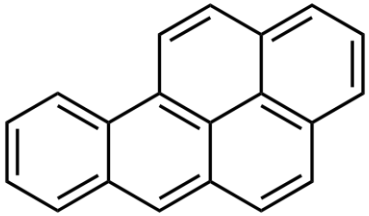
**Differences inside of a group:**

- Dioxins: 4 Cl vs 5 Cl vs 6 Cl vs 7 Cl
- PCBs: mono-ortho, non-ortho
- PBDEs: 4 Br vs 5 Br vs 6 Br
- PAHs: light vs heavy PAHs, nº rings



**There are still some unknown TF differences between fish species**

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## CONTAMINANTS CLASSIFICATION (aquaculture perspective)

### Classical contaminants

(from classical marine ingredients)

- POPs (Stockholm Convention) *(www.pops.int)*
  - ✓ OCPs (aldrin, chlordane, heptachlor, HCB,...)
  - ✓ PCBs
  - ✓ Dioxins, furans
  - ✓ PBDEs
  - ✓ Non-polar pesticides
- New POPs (HCH, HBCD,...)
- PAHs

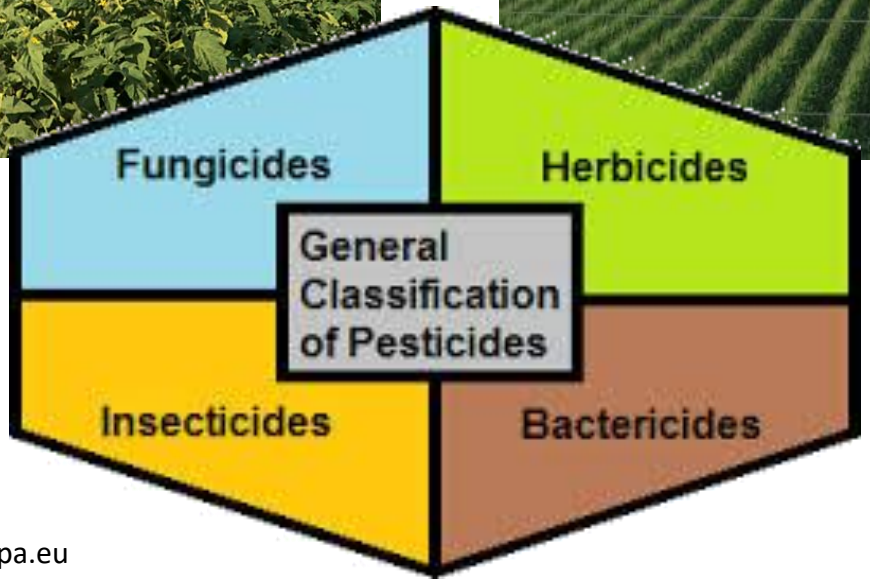
### "New" contaminants

(from novel ingredients)

- Polar pesticides (pirimiphos methyl, chlorpyrifos, boscalid, azoxystrobin,...)
- Mycotoxins (AF, FB, DON,...)
- Therapeutic agents
- Dyes

**Real advantage of marine substitution by plants --> POPs reduction**

# Pesticides




EU Pesticides Database, http://ec.europa.eu

# Mycotoxins



**13 EU regulated mycotoxins in food** (AFB1, **Σ**AFB1-AFB2-AFG1-AFG2, AFM1, DON, ZEN, OTA, PAT, FB1 + FB2, T-2 and HT-2)

**8 EU regulated mycotoxins in feed and feed ingredients** (AFB1, DON, ZEN, OTA, FB1 + FB2, T-2 and HT-2)

Commission Recom. Nº 2006/576. Off. J. Eur. Union L229, 7-9

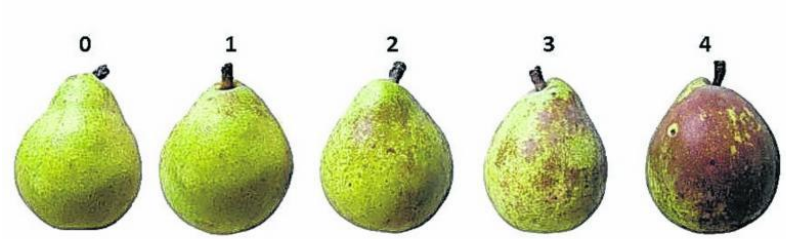
Commission Reg. Nº 1881/2006. Off. J. Eur. Union L364, 5-24

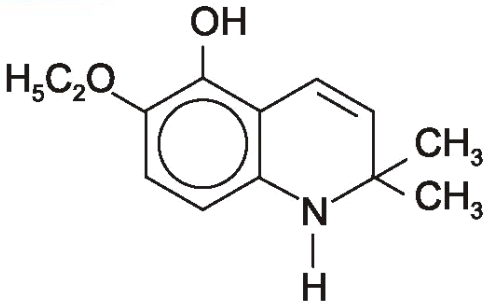
Nácher-Mestre, J. et al., Chemosphere 2015, 128, 314-320

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## OTHER UNDESIRABLES IN AQUACULTURE

