

Contamination of corn by aflatoxins in Kazakhstan

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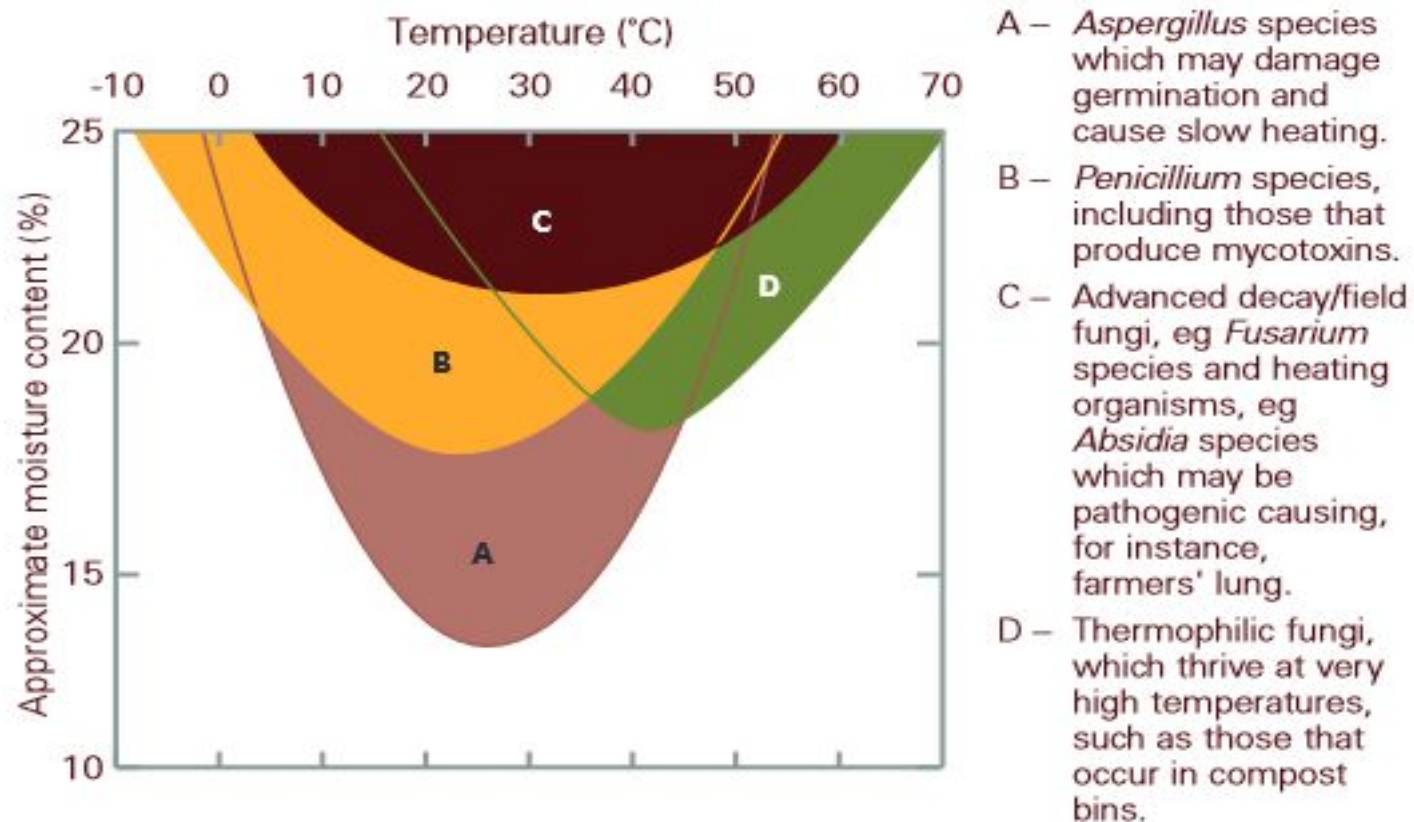
Legislation

- Codex of the Republic of Kazakhstan “On people's health and the health care system”
- Law on Food Safety
- Law on technical regulation
- Law on veterinary
- Law on Consumer Protection
- Technical regulations national and Customs Union

What are Aflatoxins?

