Deoxynivalenol (DON)

1. Material Properties

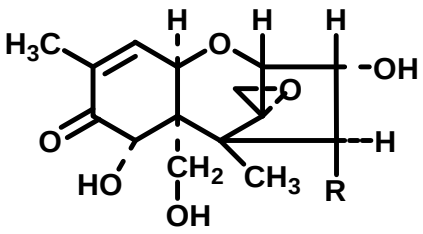
Deoxynivalenol (DON) is a trichothecene mycotoxin mainly produced by *Fusarium* fungi (*Fusarium* molds). Major producing fungi include *Fusarium* species *F.graminearum* and *F.culmorum*, one of plant pathogens that cause scab mainly in wheat and barley etc., and damages cereals the most widely by contamination in the field.

Trichothecene mycotoxins are classified into three groups by structural characteristics, and deoxynivalenol is classified into Group B.

[Trichothecenes]

Group A: T-2 toxin and HT-2 toxin
Group B: Deoxynivalenol, 3- and15-acetyldeoxynivalenol,
Nivalenol and Fusarenon-X
Group C: Roridin A and Verrucarin A

Generic name: Deoxynivalenol
Molecular weight: 296.13
Molecular formula: $C_{15}H_{20}O_6$



Chemical Structure

2. Toxicity

2.1 Poisoning symptoms

It is a potent central emetic, to which pigs are very sensitive, sheep and cattle are quite resistant, and horses much less so. The toxin may be associated with acute diarrhea, dysentery, ataxia, mucosal hemorrhages, and sudden death. Reduction in feed intake and vomiting appear at the lowest concentration. Moreover, blood disorders such as aleukia (ATA) and aplastic anemia are also observed in addition to gastroenteritis and dermatitis. Also, enhancement or reduction in immune function is observed depending on intake.

2.2 Mechanism of action

Trichothecene mycotoxins act on serotonin-mediated neurons and induce anorexia and vomiting. In addition, they inhibit the protein synthesis system by binding to the ribosomal 60S subunit, and the effect appears notably in the bone marrow, mucosal epithelia of the digestive tract, and skin, that are regions of active cell division. Moreover, they induce apoptosis in cells in the immune system, and stimulate the production of inflammatory cytokines.

2.3 Diagnosis

See the page of fundamentals of diagnosis of poisoning in Livestock Poisoning Diagnostic Manual Online Version.

3. Contamination in feeds

Deoxynivalenol contamination in maize and wheat and barley, etc. is a worldwide problem.

Major feed materials that require attention due to contamination frequency and detected concentrations include: maize, wheat, barley, rye, milo, corn gluten feed, corn gluten meal, corn DDGS, screening pellets, bran, and barley bran.

4. Analysis methods

See http://www.famic.go.jp/ffis/oie/obj/m10-deoxynivalenol.pdf

5. Regulatory situation

[Feeds]

Japan:

Feeds to be supplied to livestock, etc. (except cattle of 3 months or older)	1 ppm
Feeds to be supplied to cattle of 3 months or older	4 ppm

<Overseas>

United States:

Final wheat products	5.0-10.0 ppm

[Foods]

Japan:

Provisional standard value for wheat	1.1 ppm

<Overseas>

United States:

Final wheat products	1.0 ppm

< Risk assessment by JECFA>

Provisional tolerable daily intake (PTDI) ＝ 1 μg/kg bw/day (2001)

6. Monitoring test results etc. in Japan

See http://www.famic.go.jp/ffis/oie/sub2_h21_gaiyou_e.html or
http://www.famic.go.jp/ffis/feed/obj/H21FAMIC_monitoring_e.pdf.

7. Measures for feed contamination prevention

It is difficult to remove deoxynivalenol once it is produced, and it is highly heat-stable and its toxicity is not reduced by ordinary procedures of processing and cooking; contamination prevention measures at the stage of agricultural production are important.

The Ministry of Agriculture, Forestry and Fishery, Japan, have edited and released the "Guidelines for the reduction of contamination with deoxynivalenol and nivalenol in wheat and barley, etc." dated on December 17, 2008, on the following contents as measures that can actually be conducted in the production site by farmers and relevant organizations, etc.: ① Appropriate prevention by agrichemicals during the growth stage, ② harvesting at a suitable stage, ③separated reaping of crops with suspected contamination, ④ appropriate disposal of remains of previous crops, etc., ⑤ immediate drying of products, ⑥ selection by grain thickness and specific gravity, and ⑦ checking on the contamination level by shipping lot.

In addition, the CODEX alimentations "Code of practice for the prevention and reduction of Mycotoxin contamination in cereals, including annexes on Ochratoxin A, Zearalenone, Fumonisins and Tricothecens" have been released and efforts by GAP(Good Agricultural Practices), GMP(Good Manufacturing Practices), HACCP(Hazard Analysis Critical Control Point) , etc. are recommended.

The only effective method of preventing losses due to deoxynivalenol is to dilute affected corn with uncontaminated feed. Mixing the feed with bentonite, sweeteners, or sodium-calcium aluminosilicate is ineffective as a detoxification method, but rinsing and removing floating material is recommended.

8. Effects on foods (livestock products) and humans

No correlation to the milk production was observed when cows were fed with maize silage containing 0.4-4.6 ppm deoxynivalenol (Research Bulletin of the National Agricultural Research Center for Hokkaido Region, 2006).

Transference of deoxynivalenol to cow milk and chicken eggs is not observed or very low if any. Acute health effects in humans are usually caused via the intake of contaminated cereals, and include vomiting, anorexia and diarrhea. In humans, deoxynivalenol is detected in urine in correlation with wheat intake (Turner PC, et al., Biomarkers 2010). It has been reported that deoxynivalenol causes DNA damages and damaged protein synthesis in human hepatocytes (HepG2), etc.

9. Reference

・Konyishi, R. and Sugiyama, K. (2008) World trend of risk assessment for Mycotoxin. J Food Hyg. Safety Sci., 49, 1-10.

・FAMIC and The study group working on Feed Analytical Standard (2009) . Feed Analytical Standard・Explanation, pp165-177.

・Japanese Society for Food Hygiene and Safety(2009) Food Safety Dictionary, pp249-251.
・National Institute of Animal Health.(2010) Diagnosis of poisoning in Livestock Poisoning Diagnostic Manual Online Version.
http://ss.niah.affrc.go.jp/disease/poisoning/manual/trichothecene.html (Accessed 15 June 2010)
・Ministry of Agriculture, Forestry and Fisheries. Risk profile for Deoxynivalenol.
http://www.maff.go.jp/j/study/risk_kanri/h20_2/pdf/ref_data3.pdf (Accessed 15 June 2010)

・Ministry of Agriculture, Forestry and Fisheries. (2008) Guideline for countermeasures against Deoxynivalenol/Nivalenol of wheats.
http://www.maff.go.jp/j/press/syouan/nouan/pdf/081217-01.pdf (Accessed 15 June 2010)

・CODEX alimentarius. (2003) Code of practice for the prevention and reduction of Mycotoxin contamination in cereals, including annexes on Ochratoxin A, Zearalenone, Fumonisins and Tricothecenes.