## Ethoxyquin (ETQ)




+ metabolites

## Therapeutic agents – salicylic acid, enrofloxacin, trimethoprim,…

***"Extraordinary disease - veterinary treatment"***

## PAP residues - antibiotics, hormones, stimulants, dyes,…

***Pork meal***

***Poultry blood***

***Feather meal***

*Acetaminophen, crystal violet, norgestimate, fluoxetine,…*

Nácher-Mestre, J. et al., JAFC 2013, 2014
Nácher-Mestre, J. et al., Chemosphere 2016, 154, 231-239
Commission regulation (EU) Nº 56/2013
Love, D et al., Environ. Sci. Technol. 2012, 46, 3795-3802
Commission Regulation. Nº 37/2010. Off. J. Eur. Union L15, 1-72

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## What contaminants are important for…

## …feed-to-fillet transfer and food safety?

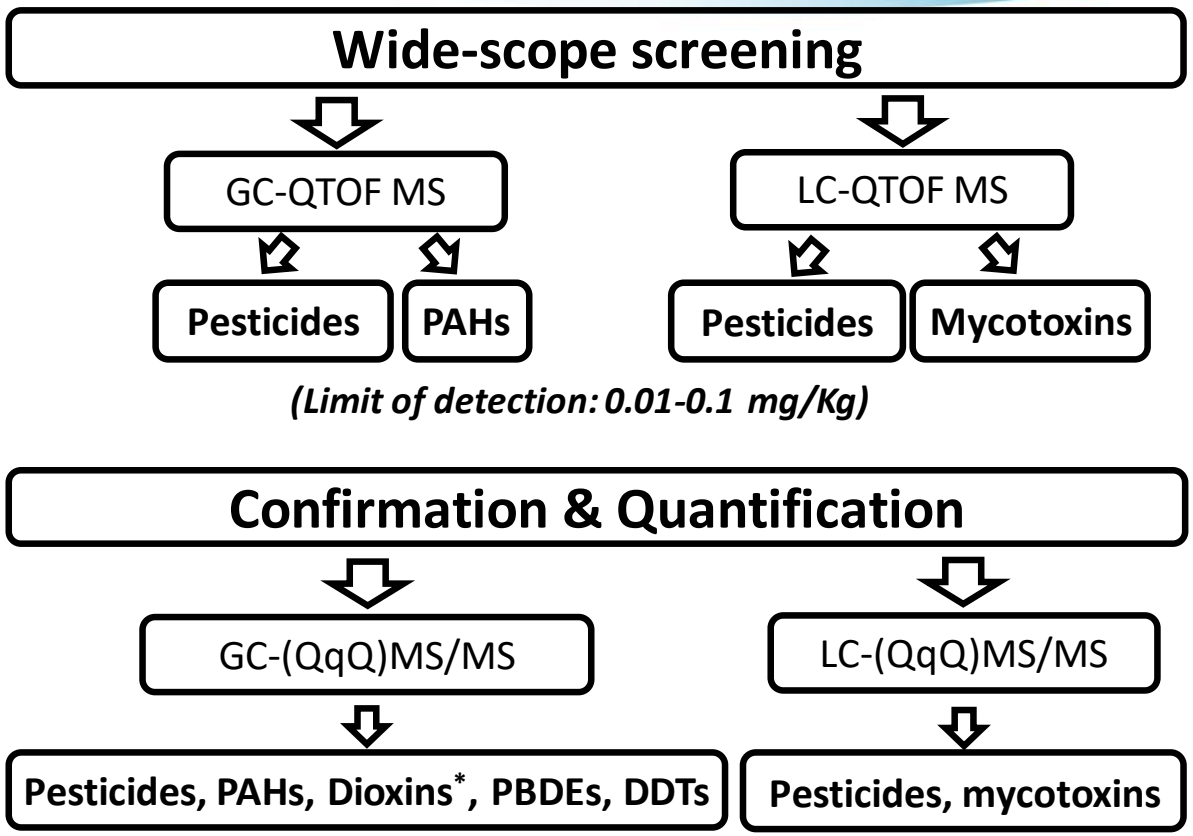
depends on where it comes from

**Marine Ingredients**
- POPs
- Chlorinated pesticides
- PAHs

**Plant Ingredients**
- Polar pesticides
- Mycotoxins
- PAHs

**Processed Animal Products (PAP)**
- Therapeutical agents
- Pharmaceuticals
- Hormones
- Dyes
- PAHs

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY







Saera-Vila et al. 2009, Aquaculture
Nácher Mestre et al. 2009, Rapid. Commun. MS
Nácher-Mestre et al. 2009, Chemosphere
Nácher-Mestre et al. 2010, Anal. Chim. Acta
Nácher-Mestre et al. 2010, Arch. Environ. Contam. Toxicol.
Berntssen MGH et al. 2011, Chemosphere
Nácher-Mestre et al. 2013, 2014, JAFC
Nácher-Mestre et al. 2015, 2016, Chemosphere
Portolés et al. 2017, Chemosphere, Talanta