Toxins produced by the fungi *Aspergillus flavus* and *Aspergillus parasiticus*

Different types of fungi thrive at different moisture contents and temperatures in stored grain

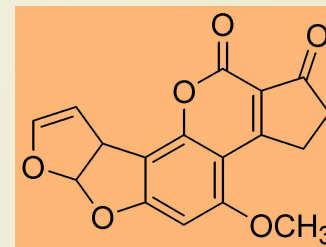


Aflatoxins are secondary fungal metabolites

Aflatoxin types include B1, B2, G1, G2

B1 is most prevalent and toxic aflatoxin

Aflatoxin is associated with drought-stressed oilseed crops including maize, peanut, cottonseed and tree nuts.



Chemical structure of aflatoxin B1



Aflatoxins in corn

Influence of aflatoxins on human health

Acute aflatoxicosis can be **fatal**.

Presenting symptoms are determined by amount of toxin consumed.

Clinical symptoms in humans include:

- Abdominal pain

- Vomiting

- Pulmonary edema

- Liver necrosis

Mycotoxins have carcinogenic, mutagenic action, suppress the immune system, affect the kidneys, liver, nervous and circulatory system.

Influence of aflatoxins on farm animals

Poultry

Highly sensitive

Aflatoxin toxicity impairs uptake of essential nutrients as well as causing tissue damage

Ruminants

Ruminants are relatively insensitive; however, aflatoxin exposure can cause growth impairment in young or lactating animals.

Metabolites in milk and related dairy products

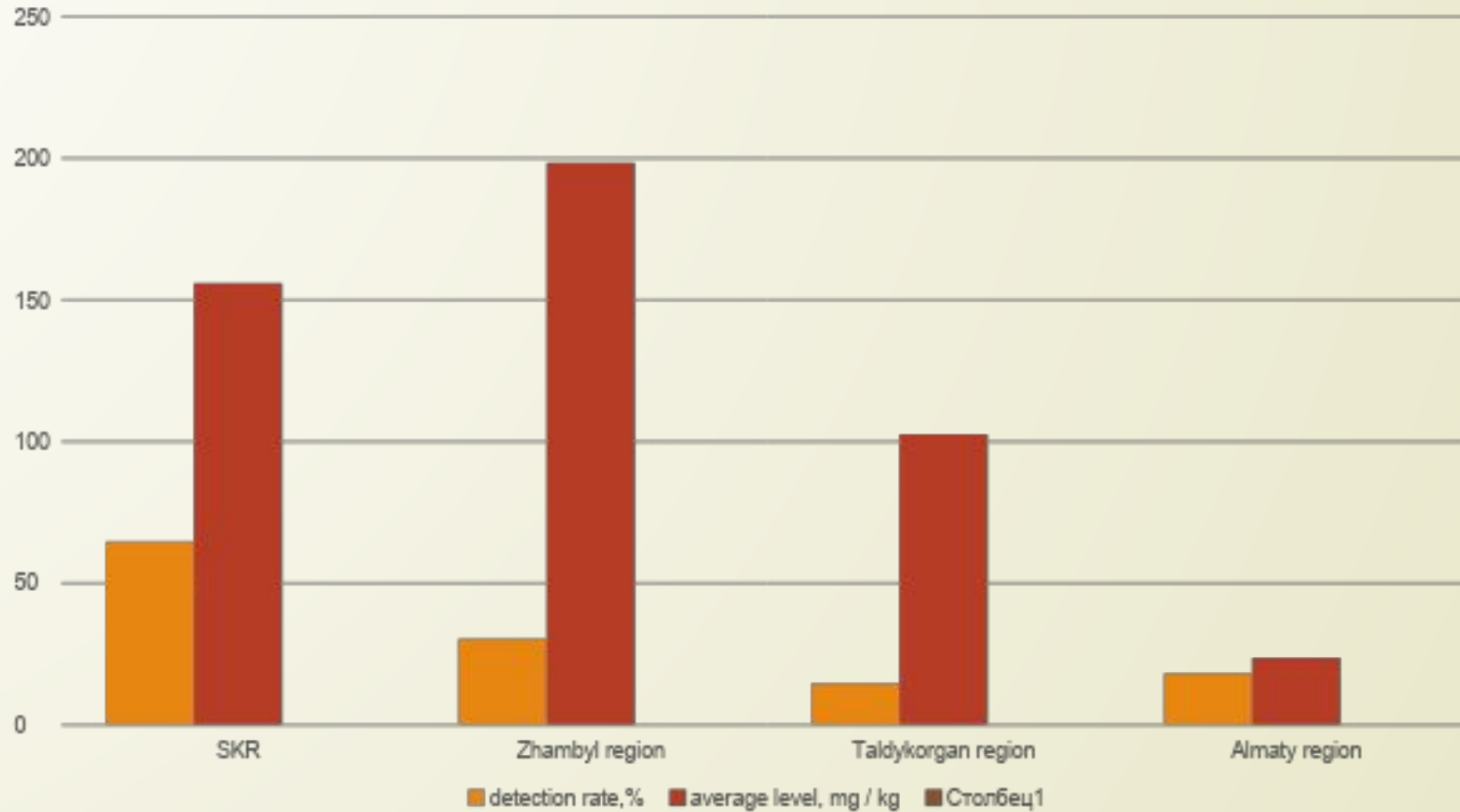
Aflatoxin consumed by cows is excreted in milk as the M1 metabolite.

