Aflatoxin

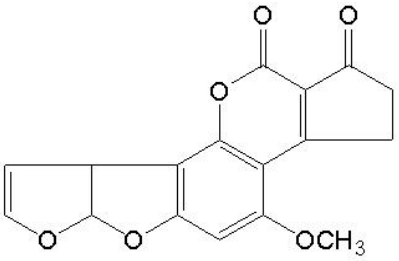
1. Material Properties

Aflatoxin is a kind of mycotoxin that was discovered from the mass poisoning of turkeys in UK in 1960, and has strong carcinogenicity.

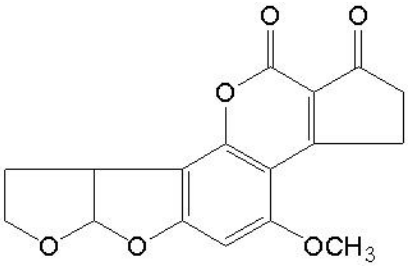
The typical mold that produces this aflatoxin is *Aspergillus flavus* which is related to *Aspergillus oryzae*. This producer widely distributed in the tropical and subtropical areas, such as Southeast Asia, the US, and Brazil among others, and grows in feed, especially in peanut and cottonseed, causing aflatoxin contamination.

Ten-odd isomers of aflatoxin have been discovered. However, most of those detected in feed contaminated with molds are B_1, B_2, G_1 and G_2. M_1 is a substance that is detected in the milk of cows which have taken feed contaminated with B_1. Codex designates M_1 allowance in milk as 0.5 ppb.

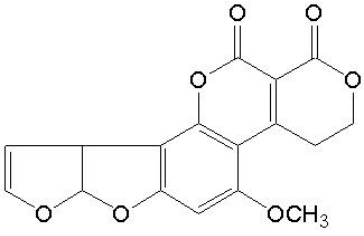
As for physicochemical properties, aflatoxin is a highly fluorescent substance, and B_1, B_2, M_1 and M_2 emit blue fluorescence, while G_1 and G_2 emit green fluorescence.



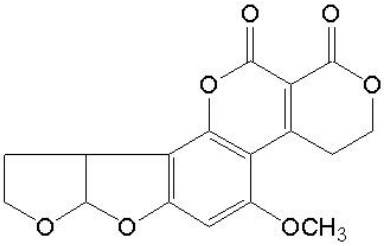
- Generic name: Aflatoxin B_1
- Molecular weight: 312.06
- Molecular formula: $C_{17}H_{12}O_6$



- Generic name: Aflatoxin B_2
- Molecular weight: 312.06
- Molecular formula: $C_{17}H_{14}O_6$



- Generic name: Aflatoxin G_1
- Molecular weight: 328.06
- Molecular formula: $C_{17}H_{12}O_7$



- Generic name: Aflatoxin G_2
- Molecular weight: 330.07
- Molecular formula: $C_{17}H_{14}O_7$

2. Toxicity

2.1 Symptoms of toxicosis for livestock

In acute toxicosis, hepatic presentations such as jaundice and cirrhosis are characteristic in aflatoxins. Hepatic disorders manifest also in secondary signs such as loss of appetite, reduced growth rate, etc.

Many also reported of hemorrhagic diarrhea.

In lactating cows, reduced lactation is also observed. In pathologic histology studies, fibrosis around the portal vein, proliferation of bile ductless is characteristic signs.

Though permissible concentration in combined feed products is 20 ppb; in lactating cows and more sensitive young and weak animals, the permissible concentration in combined feed products (for suckling carves, suckling pigs and first stage broiler chicks) is 10 ppb.

2.2 Mechanism

Epoxidation by cytochrome P450, aflatoxins then bind to DNA and/or proteins and impair their functions. Though some reported of impact in the rumen micro flora, others reported of no impact on digestive rate. Aflatoxins' toxicity also includes immunosuppressant. Disorders of peripheral lymphocyte functions in cattle have been reported.

2.3 Diagnosis

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

3. Contamination of feed

In 1960, a mass death accident in turkey caused by aflatoxin-contaminated import peanut had been happened in the UK. This is the first case of poisoning caused by contaminated feed.

Aflatoxins have been reported in most countries and on many spoiled feeds, especially harvested peanuts, peanuts-in-shells on hay, cottonseed meal, sorghum grain, corn, moldy bread, green chop sorghum, or rarely on a standing crop, e.g. ears of sweet corn.

