FACOLTÀ DI SCIENZE AGRARIE, ALIMENTARI E AMBIENTALI

UNIVERSITÀ CATTOLICA del Sacro Cuore

Programma di Sviluppo Rurale 2014-2020

Regione Emilia-Romagna

Biocontrollo

di *Aspergillus flavus* e gestione della filiera, un futuro per maiscoltura e "latte italiano di qualità"

Aflatossine e sicurezza alimentare: quali le maggiori criticità

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ISTITUTO SUPERIORE DI SANITÀ

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IL SALVAGENTE

SmaAuchan, ha risposto con lodevole prontezza. Dopo la nostra segnalazione, infatti, il Servizio qualità di Sma, ancora prima di procedere alla verifica, ha effettuato in via cautelativa il **ritiro** dei **prodotti** fuori norma da tutti i punti vendita della Penisola.

Sma ritira i pistacchi

La quantità di aflatossine pescata nei pistacchi è molto elevata. I **limiti normativi** in vigore in tutti i paesi Ue, per gli alimenti per consumo diretto, sono di 2 microgrammi/kg per l'aflatossina B1, la più pericolosa, e di 4 µg/kg per la somma di B1, B2, G1 e G2. La frutta secca di Montanaro, invece, di aflatossine ne contiene ben **24,81 µg/kg** e del tipo più aggressivo addirittura 16,6 µg/kg. Oltretutto non è la prima volta che l'azienda napoletana viene "sorpresa" da vicenda come l'ultima. C'è un precedente, infatti, che risale al **1997**, quando i pistacchi salati di Montanaro erano stati segnalati dalle auto-

Reyneri, ordinario della cattedra Coltivazioni alla facoltà di Agraria all'**Università** di **Torino**. E aggiunge: "In teoria potrebbero svilupparsi a che dopo il confezionament qualora fosse avvenuto in con zioni di umidità non adegua alla conservazione. Ma l'even è improbabile".

Da Catanzaro a Verona

La buona notizia è che l'indagin che ha coinvolto **12 città**, da Cata zaro a Verona, tra i prodotti contamin ti non ha pescato **né latte** né alimenti p la **prima infanzia**. Le **13 confezioni** risu tate **positive**, contengono farina di mais pe polenta, pistacchi, mais per pop corn, corn flakes, cioccolato, caffè e snack al mais: campioni sono stati **contaminati** da **fumonisine**, **3** da **aflatossine** e uno, il **caffè Splendid** aroma napoletano, da **ocratossina A**. In questo come in altri casi, la con-

Pasta con grano di importazione è sicura? Coldiretti contro aziende che lo usano

Ambiente & Veleni

L'anno scorso sono state acquistate all'estero 2,3 milioni di tonnellate di frumento. E secondo i coltivatori nazionali questo va a scapito della sicurezza alimentare. Anche perché in Italia i limiti alle sostanze contaminanti sono più alti che nella maggior parte del mondo: "In Canada quella materia prima non si usa neanche per gli animali". Gli industriali rispondono che il grano straniero, che ha più glutine, migliora la qualità della pasta

GINI NEL BRESCIANO

Brescia, latte contaminato per fare il formaggio: trenta indagati

Perquisizioni a tappeto dei Nas: cinque caseifici nel mirino, quattromila forme di grana sequestrate. Un indagato ha usato la scusa della mucca sentinella e corretto a mano i risultati. Un centro di raccolta cremonese ha riproposto la partita «tossica» in poche ore

Grano contaminato da aflatossine sequestrato a Bari

L'Agenzia internazionale per la ricerca sul cancro non lascia margine a grandi dubbi: nel 1993 ha classificato l'aflatossina di tipo B1 nel così detto «gruppo 1», vale a dire: «Agente cancerogeno per l'uomo». Genotossico, in altre parole. La troviamo nel mais: italiano, soprattutto, più «sensibile» rispetto a

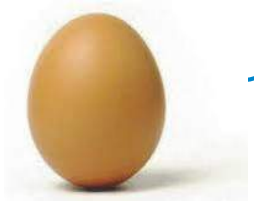
Main sources of contamination

CORN/MAIZE
SORGHUM
RICE

SUNFLOWER SEEDS
COTTON SEEDS

DRIED FIGS
PISTACHIO
GROUNDNUTS
CHESTNUT FLOUR

CHILLI
PEPPER



MILK and DERIVED PRODUCTS

EGGS

MEAT

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“Masked risk”