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY


**AQUACULTURE**

**AWARENESS**

# EU INTEREST/PROPOSALS FOR FISH SAFETY:

**AQUAMAX *2006-2010***

aquamax

SIXTH FRAMEWORK PROGRAMME

**ARRAINA *2012-2016***

ARRAINA
Advanced Research Initiatives for Nutrition & Aquaculture

SEVENTH FRAMEWORK PROGRAMME

**Development of adequate analytical methods to detect chemical residues and contaminants for fish safety assessment**

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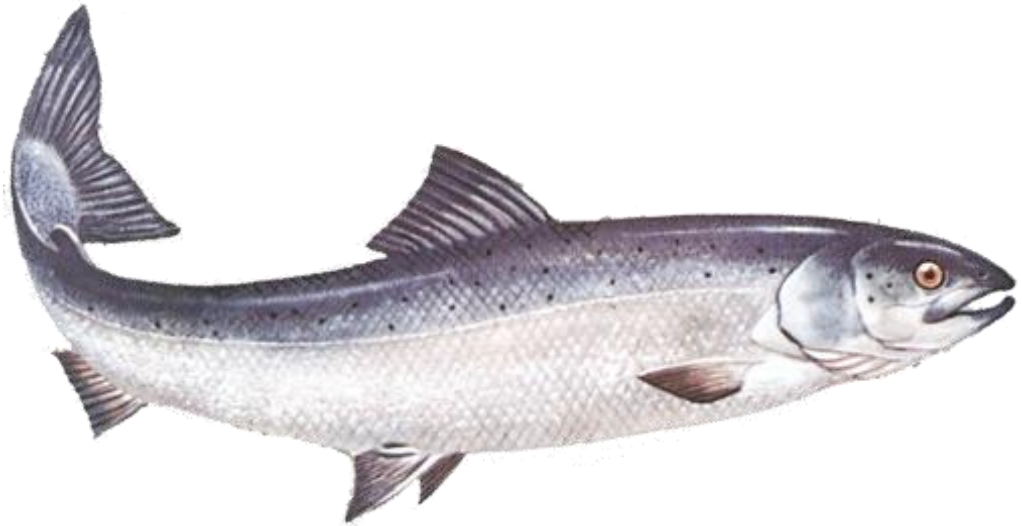
# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

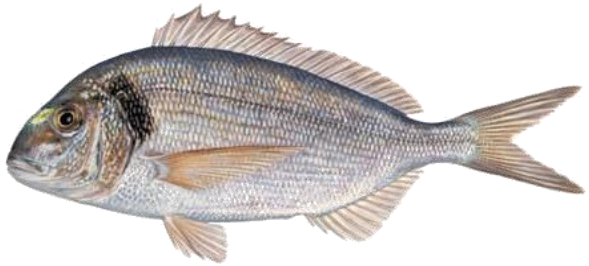
## CONTAMINANTS IN AQUACULTURE-data generated

| Compound | TEF | Salmon feed (27 weeks) A | B | D | G | Salmon fillet (27 weeks) A | B | D | G | Transfer factor A | B | D | G |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Naphtalene | 0,001 | 108,4 | 75,7 | 126,6 | 93,8 | 72,0 | 66,6 | 62,8 | 60,9 | 0,7 | 0,9 | 0,5 | 0,6 |
| Acenaphthylene | 0,001 | | | | <5 | | | | <5 | | | | |
| Acenaphtene | 0,001 | 5,5 | <5 | 6,9 | <5 | <5 | <5 | <5 | <5 | | | | |
| Fluorene | 0,001 | 13,3 | 11,1 | 21,9 | 16,0 | 11,4 | 12,5 | 8,0 | 14,4 | 0,4 | 0,9 | | |
| Phenanthrene | 0,001 | 41,4 | 26,0 | 38,9 | 37,9 | 18,8 | 17,5 | 15,0 | 19,3 | 0,5 | 1,5 | 0,8 | 0,8 |
| Anthracene | 0,001 | | | | | | | | | | | | |
| Fluoranthene | 0,001 | | | | | | | | | | | | |
| Pyrene | 0,001 | | | | | | | | | | | | |
| Benzo(a)anthracene | 0,001 | | | | | | | | | | | | |
| Chrysene | 0,001 | | | | | | | | | | | | |
| 5-Methylchrysene | 0,001 | | | | | | | | | | | | |
| Cyclopenta(cd)pyrene | 0,001 | | | | | | | | | | | | |
| Benzo(b)fluoranthene | 0,001 | | | | | | | | | | | | |
| Benzo(k)fluoranthene | 0,001 | | | | | | | | | | | | |
| Benzo(a)pyrene | 0,001 | | | | | | | | | | | | |
| Indeno(1,2,3-cd)pyrene | 0,001 | | | | | | | | | | | | |
| Dibenzo(a,h)anthracene | 0,001 | | | | | | | | | | | | |
| Benzo(ghi)perylene | 0,001 | | | | | | | | | | | | |
| **Σ PAH** | | | | | | | | | | | | | |
| **Σ PAH (4 EU)** | | | | | | | | | | | | | |
| **EU PAH (8)** | | | | | | | | | | | | | |
| Chrysene | 0,001 | | | | | | | | | | | | |
| Pirimiphos-methyl | 0,001 | | | | | | | | | | | | |
| Boscalid | 0,001 | | | | | | | | | | | | |
| Azoxystrobin | 0,001 | | | | | | | | | | | | |
| Ethoxyquin | 0,001 | 5635,1 | 6436,9 | 5684,9 | 5450,4 | 417,58 | 390,38 | 314,52 | 125,74 | 0,07 | 0,06 | 0,06 | 0,02 |
| Ethoxyquin dimer | 0,001 | 1428,8 | 1419,7 | 1399,5 | 1317,6 | 35,4 | 153,4 | 158,2 | 29,1 | 0,02 | 0,11 | 0,11 | 0,02 |