4. Analytical method

See http://www.famic.go.jp/ffis/oie/sub3/sub3_mycotoxin.html.

5. **Regulation status** (at present march, 2011)

【Feed】

Japan:

Formula feed, suckling calf, dairy cattle, piglet, starting chick, starting period broiler	0.01mg／kg
Formula feed, cattle other than above, swine, chicken, and quail	0.02mg／kg
Peanuts oil meal	1mg／kg

< Overseas >

United States:

Corn for beef cattle (finish time), products derived from peanuts	300μg／kg
Cottonseed oil meal for beef cattle, swine and chicken	300μg／kg
Corn for swine (finish time), products derived from peanuts	100μg／kg
Corn for breeding cattle, swine and adult chicken, products derived from peanuts	100μg／kg
Corn for growing dairy animals, products derived from peanuts and others (except cottonseed oil meal)	20μg／kg
For all dairy animal products other than those described below	20μg／kg

EU:

For cattle, sheep and goat (except dairy animals, calf and lamb)	20μg／kg
For dairy animals	5μg／kg
For calf and lamb	10μg／kg
For swine and chicken (except piglet and poulet)	20μg／kg
Livestock other than those described above	10μg／kg

【Food】

Japan:

All food: Aflatoxin must not be detected.

(Aflatoxin B_1, detection limit 10μg／kg)

Overseas:

Codex:	Milk	0.5 μg／kg (Aflatoxin M_1)
Codex:	Peanut	15μg／kg (Aflatoxin $B_1+B_2+G_1+G_2$)
US :	All food	20μg／kg (Aflatoxin $B_1+B_2+G_1+G_2$)
EU :	Processed cereal	2μg／kg (Aflatoxin $B_1+B_2+G_1+G_2$)

: Unprocessed cereal　2μg／kg　(Aflatoxin B_1＋B_2＋G_1＋G_2)
: Processed peanut　8μg／kg　(Aflatoxin B_1＋B_2＋G_1＋G_2)
: Nuts and dried fruit　5μg／kg　(Aflatoxin B_1＋B_2＋G_1＋G_2)
: Spice (red pepper, pepper, etc.)　5μg／kg　(Aflatoxin B_1＋B_2＋G_1＋G_2)

6. Monitoring inspection results 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

Several studies about the treatment for the degradation of aflatoxins are reported. Among these treatment methods, the use of ultraviolet radiation, heat, oxidizing agents such as hydrogen peroxide, sodium hypochloride, or exposure to alkaline substances like ammonia, sodium bisulfate and sulfur dioxide gas can be given as examples. Among these agents, the use of ammonia was commercially applied in detoxifying cotton seed and corn in the US. However, toxic residues and objectionable changes in the sensory and nutritional quality of decontaminated materials have occurred. The effects of aflatoxin degradation techniques are still investigated and there is need for new toxicological data on the substances that are formed as a result of the degradation treatment

8. Influences on food (livestock) and on human

Because the toxin is excreted in cow's milk, the disease has public health importance. Because the healthy damage to the human is concerned about through milk and dairy products, the prevention of the healthy damage is planned by regulation for M_1 in the aflatoxin and milk of feed. Aflatoxin is now an important consideration in the etiology of human hepatocellular carcinoma. Aflatoxin M_1, a metabolite of aflatoxin B_1, is found in the milk of dairy cattle that have ingested moldy feed. If a mammal such as a dairy cow consumes aflatoxin B_1 in the diet, about 1-3% amount of B_1 that is consumed will appear in milk as aflatoxin M_1. Aflatoxin M_1 is stable in raw milk and processed milk products and is unaffected by pasteurization or processing into cheese and yogurt. The ability of this toxin to induce tumors in experimental animals and the relatively large consumption of milk by children has made in a food contaminant of worldwide concern. There is a report that an outbreak of acute toxicosis in human and dog caused by an intake of the afltoxin-contaminated corn was happened in Kenya and India.

On the other hand, meat from animals that have consumed aflatoxin-contaminated

feed is of lesser significance. The ratio of aflatoxin B_1 in the dairy to aflatoxin M_1 found in milk is found to be approximately 75:1. The ratio of aflatoxin concentration in feed to that in eggs and the livers of certain animals were determinate to be higher.

10. Reference

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