- Ingredients for preparation of icecreams (pistachio/almond/ hazelnuts/walnuts/Chocolate with chili)
- Meat-based products (mortadella) with pistachio
- Spreads/vegetable oils
- Snacks

Occurrence in processed foods

European Commission

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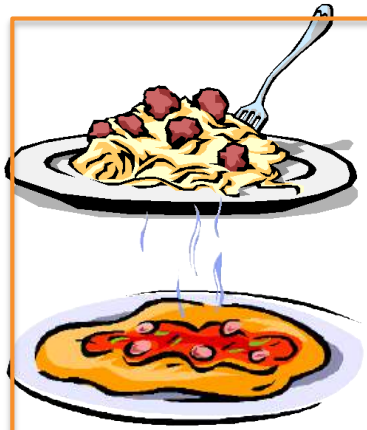

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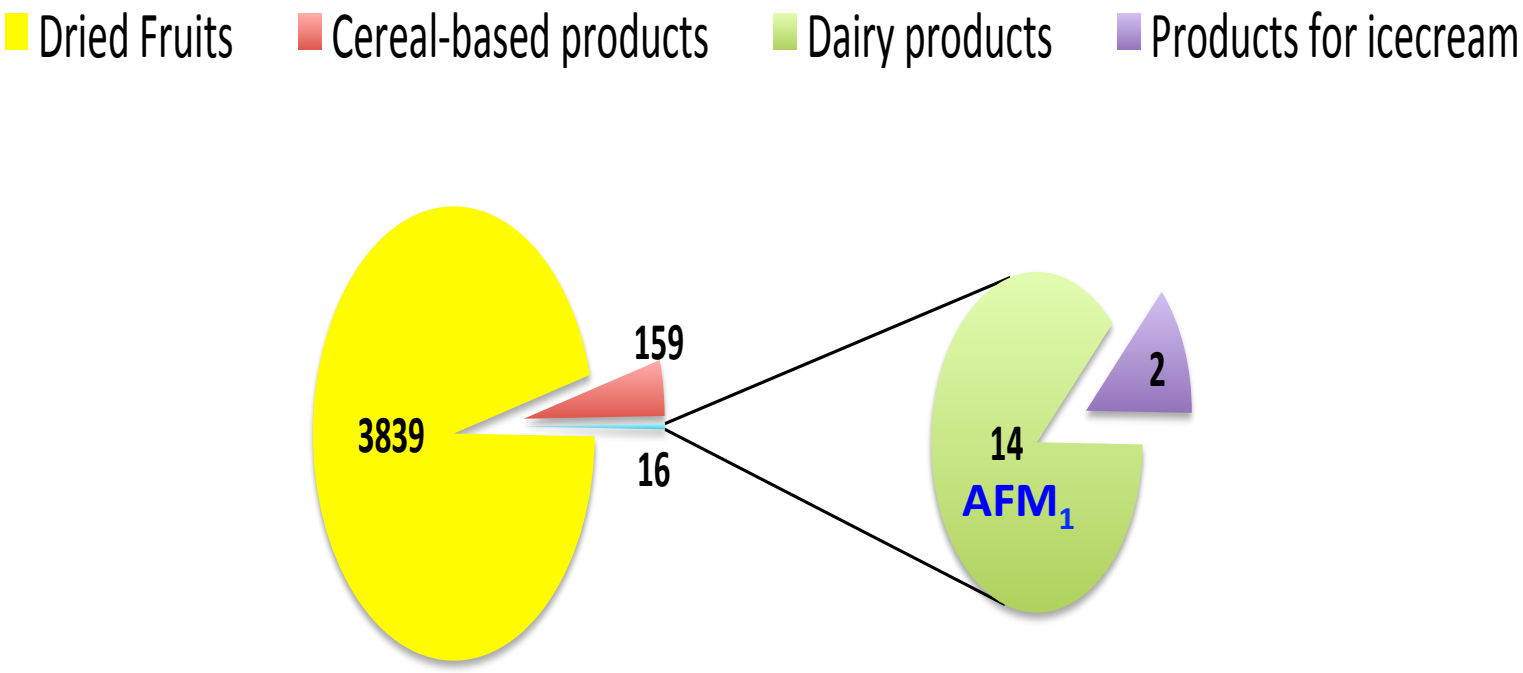
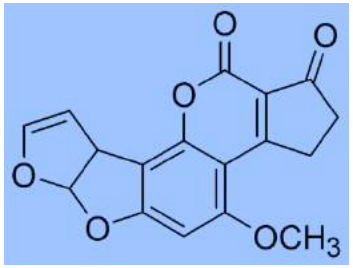
AFB1/AFM1-Number of RASFF Notifications (2007-2017)



