Other aspects of the use of humic substances in livestock

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The group of Animal Nutrition

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Expertise

- impact of **different types of feed additives** on animal health and performance
- prevention and treatment of **diarrhoea in weaned piglets** caused by enterotoxigenic *Escherichia coli*

Services and consulting services

- **serum biochemical profiles** (Mindray BS200 biochemical analyser)
- determination of essential **nutrients in feed** (AOAC method)
- **experiments using experimental animals** and collection of samples (blood, organs, tissue, feces)

Research project

The use of humic substances as a feed additive for the prevention of diarrhoeal diseases of piglets and improvement of pig performance 2012 – 2016

<u>The aim of the project</u>

- effects and safety of **humates with trace elements** in **prophylaxis of diarrhoea** and growth efficiency improvement in pigs
- **technological parameters** suitable for their production from natural raw materials

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Effect of humic substances on lipid and fatty acid profile

HS in diet of animals:

- decrease serum **cholesterol** (Samudovska and Demeterova 2010; Mista et al. 2012; Ozturk et al. 2012)
- affect unsaturated (U), saturated (S) **FA** and

  UFA:SFA ratio in meat (Wang et al. 2008)
- redistribution of lipids:

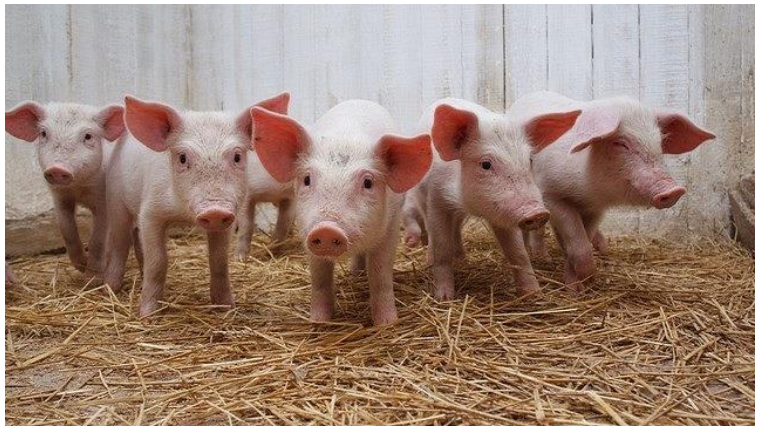
reduce backfat thickness (Wang et al. 2008)

improve **marbling** of meat (Wang et al. 2008)





Effect of HS on lipid and FA profile in weaned piglets



C.....basal diet

ZnO2.5..... basal diet + 2.5 g ZnO/kg

ZnO1.7+HNa(f)...basal diet + 1.7 g ZnO + **20.0 g HNa/kg**

ZnO1.7+HNa(w)..basal diet + 1.7 g ZnO/kg and drinking **water with 0.2% HNa**

Conclusions

- **Cholesterol, HDL and LDL were not affected** by HNa supplementation
- Partial replacement of ZnO by HNa in feed provided significantly **lower serum TGC, lower total amount of FA** in serum in comparison with ZnO2.5
- Partial replacements of ZnO by HNa - **positive effect on PUFA n6/n3** ratio in serum in comparison with ZnO2.5

Mycotoxins (MT)

structurally diverse secondary fungal metabolites

> 300: deoxynivalenol, zearalenon, fumonisins, T-2 toxin, ochratoxin A, aflatoxin (B1)

2015: 84% from 8271 of agricultural commodities contaminated with MT

	Afla	ZEN	DON	T-2	FUM	OTA
EUROPE	**11%**	**64%**	**77%**	**42%**	**54%**	**26%**

corn, dried distillers grain

(Mycotoxin report, Biomin, 2015)

Mould and MT hazard in the feed chain

Aspergillus, Penicillium, Fusarium...

- **mould growth-alterations in the nutritional content**

- **production of MT**

- ↓feed intake, ↓weight gain, carcinogenic, mutagenic, teratogenic, oestrogenic, immunotoxic, hepatotoxic, nephrotoxic, neurotoxic, reprotoxic...

- presence in tissues - OTA (kidney, liver), milk-AFM1
- synergistic effect, subclinical effect
- **masked/bound mycotoxins**!