The M1 metabolite can be absorbed by calves or humans causing growth failure.

The M1 metabolite also remains present in milk-based products such as cheese and yogurt.

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.

Indicators of contamination corn by aflatoxin on regions of Kazakhstan



The toxigenic potential strains of fungi *A.flavus*

Region	Investigated strains									
	Total quantity	Including toxigenic								
		Total		The average level of aflatoxins, µg/kg	Including activity, µg/kg					
		amount	%		to 5.0		5.1-100		over 100	
					amount	%	amount	%	amount	%
South Kazakhstan	49	49	95.5	787.6	4	8.5	26	55.3	17	36.2
Zhambyl	24	20	83.3	82.1	2	10.0	13	65.0	5	25.0
Taldykorgan	25	15	60.0	43.2	3	2.0	11	44.0	1	4.0
Almaty	20	11	55.0	28.8	4	36.4	7	63.6	-	-
Total	118	93	78.8	456.2	13	14.0	57	61.3	23	24.7

(Remmele V.V., 2010)

Amount of mycotoxin-aflatoxin in corn

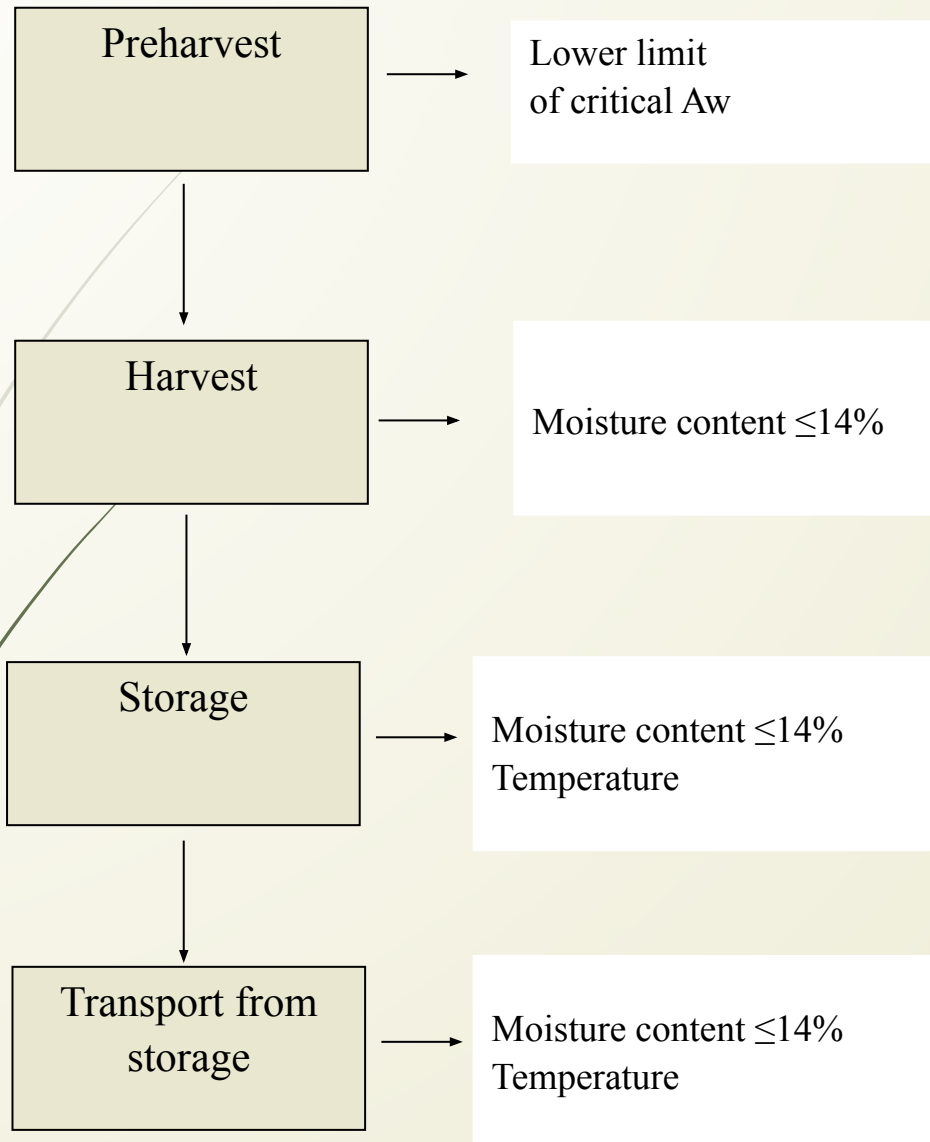
Commodity	# sample	>LOD µg/kg	Range, µg/kg	Name of the toxin
Corn	35	0.1	240-2.3	B1
			48-9.4	B2
			120-40	G1
			20-4.8	G2