Total Number = 4014

AFB1 – Toxicological issues



- Classified by IARC as in Group 1: evidence for carcinogenicity in humans
- Main approach to be implemented for reducing AFB1 presence in F/F: ALARA (As Low As Reasonable Achievable)
- In theory, no AFB1 should be present in foods
- In practice, the effort is to "tolerate" very few ng/kg bw/day (No HBGV quantified)

Aflatoxin B1 as genotoxic and carcinogenic compound

Genotoxic substances interact with DNA, directly or after metabolic transformation (direct-acting genotoxic chemicals), the absence of a threshold in their mechanism of action is generally assumed, i.e. there is no dose without a potential effect. **No level of aflatoxin exposure is considered safe for humans.**

Target organ: Liver

As carcinogenic substances, AFB1 exposure can induce the development of chronic pathologies such as cancer, as a result of DNA damages.

Vulnerable population groups

- Fetus
- Infants
- Toddlers

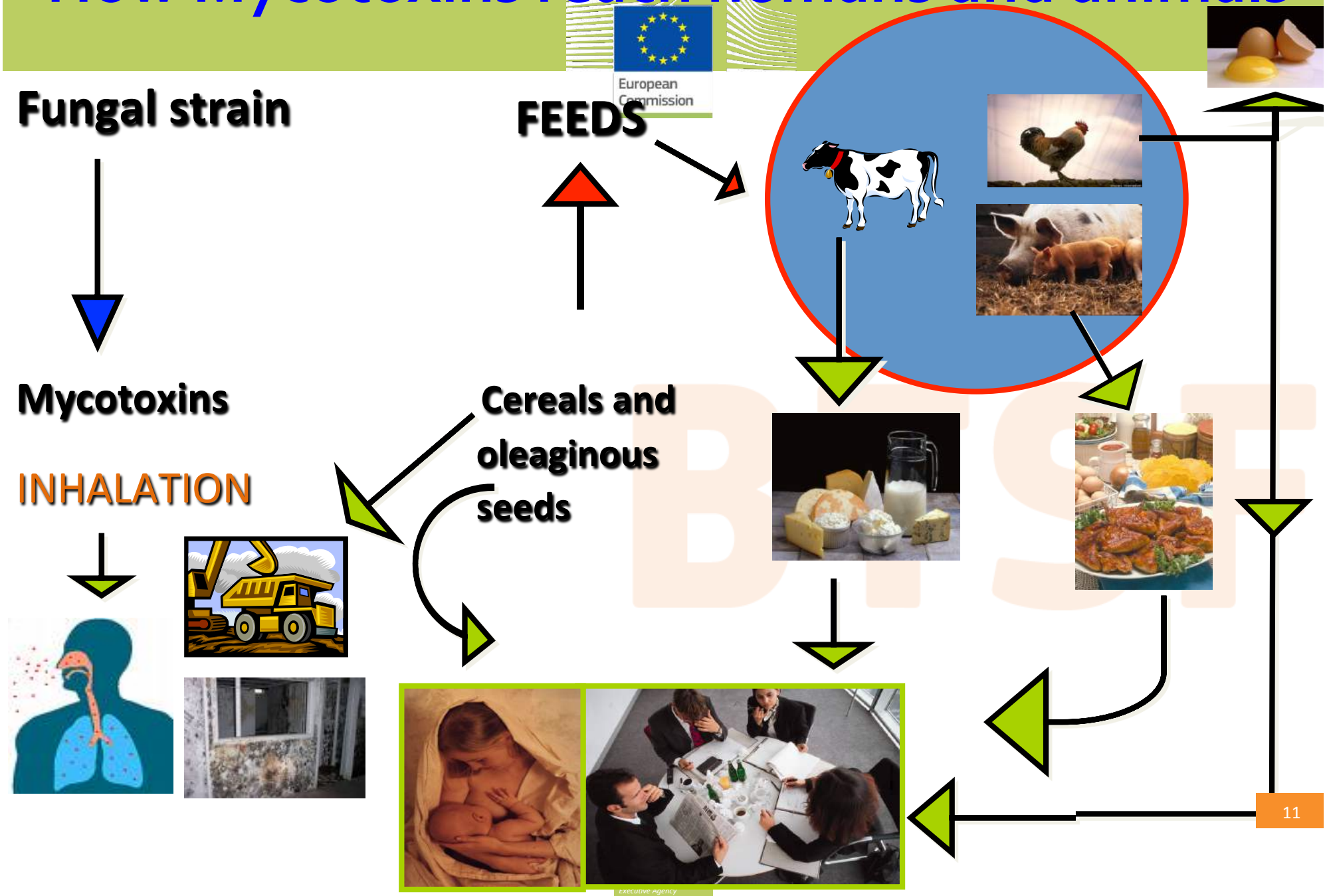
} ***Stunting, Growth failure***

- Children (focus on 3-10 years)
- Pregnant Women (Exposure for mother and fetus)
- Breastfeeding mother (Exposure for baby)
- Celiacs
- Workers (occupational risk)

Aflatoxins and "One Health" Approach

The goal of the One Health approach is to consider and improve the global health through a better understanding of complex relationships and dependencies between humans, animals, and the environment.

How Mycotoxins reach humans and animals



Aflatoxins and Environment

- Conditions favoring aflatoxin formation include:
  - High temperature
  - High humidity
  - Presence of external plant stressors:
    - **Periods of drought (In Italy 2003 – 2012)**
    - Insect infestation
- Soil conditions conducive to *Aspergillus* growth
  - High organic content
  - High moisture

Climate change

In a recent publication, it was depicted a scenario correlating the global warming of planet (+2°C and +5°C) with aflatoxin production in maize.
As far as our country, a slight increase of the risk is expected while this climatic change could lead to **an emerging risk** in Northern and Eastern Europe countries