- **Knowledge and key information of contaminants on:**
  - **Marine ingredients**
  - **Plant meals and plant oils**
  - **PAPs**
- **Established MRLs >> [ ] findings (after plant-based feed)**
- **Feed-to-fillet Transfer Factor**
- **Fish safety conclusions – future trends**

# COMPREHENSIVE DATA FROM ACTIVE FEEDING TRIALS ON ATLANTIC SALMON AND GILTHEAD SEA BREAM





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# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

**Alternative feed reared on plant sources**

| Ingredients (% of total) | Atlantic salmon | Sea bream |
|---|---|---|
| **Vegetable meal mixture** | 65 | 73.84 |
| *Wheat* | *6* | *6.64* |
| *Wheat gluten* | *15* | *7.3* |
| *Corn gluten* | *4* | *25* |
| ***Soybean protein*** | ***18*** | ***25*** |
| *Pea protein* | *13* | |
| *Rapeseed meal* | | *9.9* |
| *Field peas* | *9* | |
| Vegetable oil mixture | 15.8 | 13.0 |
| *Linseed oil* | *2.2* | |
| *Palm oil* | *4.8* | *6.5* |
| *Rapeseed oil* | *8.8* | *6.5* |
| Marine sources | 14.4 | 7.5 |
| *Fish meal* | *8* | *3* |
| *Fish oil* | *4.4* | *2.5* |
| *Krill meal* | *2* | |
| *Fish protein* | | *2* |
| Vitamin and mineral supplementation | 4.8 | 5.66 |

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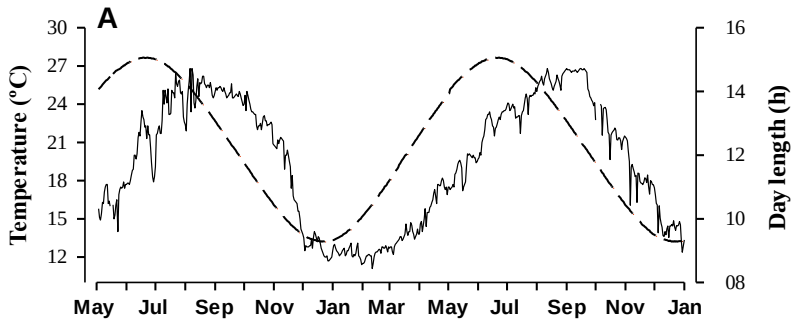


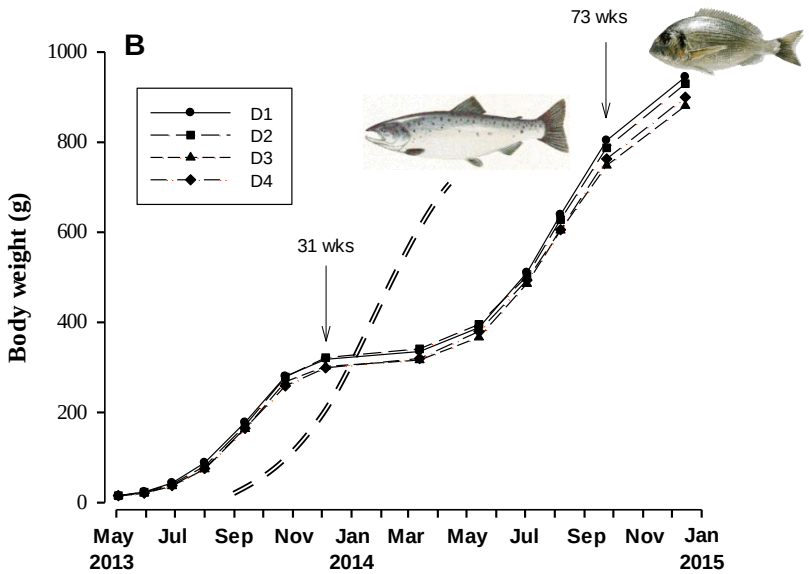


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# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## Undesirables overview throughout salmon and sea bream feeding

| *Sample \ Compound* | PESTICIDES | | PAHs | MYCOTOXINS | POPs | ETQ* / ETQ-D |
|---|---|---|---|---|---|---|
| | POLAR | NON-POLAR | | | | |
| Plant meal | ✓ | | ✓ | ✓ | | ✓ |
| Plant oil | ✓ | | ✓ | ✓ | | ✓ |
| Marine ingredients | ✓ | ✓ | ✓ | | ✓ | ✓ |

✓= identified

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## Undesirables overview throughout salmon and sea bream feeding

| *Sample \ Compound* | PESTICIDES POLAR | PESTICIDES NON-POLAR | PAHs | MYCOTOXINS | POPs | ETQ* / ETQ-D |
|---|---|---|---|---|---|---|
| Plant meal | ✓ | | ✓ | ✓ | | ✓ |
| Plant oil | ✓ | | ✓ | ✓ | | ✓ |
| Marine ingredients | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Plant-based Feed | ✓ | | ✓ | ✓ | | ✓ |

