

MYCOTOXIN LEVELS IN SOYBEAN MEALS

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Mycotoxin evaluation is frequent in feed mills for grain sources like corn, wheat, and barley or products like peanuts and cottonseed.



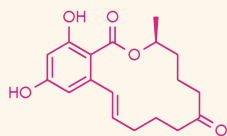
However, **soybean meal, the most common protein source in feed for all animal species, needs more attention in this critical quality aspect.**

Several studies have indicated that **soybean meal appears to be less susceptible to mycotoxin contamination than most grains.**

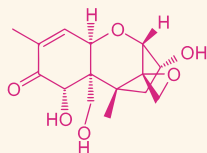


However, **significant differences can be observed in contamination with mycotoxins among sources of soybean meal.**

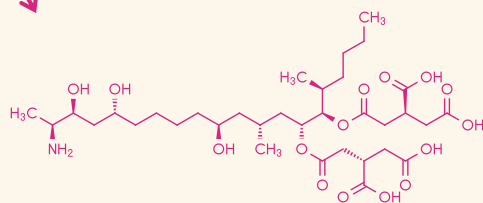
Previous reports have indicated that **the main mycotoxins eventually observed in soybean meals can be:**



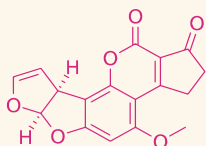
Zearalenone (ZEN)



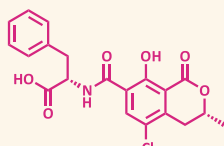
Deoxynivalenol (DON)



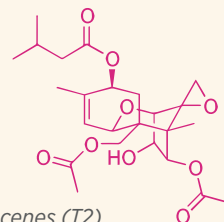
Fumonisin (FUM)



Aflatoxins (Afla)



Ochratoxins (OTA)



Trichothecenes (T2)



However, several publications suggest **some variability per region. That effect should be clarified to determine if contamination relates with:**

- » The location where samples were collected or
- » The origin of production and manage risks according to these factors.

Global evaluations of samples are necessary since **soybean meals have considerable trade worldwide**. Relevant **differences in nutrient and processing quality** have been reported among countries of origin.



The data reported here also indicate **differences among sources of soybean meal on mycotoxin contamination**.

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DESCRIPTION OF THIS WORLDWIDE MYCOTOXIN SURVEY

The **data on mycotoxin levels in soybean meal** presented in this article are part of the dsm-firmenich **World Mycotoxin Survey**.

- Starting in 2004, it is the longest-running and **most comprehensive data set on mycotoxin occurrence** and **allows studying variation in mycotoxin occurrence worldwide**.

Dsm-firmenich offers mycotoxin analysis to customers as a service to **identify mycotoxin risk in their raw commodities and final feeds**.

The increasing sample size over the years **gives detailed insights into the incidence of the six major mycotoxins** in the agricultural commodities used for livestock feed.

This information aids in **identifying the potential risks** posed to **livestock animal production per region** or in imported feed ingredients.



METHODS USED

Most results included in the survey are obtained using methods like ELISA, HPLC, or state-of-the-art LC-MS/MS-based multi-mycotoxin methods.



Samples that tested positive for one of the main mycotoxins are also presented as the percentage of contaminated samples.



The average and median of positives are calculated in ppb of all positively tested samples. The maximum levels are also described.



Such high levels are seldom observed, but still, they occur and underline the importance of testing for mycotoxin occurrence.



SOYBEAN MEAL PRODUCING COUNTRIES

China, the United States, Brazil, Argentina, and India are leading soybean meal producers. The 27 European Union countries may produce more soybean meal together than India, but not as individual countries.



Considering the production volume and the data in the DSM-Firmenich World Mycotoxin Survey that can track the origin of the soybean meal, we looked at the results of soybean meal samples from China, USA, Brazil, Argentina, and India analyzed from June 2022 to June 2023.





RESULTS OF THE MYCOTOXIN SURVEY

The results of this study are summarized in the following Table and the prevalence of each mycotoxin per country in the Figures.

The contamination levels of all soybean samples worldwide are always lower than reported in grains, confirming what scientific papers have indicated.

However, they are present in this feedstuff and may occasionally contribute to total feed contamination.

It is evident that the differences among soybean meal-producing countries on types of mycotoxins and levels of contamination observed.



The most significant number of samples evaluated were from Argentina and Brazil, and the lowest was from India.



Variability in the number of samples per country corresponds to all samples received from each origin for mycotoxin screening this year.



The most frequent mycotoxins observed were ZEN, FUM, and DON.



They indicated contamination with *Fusarium* molds is the most common in soybean meals worldwide.