Toxic effects on Humans

Mainly ***chronic*** effects (Liver Cancer (HBV↑) and serious impairment of immune system)

Acute aflatoxicosis can be **fatal** (especially in developing countries)

Presenting symptoms are determined by amount of toxin consumed.

Clinical symptoms in humans include:

- Abdominal pain
- Vomiting
- Pulmonary edema
- Liver necrosis

Toxic effects on vulnerable animal species

- In all species, there is the evidence of acute and chronic liver disease together with a general reduction in weight gains, feed efficiency, immune response and production.
- Turkeys, ducklings, dogs, trouts, poultry, pigs, sheeps, ruminants are sensitive to aflatoxins in decrescent order
- Animal deaths and reduced productivity from aflatoxin exposure can have significant negative 'economic' impact in addition to the negative health outcomes for those who consume contaminated animal products

AFM_1 toxicity

AFM_1 is the main (faster) metabolite of AFB_1. For a milk production of 20 and 46 kg/die, the excretion of AFM1 in milk is around 2 and 5,7%, respectively (high individual variability, 3% on average)

IARC concluded that there is sufficient evidence that aflatoxin M1 is a genotoxic carcinogen; its carcinogenic potency is 10-times lower than AFB1. AFM1: (Group 2B)

AFM1 is predominantly associated with casein, so that dairy products from curd contain a higher concentration than whey.

Studies showed that AFM1 concentration is about 3 fold higher in many soft cheeses and about 5 fold higher in hard cheeses than in milk. Cheese ripening and proteolysis of casein increases the recovery of AFM1 from naturally-contaminated milk;
(Prandini, 2002)

AFM1 Conversion factors from milk to dairy products*

Product	Conversion factor
Raw Milk	1 (0,05 ug/kg)
Grana-like	5,5 (0,275 ug/kg)
Soft cheese (e.g. ricotta)	3 (0,150 ug/kg)

* **Recommended** by the Italian Committee of Food Safety of the Italian Ministry of Health (2013)

- Critical point: semi-hard cheese?