✓= identified

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## Undesirables overview throughout salmon and sea bream feeding

| *Sample \ Compound* | PESTICIDES POLAR | PESTICIDES NON-POLAR | PAHs | MYCOTOXINS | POPs | ETQ* / ETQ-D |
|---|---|---|---|---|---|---|
| Plant meal | ✓ | | ✓ | ✓ | | ✓ |
| Plant oil | ✓ | | ✓ | ✓ | | ✓ |
| Marine ingredients | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Plant-based Feed | ✓ | | ✓ | ✓ | | ✓ |
| Fish fillet | | | ✓ | | | ✓ |

✓= identified

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## Undesirables overview throughout salmon and sea bream feeding

ARRAINA *2012-2016*

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## Pesticides

| Concentrations (ng/g, ww) | Sea bream FEED | | | | Salmon FEED | | | |
|---|---|---|---|---|---|---|---|---|
| | D1 | D2 | D3 | D4 | A | B | D | G |
| Chlorpiriphos-methyl | <5 | 5,1 | 7,0 | <5 | | 8,8 | | |
| | | | | | | | | |
| Pirimiphos-methyl | 15,7 | 24,1 | 27,4 | 28,5 | 11,3 | 49,0 | 5,8 | 6,6 |
| | | | | | | | | |
| Boscalid | | | | | 8,6 | <5 | <5 | <5 |
| | | | | | | | | |
| Azoxystrobin | | | | | 9,0 | <5 | <5 | <5 |

**800 pesticides were studied by means of GC & LC coupled to HRMS**

**No feed-to-fillet transfer of pesticides**

*Nácher-Mestre et al., 2013, 2014. Portolés et al., 2017*

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## Undesirables overview throughout salmon and sea bream feeding

**PAHs**

**AQUAMAX *2006-2010***

**ARRAINA *2012-2016***

| Average Concentrations (ng/g, ww) | FEED | | FILLET | | FEED | | | FILLET | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sea bream | Salmon | Sea bream | Salmon | Sea bream -1 | Sea bream -2 | Salmon | Sea bream (300g) | Sea bream (700g) | Salmon (800g) |
| **∑PAH** | 234 | 59 | 6,3 | 6,5 | 156 | 163 | 198 | 164 | 161 | 168 |

Commission Regulation. Nº 1881/2006. Off. J. Eur. Union L364, 5-24
European Food Safety Authority. Opinion of the Scientific Committee/Scientific Panel. EFSA-Q-2007-136

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## Undesirables overview throughout salmon and sea bream feeding

## PAHs

**AQUAMAX *2006-2010***

**ARRAINA *2012-2016***

| Average Concentrations (ng/g, ww) | FEED | | FILLET | | FEED | | | FILLET | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sea bream | Salmon | Sea bream | Salmon | Sea bream -1 | Sea bream -2 | Salmon | Sea bream (300g) | Sea bream (700g) | Salmon (800g) |
| ∑PAH | 234 | 59 | 6,3 | 6,5 | 156 | 163 | 198 | 164 | 161 | 168 |
| | | | | | | | | | | |
| BaPEs | 1,01 | 9,45 | 0,01 | 0,57 | 0,15 | 0,16 | 0,22 | 0,16 | 0,16 | 0,17 |

Commission Regulation. Nº 1881/2006. Off. J. Eur. Union L364, 5-24
European Food Safety Authority. Opinion of the Scientific Committee/Scientific Panel. EFSA-Q-2007-136

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## Undesirables overview throughout salmon and sea bream feeding

## PAHs

**AQUAMAX *2006-2010***

aquamax

**ARRAINA *2012-2016***

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Advanced Research Initiatives for Nutrition & Aquaculture

| Average Concentrations (ng/g, ww) | FEED | | FILLET | | FEED | | | FILLET | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sea bream | Salmon | Sea bream | Salmon | Sea bream -1 | Sea bream -2 | Salmon | Sea bream (300g) | Sea bream (700g) | Salmon (800g) |
| ∑PAH | 234 | 59 | 6,3 | 6,5 | 156 | 163 | 198 | 164 | 161 | 168 |
| BaPEs | 1,01 | 9,45 | 0,01 | 0,57 | 0,15 | 0,16 | 0,22 | 0,16 | 0,16 | 0,17 |
| EU-BaPE limits | | | 2,0 | | | | | | 2,0 | |

**PAHs transfer has increased when using plant-based diets at higher %**

**Despite of these conditions, fillet concentrations remain below EU limits**


Commission Regulation. Nº 1881/2006. Off. J. Eur. Union L364, 5-24

European Food Safety Authority. Opinion of the Scientific Committee/Scientific Panel. EFSA-Q-2007-136

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## Undesirables overview throughout salmon and sea bream feeding