Legislative regulations

- DIRECTIVE 2002/32/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on undesirable substances in animal feed (**aflatoxin B1**)

maximum content in mg/kg

- COMMISSION RECOMMENDATION on the presence of **deoxynivalenol, zearalenone, ochratoxin A, T-2 and HT-2 and fumonisins** in products intended for animal feeding (2006/576/EC)

guidance value in mg/kg

Strategies for detoxification/inactivation of MT

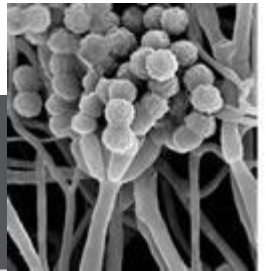
1. prevention of fungal infection
2. nutritional feed aditives
3. physical, chemical, biological methods for

reduction of the contamination by MT

➢ **BIOTRANSFORMATION, BIODEGRADATION** of MT microorganisms and their enzymes (*Eubacterium* spp., *Trichosporon* spp., *Nocardia* spp., *Flavobacterium aurantiacum*)

➢ **ADSORBTION** - high affinity to MT, ↓dissociation, high binding capacity

multi-binding capacity, mix of adsorbents +++



NON-NUTRITIVE ADSORBTIVE MATERIALS

INORGANIC: bentonites, montmorillonites, zeolites, modified clays...

BUT

- *adsorbtion of trace elements*
- *aflatoxins +++, other MT – limited*
- *contaminants*

ORGANIC: activated charcoal, syntetic polymers, **humic substances,** esterified glucomannan (cell wall of yeast), yeast, lactic acid bacteria, dietary fibres

- *efficient against a larger range of MT*
- *biodegradable, (immunostimulants)*

PROMISING – FURTHER RESEARCH IS NEEDED!

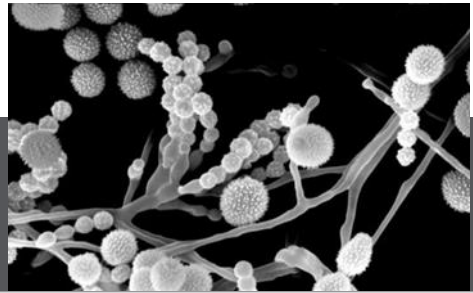
Regulation (EC) No 1831/2003 on additives for use in animal nutrition

Technological additives

Substances for the reduction of the contamination of feed by

- **deoxynivalenol** - strain DSM 11798 of the *Coriobacteriaceae* family (pigs)
- **fumonisins** - fumonisin esterase produced by *Komagataella pastoris* (pigs)
- **aflatoxin B1, fumonisins** - bentonite

(ruminants, poultry, pigs)



Humic substances-natural complexing compounds

- **reactive groups**-hydroxyl, phenol, carboxyl, methoxy...
- large specific **surface**, hydrophilic, flexible
- strong **adsorbtion** (microbial toxins, haevy metals, mutagens) ion exchange, chelation, **complexation** activity
- high **mycotoxin adsorbtion** capacity-reduction of its bioavailability (zearalenon, aflatoxins)

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Humic substances in prevention of mycotoxicosis in animals

GOOD ADSORBTION

- **oxihumate, humate - AF B1 - broilers** (van Rensburg et al., 2006; Ghari et al., 2010)
- **sodium humate - AF B1 - *in vitro*** (Ye et al., 2009)
- **natural humic acid polymers - ZEN *in vitro*** (Sabater-Vilar et al., 2007; de Mil et al., 2015)
- **humic acid polymers - ZEN, OTA - adsorbtion at pH 3, desorbtion at pH 8.4** (Santos et al., 2011)

INEFFICIENT ADSORBTION

- **DON** (Sabater-Vilar et al., 2007; Dänicke et al., 2012)

Humic substances as MT binders in animal diet

- ↑**albumin** and **total protein** levels
- ↓ **enzyme activities** (AST, LDH, GGT)

in serum

- reduction of the immunotoxic effect of MT
- protective effect on the **liver** and **bursa of Fabricius**
- **not adsorb other nutrients**
- **antioxidants, growth promoter, antimicrobial effect, improvement of gut health**

Study of the effects of MT binders

- ***IN VITRO studies* - pre-screening**

Adsorbent binding capacity - adsorbtion isotherms

Effect of

✓ pH (3-8), time

✓ amount of adsorbent, MT

✓ feed (adsorbtion of nutrient and MT)

toxic effect of binders

gastrointestinal models

Desorbtion at different pH

- ***IN VIVO studies* - effectiveness in animals**

NEW RESEARCH PROJECT COLLABORATION...

???

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