Amount of mycotoxin-aflatoxin (*Aspergillus flavus*) in some crops

#	Culture	Number toxin mg / kg	Name of the toxin
1	Wheat, c. Astana	0.27	B2
2	Corn, SKR	6.0 4.5	B1 G1
3	Wheat "Kazakhstan", c.Almaty	0.8 3.0	B2 G1
4	Corn, Almaty	Not detected	
5	Barley, Astana	4.0 3.0	B1 G1
6	Chickpeas, Karaganda	Not detected	
7	Soybeans, Almaty region	Not detected	
8	Rice, Kyzylorda region	1.3	B1

(Rogalskaya A.A. et al., 2014)

Flow chart of the chain contamination of corn



Plants affected by drought stress are not only more susceptible to fungal attack, but the low moisture also favours *Aspergillus flavus* and *A. parasiticus*. It is essential to ensure sufficient available moisture throughout the growth period

Excess moisture in storage is the primary cause of fungal growth. The most important strategy is ensuring moisture content of maize destined for storage is below 14%. Fungi and mycotoxins grow at temperatures between 20 °C and 30 °C

Infection during transport may occur through cross contamination from insect and rodent pests or from contaminated storage vessels and areas.

Analysis of the effect of water activity, temperature, different conditions on the growth mould, mycotoxin

Step	a_w	Condition	Mould growth	Mycotoxin prediction
Harvest	>0.82 at $t=28\div35\text{ }^{\circ}\text{C}$	Delayed harvest; Harvest maize in heaps; Cobs shelled later; No sorting at harvest; Delayed drying	Yes	Yes
Storage	>0.70 at $t=20\div30\text{ }^{\circ}\text{C}$	Maize stored for 8-10 months Maize stored in poorly aerated stores	Yes	Yes

Comparative analysis of content mycotoxins in maize (for human consumption) of legislations of EU and Customs Union (Kazakhstan, Russian Federation, Belarus)

on legislations of Customs Union	on legislations of EU
Aflatoxins B1 (5.0 µg/kg) Zearalenon Fumonisin	Aflatoxins B1 (5.0 µg/kg) sum B1, B2, G1 and G2 (10 µg/kg) Ochratoxin A Zearalenon Deoxynivalenol Fumonisin

Conclusions

- the Republic of Kazakhstan is a zone of increased risk of contamination of corn by aflatoxin. Widespread and high potential toxigenic fungi *A. flavus*
- Mycotoxins are constant and serious threat to human and animal health.
- The main way to solve the problem of the quality of grain products - is to reduce the initial contamination of raw materials (GMP).



Thank you for attention