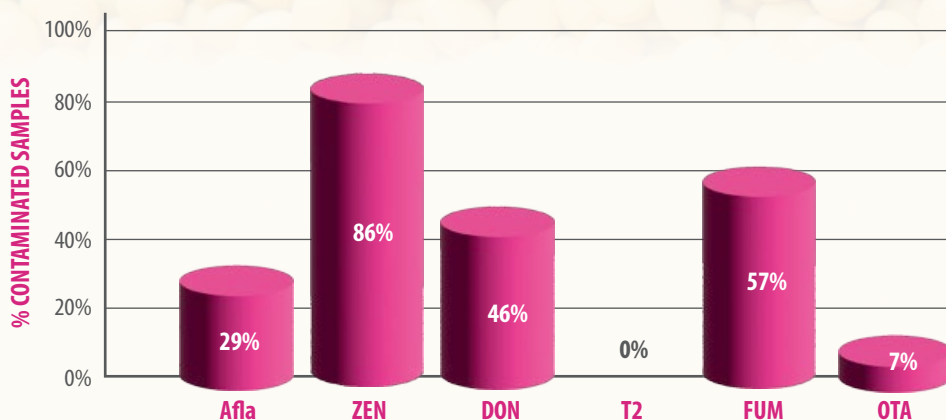


Figure 1. Prevalence of mycotoxins detected in soybean meal samples from China



In **China (Figure 1)**, **Argentina (Figure 4)**, and **India (Figure 5)**, **86% or 82% of the samples were positive for ZEN**; however, in **India**, **97% of the samples analyzed were positive for OTA** and **92% positive for T2 (Figure 5)**.

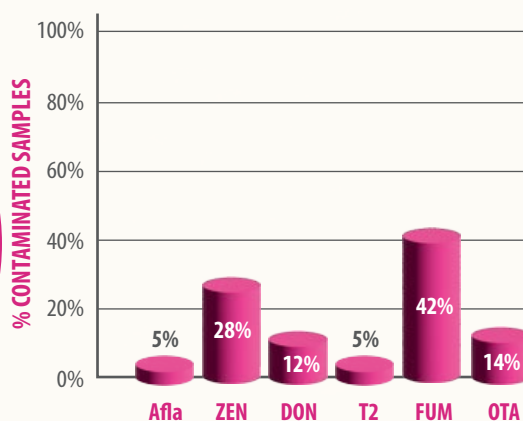


Figure 2. Prevalence of mycotoxins detected in soybean meal samples from the United States

United States soybean meal (Figure 2) had the lowest percentage of samples positive for ZEN (28%) among all five countries studied and the lowest average and median concentration (17 and 15 ppb) or maximum level (38 ppb) of ZEN.

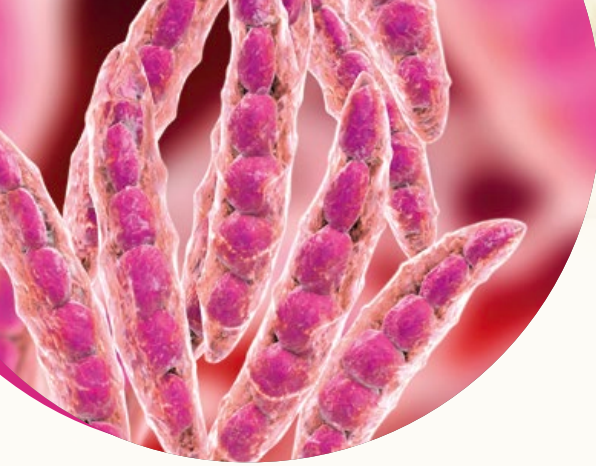
Aflatoxins were the second most common mycotoxin observed in Argentinian soybean meals, with 63% of the 1,459 samples evaluated being positive (919 samples).



However, **contamination levels were around 2-3 ppb in Argentinian soybeans**, and similar levels were observed in the **Chinese and Indian soybean meals**, with 29 and 26% of the samples positive for Afla.



In all other countries, the ZEN levels observed were almost three times (2.3 to 3.6) higher. The highest levels of ZEN (Table 1) were observed in samples from Argentina and Brazil (1000 and 809 ppb).



A few samples from Brazil (13 out of 673) **and the USA** (2 out of 43) **had Afla** (Figures 3 and 2).



➤ However, **the median concentration of Afla in Brazilian samples was 4 ppb**. In comparison, the two USA samples reached a median of 45 ppb, which could be considered outliers and hard to observe again.

No samples of Brazilian soybean meal were positive for OTA (Figure 3), indicating low or no contamination with *Penicillium* molds in these samples.



No T2 was observed in the Chinese samples (Figure 1), but **46% (26 out of 56) were positive for DON**.