| Mycotoxins (ng/g, ww) | Sunflower meal | Rapeseed meal | wheat | wheat gluten | corn gluten | Pea protein | SOY PROTEIN CONCENTRATE |
|---|---|---|---|---|---|---|---|
| | (n=1) | (n=1) | (n=3) | (n=4) | (n=3) | (n=3) | (n=4) |
| AFG2 | - | - | - | - | - | - | - |
| AFG1 | - | - | - | - | - | - | - |
| AFB2 | - | - | - | - | - | - | - |
| **AFB1** | - | - | - | - | - | - | - |
| NIV | - | - | - | - | - | - | - |
| Fus X | - | - | - | - | - | - | - |
| **DON** | - | - | 53-371 (3) | 17-504 (4) | 139-814 (3) | - | - |
| 3-AcDON | - | - | - | - | - | - | - |
| 15-AcDON | - | - | - | - | 53-452 | - | - |
| NEO | | | | | | | |
| DIA | - | - | - | - | - | - | - |
| **HT-2** | | - | 4-8.1 (2) | 4 (2) | 67 (1) | - | - |
| **T-2** | - | - | 4 (1) | 4 (2) | 2.8 (1) | - | - |
| **ZEN** | - | - | - | 14-17 (2) | 8-13 (3) | - | - |
| **OTA** | 0.4 | 0.4 | 0.4 (1) | 2.0-5.2 (4) | 0.4 (3) | 1.8 (1) | - |
| **FB1** | - | - | - | 0.4-8.2 (2) | 0.4-2319 (3) | - | 0.4 (2) |
| **FB2** | - | - | - | 2.9 (1) | 2.9-1943 (3) | - | 0.5 (1) |
| FB3 | - | - | - | 2.1 (1) | 7.8-638 (3) | - | - |
| **Sum FB1+FB2+FB3** | - | - | - | 13.2 | 11.1-4901 | - | - |

**No feed-to-fillet transfer of mycotoxins**

Commission Recom. Nº 2006/576. Off. J. Eur. Union L229, 7-9

Nácher-Mestre, J. et al., Chemosphere 2015, 128, 314-320

# IMPACT OF NEW DIET FORMULATIONS ON FOOD SAFETY

## Undesirables overview throughout salmon and sea bream feeding

ARRAINA *2012-2016*

## Ethoxyquin and its dimer

| Average Concentrations (ng/g, ww) | FEED | | | FILLET | | |
|---|---|---|---|---|---|---|
| | Sea bream -1 | Sea bream -2 | Salmon | Sea bream (300g) | Sea bream (700g) | Salmon (800g) |
| ETQ | 7934 | 7334 | 5801 | 440 | 418 | 312 |
| | | | | | | |
| ETQ dimer | 10228 | 13718 | 1391 | 383 | 703 | 94 |

**All ingredients, feeds and fish were positive for ETQ and ETQ dimer**

**ETQ/ETQ dimer are transferred from ingredients to edible fillets**

**TF between 0.02-0.11**

**EFSA opinion on the review of the existing maximum residue levels (MRLs) for ethoxyquin according to Article 12 of Reg. (EC) No 396/2005**

# Undesirables OVERVIEW throughout salmon and sea bream feeding

| *Sample \ Compound* | PESTICIDES | | PAHs | MYCOTOXINS | POPs | ETQ* / ETQ-D |
|---|---|---|---|---|---|---|
| | POLAR | NON-POLAR | | | | |
| Plant meal | ✓ | | ✓ | ✓ | | ✓ |
| Plant oil | ✓ | | ✓ | ✓ | | ✓ |
| Marine ingredients | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Feed | ✓ | | ✓ | ✓ | | ✓ |
| Fish fillet | | | ✓ | | | ✓ |

# Undesirables OVERVIEW throughout salmon and sea bream feeding

| *Sample \ Compound* | PESTICIDES POLAR | PESTICIDES NON-POLAR | PAHs | MYCOTOXINS | POPs | ETQ* / ETQ-D |
|---|---|---|---|---|---|---|
| Plant meal | ✓ | | ✓ | ✓ | | ✓ |
| Plant oil | ✓ | | ✓ | ✓ | | ✓ |
| Marine ingredients | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Feed | ✓ | | ✓ | ✓ | | ✓ |
| Fish fillet | | | ✓ | | | ✓ |
| Transfer factor = *[fish] / [feed]* | | | | | | |
| Sea bream | - | - | 0.5-2.0 | - | - | 0.05-0.07/0.03-0.07 |
| Atlantic salmon | - | - | 0.4-1.3 | - | - | 0.02-0.07/0.02-0.11 |

*preservative

**No feed-to-fillet transfer of pesticides and mycotoxins (after plant feeding)**

# Undesirables OVERVIEW throughout salmon and sea bream feeding

| *Sample \ Compound* | PESTICIDES POLAR | PESTICIDES NON-POLAR | PAHs | MYCOTOXINS | POPs | ETQ* / ETQ-D |
|---|---|---|---|---|---|---|
| Plant meal | ✓ | | ✓ | ✓ | | ✓ |
| Plant oil | ✓ | | ✓ | ✓ | | ✓ |
| Marine ingredients | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Feed | ✓ | | ✓ | ✓ | | ✓ |
| Fish fillet | | | ✓ | | | ✓ |
| Transfer factor = *[fish] / [feed]* | | | | | | |
| Sea bream | - | - | 0.5-2.0 | - | - | 0.05-0.07/0.03-0.07 |
| Atlantic salmon | - | - | 0.4-1.3 | - | - | 0.02-0.07/0.02-0.11 |

*preservative

**No feed-to-fillet transfer of pesticides and mycotoxins**

**PAHs were found in all samples. Fillet BaPEs were aprox. 20-fold below MRL (2µg/kg)**

# Undesirables OVERVIEW throughout salmon and sea bream feeding

| *Sample \ Compound* | PESTICIDES POLAR | PESTICIDES NON-POLAR | PAHs | MYCOTOXINS | POPs | ETQ* / ETQ-D |
|---|---|---|---|---|---|---|
| Plant meal | ✓ | | ✓ | ✓ | | ✓ |
| Plant oil | ✓ | | ✓ | ✓ | | ✓ |
| Marine ingredients | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Feed | ✓ | | ✓ | ✓ | | ✓ |
| Fish fillet | | | ✓ | | | ✓ |
| Transfer factor = *[fish] / [feed]* | | | | | | |
| Sea bream | - | - | 0.5-2.0 | - | - | 0.05-0.07/0.03-0.07 |
| Atlantic salmon | - | - | 0.4-1.3 | - | - | 0.02-0.07/0.02-0.11 |