Risk assessment issues

- The legal limit for AFM1 (0.05 µg/kg) reflects the daily dose able to provoke a risk of 1 case of cancer over 1 million of humans (1: 10^6). The PMTDI (Provisional Maximum Tolerable Daily Intake) was set at 0.2 ng/kg body weight (corresponding to 1-14 ng/individual)
- From official consumption data of milk, the tolerable AFM1 concentration in milk should be:
- 14 (ng AFM1/individual) / 0.5 (L latte/individual) = 28 ng/kg (=0.03 µg/kg). **But the daily contribution deriving from all the other sources must be considered.**
- What about a child of 10kg?

Operative conditions in the herd

- With the aim to produce milk with AFM1 < 50 ng/kg (legal limit) the daily average FEED AFB1 intake per animal should be < 40 µg/animal/day
- **AFM1 (ng/kg in milk) = 1,19 x AFB1 (µg/animal/die) + 1,9**
- By considering an average feed consumption of 12 kg/dm/day per milk-producing bovine: max AFB1 content in the **FEED** = 3.3 µg/kg (ppb), (5 µg/kg is the legal limit)
- **BUT WHAT ARE THE NUMBERS for CORN? (Max Legal limit is 20 µg/kg)**

2 kg of corn out of 12 kg of feed?

Challenging points in AFB_1/AFM_1 control

- Reliability of sampling plans (heterogeneity) *(Considering the dairy food chain AFB1 in corn and AFM1 in cheese)*
- Possible "dilution" effect in tank milk
- Lack at European level of **specific** ML for AFM_1 in dairy products (Cheese and homologues) (in Italy recommended levels have been set)
- Control on foods at import
- Real presence of AFB_1 in main ingredients in feeds (maize, cottonseed, peanut meal)

Sampling procedure used in Lombardy

Number of forms	Number of forms from which take one incremental samples
< 50 forms	1
51 – 200 forms	2
> 200 forms	3
N= Number of forms produced in a day	$\sqrt{N}$

Conclusions

First goal: Consumer health and well-ness of animals must be preserved.

EFSA opinion concluded that the exposure to aflatoxins deriving from all the possible sources (dietary, occupational, housing), should be kept as low as possible, due to their genotoxicity and carcinogenicity.

Available data show that this goal is reachable if, due to a proper (efficient and effective) endorsement and enforcement of existing food law, the number of marketed food products contaminated by aflatoxins is reduced

More specifically…..

Aflatoxin issue is strictly related to the food chain, from corn to dairy products.

Critical points:

systematic monitoring of feeds,

control of milk at level of individual supplier, monitoring of cheese-derived products,

need for setting legal limits in dairy products (*conversion factors*),

need to set and harmonise sampling (for cheese) and analysis methods (fast and reliable)

GAPs and GSPs

- Pre-harvest
  - Pest management for insects (particularly soil insects), weeds, and nematodes
  - Proper sowing date
  - Proper Irrigation
  - Crop rotation or fertilization
  - Use of drought tolerant and locally adapted varieties (if possible)

- Harvest
  - For maize, harvest early to prevent completion of the *Aspergillus* life cycle (depending on the climate conditions)
- Post-harvest
  - Proper drying in storage sites (Aw, T, Moisture)

Possible preventive actions:

- ***Biocontrol***
- ***Proper suppliers selection at primary production level***
- ***Proper use of GAPs***
- ***Proper implementation of HACCP approach***
- ***Proper use of sampling procedures in the implementation of own-check and OC activity***

Post-Exposure Management and Prevention of Disease

- Dietary interventions
  - Multivariate diets **(FOOD sector)**
  - Addition of compounds that decrease aflatoxin absorption (bentonite, clays, fermenting agents**) (FEED sector)**
- Hepatitis B vaccination
  - Hepatitis B and aflatoxin exposure are co-factors able to increase the probability of risk of liver cancer
  - Vaccination against Hepatitis B reduces liver cancer rates by 45-50%

Prevention: Economic Challenges

- Cost is a major challenge since many areas where aflatoxin contaminated crops are staples, lack financial resources
- Stakeholders who benefit are not necessarily those who bear the costs
  - Growers: carry the cost burden of many interventions
  - Consumers: benefit most from interventions
  - Government: mediate between growers and consumers, by regulation or funding of interventions, to improve public health

A One Health approach will try to balance the needs of the growers to make a sustainable living with protecting consumers from aflatoxin contamination by managing environment.

Thanks for attention

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