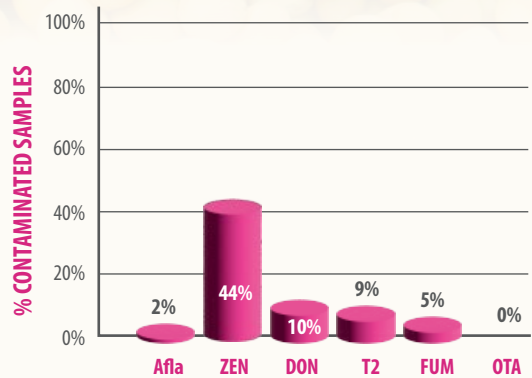


Figure 3. Prevalence of mycotoxins detected in soybean meal samples from Brazil

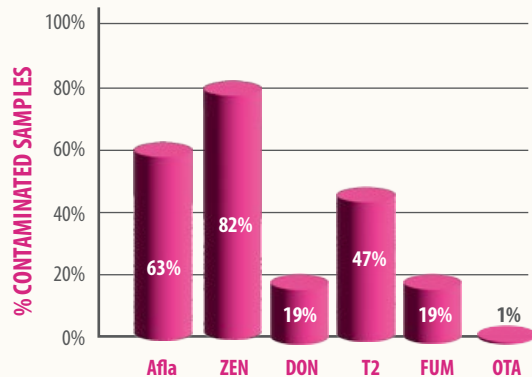


Figure 4. Prevalence of mycotoxins detected in soybean meal samples from Argentina

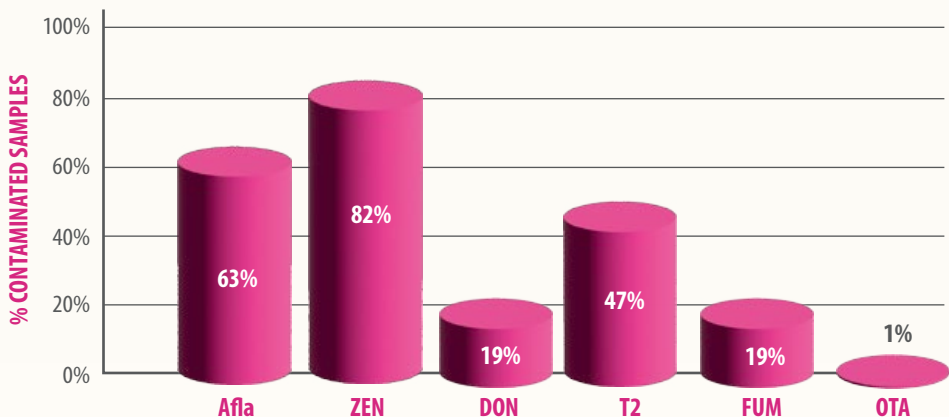


Figure 5. Prevalence of mycotoxins detected in soybean meal samples from India

The United States soybean meals positive for mycotoxins generally had the lowest average and median concentrations of DON, T2, FUM, and OTA observed worldwide (*Table 1*).



Using only the median values of positive samples, the US soybean meal had 7.1 to 17.6 times less DON, 2.8 to 4.4 times less T2, 6.6 to 23.4 times less FUM, and 2.0 to 18.0 times less OTA than other countries.



China and the USA soybean meals had similar number of samples positive for FUM (Figures 1 and 2) and similar median concentrations (*Table 1*).

China



Parameter	Afla	ZEN	DON	T2	FUM	OTA
Number of samples	56	56	56	14	14	14
Average of positives (ppb)	3	49	581		96	10
Median of positives (ppb)	3	49	600		37	10
Maximum (ppb)	4	88	1160	0	306	10

USA



Parameter	Afla	ZEN	DON	T2	FUM	OTA
Number of samples	43	43	43	43	43	43
Average of positives (ppb)	45	17	97	8	127	2
Median of positives (ppb)	45	15	34	8	38	2
Maximum (ppb)	90	38	309	11	1058	4

Brazil



Parameter	Afla	ZEN	DON	T2	FUM	OTA
Number of samples	673	603	672	95	683	17
Average of positives (ppb)	4	48	485	28	873	
Median of positives (ppb)	4	37	438	26	350	
Maximum (ppb)	14	809	1700	59	13224	0

Argentina	Parameter	Afla	ZEN	DON	T2	FUM	OTA
	Number of samples	1459	1555	451	1205	383	537
	Average of positives (ppb)	3	53	359	32	1161	4
	Median of positives (ppb)	2	49	280	22	890	4
	Maximum (ppb)	30	1000	1090	179	3760	4
India	Parameter	Afla	ZEN	DON	T2	FUM	OTA
	Number of samples	38	38	38	38	38	38
	Average of positives (ppb)	10	61	2328	36	332	35
	Median of positives (ppb)	4	34	240	35	250	36
	Maximum (ppb)	33	794	6720	91	590	89

Table 1. Results of the dsm-firmenich World Mycotoxin Survey in soybean meal samples collected from June 2022 to June 2023 and classified by country of origin.

CONCLUSIONS

Based on the median concentration of these mycotoxins and the number of positive samples within the survey, the United States soybean meal is currently the safest source to avoid multi-mycotoxin contamination.



However, monitoring mycotoxins in all soybean meals every year is always advisable because concentrations of mycotoxins may occur due to annual weather fluctuations.

Mycotoxin levels in soybean meals

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