*preservative

**No feed-to-fillet transfer of pesticides and mycotoxins**

**PAHs were found in all samples. Fillet BaPEs were aprox. 20-fold below MRL (2µg/kg)**

**POPs were not found in plant material, feed and fish fillets of salmon and sea bream**

# Undesirables OVERVIEW throughout salmon and sea bream feeding

| *Sample \ Compound* | PESTICIDES POLAR | PESTICIDES NON-POLAR | PAHs | MYCOTOXINS | POPs | ETQ* / ETQ-D |
|---|---|---|---|---|---|---|
| Plant meal | ✓ | | ✓ | ✓ | | ✓ |
| Plant oil | ✓ | | ✓ | ✓ | | ✓ |
| Marine ingredients | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Feed | ✓ | | ✓ | ✓ | | ✓ |
| Fish fillet | | | ✓ | | | ✓ |
| Transfer factor = *[fish] / [feed]* | | | | | | |
| Sea bream | - | - | 0.5-2.0 | - | - | 0.05-0.07/0.03-0.07 |
| Atlantic salmon | - | - | 0.4-1.3 | - | - | 0.02-0.07/0.02-0.11 |

*preservative

- **No feed-to-fillet transfer of pesticides and mycotoxins**
- **PAHs were found in all samples. Fillet BaPEs were aprox. 20-fold below MRL (2µg/kg)**
- **POPs were not found in plant material, feed and fish fillets of salmon and sea bream**
- Ingredient-to-feed dilution factor contributes to the absence of POPs and non-polar pesticides in fillet

# Undesirables OVERVIEW throughout salmon and sea bream feeding

| *Sample \ Compound* | PESTICIDES POLAR | PESTICIDES NON-POLAR | PAHs | MYCOTOXINS | POPs | ETQ* / ETQ-D |
|---|---|---|---|---|---|---|
| Plant meal | ✓ | | ✓ | ✓ | | ✓ |
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| Transfer factor = *[fish] / [feed]* | | | | | | |
| Sea bream | - | - | 0.5-2.0 | - | - | 0.05-0.07/0.03-0.07 |
| Atlantic salmon | - | - | 0.4-1.3 | - | - | 0.02-0.07/0.02-0.11 |

*preservative

- **No feed-to-fillet transfer of pesticides and mycotoxins**
- **PAHs were found in all samples. Fillet BaPEs were aprox. 20-fold below MRL (2µg/kg)**
- **POPs were not found in plant material, feed and fish fillets of salmon and sea bream**
- Ingredient-to-feed dilution factor contributes to the absence of POPs and non-polar pesticides in fillet
- ETQ and its dimer were found at concentrations around mg/kg in all samples

# Teşekkür ederim!

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# Impact of new diet formulations on food safety

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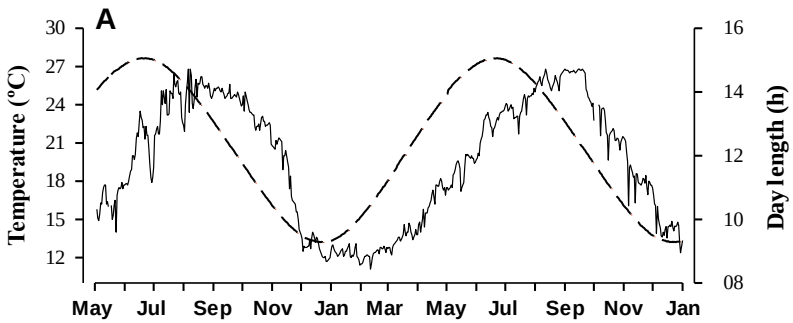
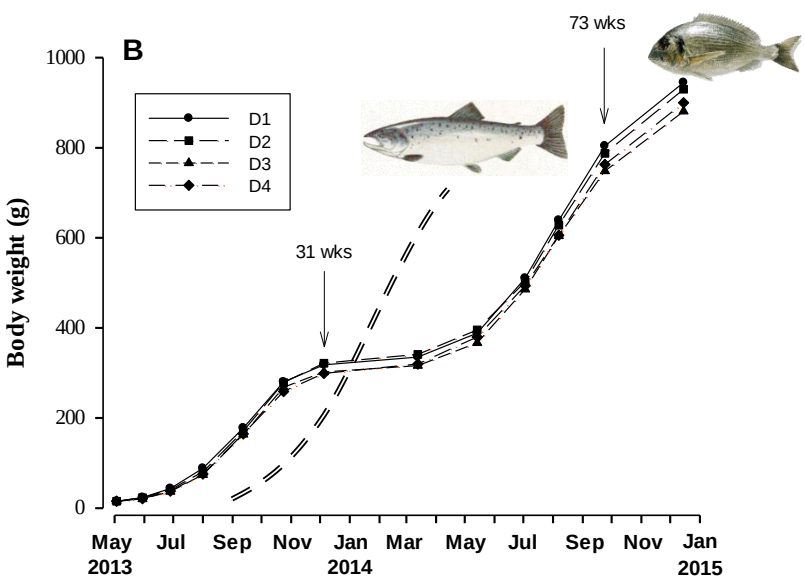
# GROWTH IMPLICATIONS ON FISH SAFETY

