Effects of high Fumonisin B_1–concentrations in maize on performance and health condition of fattening pigs

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Introduction:
Fusarium verticillioides occurs almost everywhere that maize is grown, supported by high temperatures, drought and heavy insect damage. An estimated 59% of the maize crop wordwide is contaminated with fumonisins and Fumonisin B_1 (FB_1) is the most toxic one. Various diseases caused by fumonisins have been reported in animals, such as liver and kidney cancer in rodents, leukoencephalomalacia in equines, pulmonary oedema in pigs.

Problems:

1. The effects of high Fumonisin B_1–concentrations (43 ppm FB_1) applicated for the duration of 6 weeks on fattening results and condition of feeding pigs.
2. Efficiency of a surface modified, 3-layered-phyllosilicate (FIXAT®, Süd-Chemie AG) for compensation of the effects resulted by the FB_1.

Results:
The experimental diet was artificially contaminated with FB_1, resulting from the inoculation of maize with *Fusarium verticillioides* spores under laboratory conditions.
1. Effects: The high FB_1-concentrations caused significant reduced weight gain in the T-1 group by 12-19% (c. 4-6 kg reduced average weight gain). This negative effect could totally be neutralized by the application of FIXAT® (groups T-3, T-4). Simultaneously the feed conversion improved.
Starting with sporadic diarrhoea immediately after feeding the contaminated diet, 75% of the pigs of the T-1 group presented at the end of the trial accesses of intermittent diarrhoea and increased respiratory and cardiac frequency. This correlated with distinctly increased concentrations of coliformes microorganisms in the duodenal content, as an depressing effect on the immunologycal system caused by FB_1.
The biochemical analysis of the liver resulted in significant increase of the urea- and creatinine-concentrations (Tab. 1), as an indication for a beginning renal insufficiency. A statistically assured increase in the hepatic enzyme activity of AST and ALT emphasized an acute hepatitis. The histopatological damages of lung and heart by FB_1 were much more radical than of liver and kidneys. The pigs of T-1 group suffered from induration and capillary bleeding of the lung and concerning the heart from hydropericadium and cardiomegaly. The noticeable increased relation of sphynganine:sphyngosine (Tab. 2) in the urine of T-1 group, used as a diagnostic biomarker for fumonisin exposure, showed an inhibition of the enzyme ceramid synthetase.
2. Efficiency of the adsorber: By feeding the mycotoxin-adsorber FIXAT® (T-3, T-4) all analysed parameters remained nearly constant on the level of the control group (T-2), depending on the application-rate. Therefore a renal and hepatic protective effect against high FB_1-concentrations could be proved. In the same way histopatological damages of lung and heart could totally be prevented by the adsorber.

Table 1: Biochemical renal and hepatic profile

	T-1	T-2	T-3	T-4
mg/100 ml	Contaminated FB_1 (43 ppm)	Control, without FB_1	**FIXAT®** 2kg/to +FB_1 (43 ppm)	**FIXAT®** 4kg/to +FB_1 (43 ppm)
Urea	$58,5^a$	$32,5^b$	$37,0^b$	$33,0^b$
Creatinine	$1,7^a$	0,8	0,9	$0,7^b$
AST[1)]	216^a	145^b	160^b	139^b
ALT[2)]	132^a	85^b	101^b	98^b

[a) b)] means differ, P<0,05 , n=8 [1)]Aspartat-amino-transferase [2)]Alaninaminotransferase

Table 2: Relation sphynganine:sphyngosine

Reference value <1,0	1,9	0,12	0,5	0,2