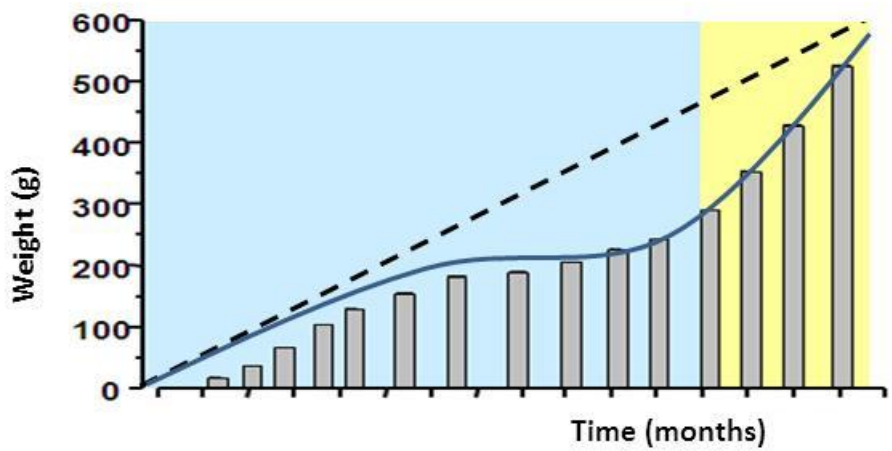



**Stationary growing**
**vs**
**non-stationary growing stages**




Gilthead sea bream growth _Nutrigroup IATS

**Risk dependent on fish species**




Atlantic Salmon

Gilthead sea bream

Nácher-Mestre, et al., Arch Environ Contam Toxicol (2010) 59:137-146

Recibidos (1) - nacher@u | EU Pesticides database -

ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=pesticide.residue.selection&language=EN

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EU Pesticides database

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PESTICIDES

- EU Pesticides database
  - Search active substances
  - Search products
  - **Search pesticide residues**
  - Download MRLs data
- Sustainable use of pesticides
- Approval of active substances
- Authorisation of Plant Protection Products
- Maximum Residue levels

« ALL TOPICS

# Search pesticide residues

## 1 Select pesticide residues (5 max)

Search: gly

| | Pesticide residues |
|---|---|
| F | |
| ☐ | Fluoroglycofene |
| G | |
| ☐ | Glyphosate |
| T | |
| ☐ | Trimethyl-sulfonium cation, resulting from the use of glyphosate (F) |

## 2 Select products

Search: soya

| Code | Groups and examples of individual products to which the MRLs apply (a) |
|---|---|
| ☐ 0251040 | Cresses and other sprouts and shoots |
| ☐ 0260010 | Beans (with pods) |
| ☐ 0260020 | Beans (without pods) |
| ☐ 0300010 | Beans |
| ☐ 0401070 | Soyabeans |

## 3 Select

- ◉ Current MRLs
- ○ MRLs evolution (max 1 pesticide)

4 Display

Pesticides selected

Products selected

All ×

PESTICIDES

- EU Pesticides database
  - Search active substances
  - Search products
  - Search pesticide residues
    - MRL evolution
  - Download MRLs data
- Sustainable use of pesticides
- Approval of active substances
- Authorisation of Plant Protection Products
- Maximum Residue levels

« ALL TOPICS

# Glyphosate

Newer | Historic of publications | Older

Export to Excel

Search:

Showing 1 to 1 of 1 entries 50 records per page

1

Pesticide residues and maximum residue levels (mg/kg)

| Code number | Groups and examples of individual products to which the MRLs apply (a) | Reg. (EU) No 293/2013 | Reg. (EU) No 441/2012 | Reg. (EC) No 839/2008 | Reg. (EC) No 149/2008 |
|---|---|---|---|---|---|
| 0401070 | Soyabeans | 20.0 | 20.0 | 20.0 | 20.0 |

Showing 1 to 1 of 1 entries

1

Table legend

Category | Group | Subgroup | Main product | Others | Clickable Footnotes | N/A Not published yet | * Indicates lower limit of analytical determination

# Current MRL values

t to Excel

Search:

5 of 5 entries 50 records per page

« ‹ 1 › »

Pesticide residues and maximum residue levels (mg/kg)

| Products to which MRLs apply (Part A of Annex I to Reg. 396/2005) | Azoxystrobin | Chlorpyrifos (F) | Chlorpyrifos-methyl (F) | Pirimiphos-methyl (F) | Boscalid (F) (R) (A) |
|---|---|---|---|---|---|
| Sunflower seeds | 0.5 | 0.05* | 0.05* | 0.5 | 1.0 |
| Rapeseeds/canola seeds | 0.5 | 0.05* | 0.05* | 0.5 | 1.0 |
| Soyabeans | 0.5 | 0.05* | 0.05* | 0.5 | 3.0 |
| Maize/corn | 0.02 | 0.05 | 3.0 | 0.5 | 0.15 |
| Wheat | 0.5 | 0.05* | 3.0 | 5.0 | 0.8 |