What you cannot see in DDGS

Biomin analyses DDGS samples for mycotoxin contamination

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BIOMIN conducted a mycotoxin survey with 103 worldwide DDGS samples. The insights gained should be important for all players in the animal production industry.

The inclusion of DDGS – dried distillers grains with soluble, a by-product from bioethanol production – in animal diets has increased over the last few years. Rising prices for feedstuffs and feeds worldwide have demanded the development of successful and economical sources of energy and proteins in animal diets. DDGS seems to gather these characteristics. However, it should never be considered that the mycotoxin menace is eliminated by the fermentation processes occurring during bioethanol production. Mycotoxins are the toxic compounds produced by fungi during the growth and storage of agricultural products. Raw materials' contamination in terms of mycotoxins is carried-over and even augmented during bioethanol production. A DDGS survey has been initiated by BIOMIN. In this study 103 samples from all over the world were tested for the most important mycotoxins affecting livestock production. 99% of DDGS samples tested positive for at least one mycotoxin. 96% of these samples have shown a simultaneous contamination of 2 or more mycotoxins. Only one sample (wheat DDGS) out of 103, tested negative for the analyzed mycotoxins. The alert is out!

Bioethanol

By December 2006, Kyoto's Protocol had already been signed by 169 countries worldwide. The final objective of such agreement is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". Since the road transport network accounts for 22% of all greenhouse emissions, research on a less pollutant fuel was compulsory and has led to the development of bioethanol which presents a wide range of advantages over fossil fuels. First, the crops used for its production will absorb a great amount of CO_2 while growing. Secondly, bioethanol will help to extend the decreasing fuel supply worldwide and will increase fuel security representing much less toxicity and hazardous impacts on the environment.

DDGS and animal nutrition

One may question the relation of this topic with animal nutrition; however, nowadays, due to the rising prices of feedstuffs and feed, DDGS has been increasingly introduced in animal feeds as a source of proteins and energy, being an economical replacement to corn, soybean meal and meat and bone meal.

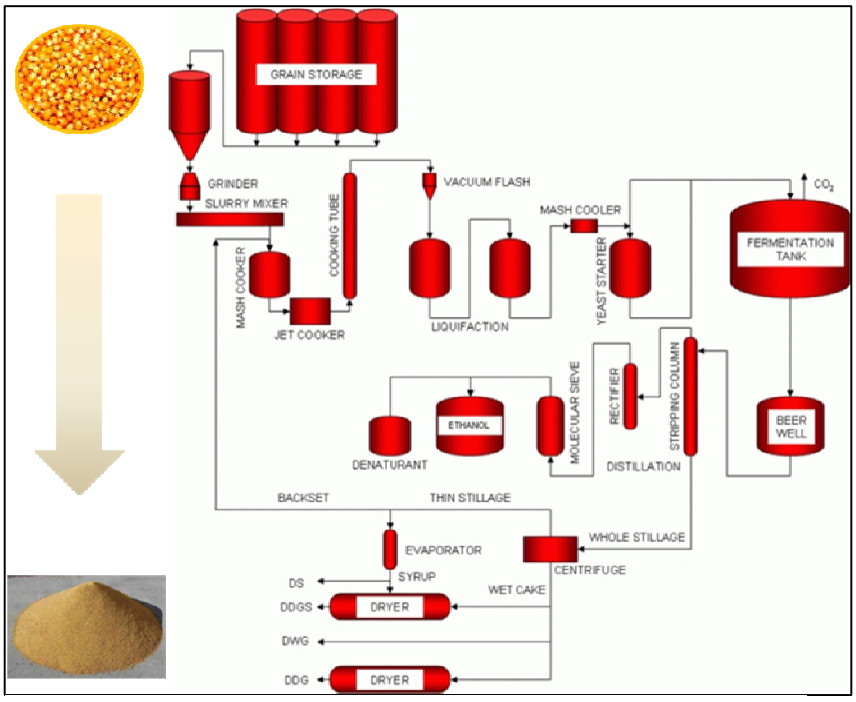

Figure 1 - DDGS as a by-product of bioethanol production

Bioethanol is mainly produced from sugars derived from fuel or energy crops, especially maize. The cereal grains suffer a variety of complex physical and chemical processes and DDGS is obtained as a by-product (see picture 1). Within a cereal grain, the main parts used for the production of bioethanol are the bran and the endosperm, as these are the structures that gather most part of the starch, cellulose, hemi-cellulose and lignin.

DDGS and mycotoxins

The inclusion of DDGS in animals' diets must be carefully calculated since toxic compounds such as mycotoxins are probably present as contaminants posing a serious threat to animal health, either by their carcinogenic (e.g. aflatoxins, ochratoxin, fumonisins), estrogenic (zearalenone), neurotoxic (fumonisins), dermatotoxic (deoxynivalenol and T-2 toxin) or by their immunosuppressive (aflatoxins, ochratoxin A, trichothecenes) effects.

Mycotoxins contaminate a great part of all agricultural products both on the field and after harvest, depending on the producing fungi. It is common to find statements declaring that the mycotoxin contamination in finished feeds is proportional to the mycotoxin concentration in the unprocessed cereal and on the percentage of DDGS included in the diet. However, mycotoxins' distribution within a cereal grain does not follow a homogeneous pattern. Research has shown that fusariotoxins for example, tend to concentrate more in the bran and germ of the cereal, leading therefore to a DDGS mycotoxin contamination generally 3 times higher than the original maize.

According to a Food and Drug Administration survey in 2006, the quantity of distillers grains marketed for feed had a 340% increase since 1995, as a consequence of the rising amounts of bioethanol produced. Therefore, DDGS's addition on animal diets has been a matter of great reflection and discussion.

BIOMIN´s DDGS survey

To understand to what extend the DDGS inclusion in animal diets is safe and to provide customers insights in the occurrence of mycotoxins in DDGS samples worldwide, BIOMIN initiated and carried out a study with 103 samples mainly received from the United States (67%) and Asia. Samples were tested for major mycotoxins of interest in animal husbandry – aflatoxin B_1, zearalenone (ZON), deoxynivalenol (DON or vomitoxin), T-2 toxin and fumonisins (FUM). All tests have been conducted by Quantas Analytics Austria, and Romer Labs Singapore. The analyses were performed using standard procedures. Aflatoxins, ZON and total FUM were analyzed by HPLC (High Pressure Liquid Chromatography) whereas DON values were obtained by TLC (Thin Layer Chromatography). For the purpose of data analysis, non-detect levels were based on the quantification limits of the test method for each toxin: Aflatoxin B1 <0. 5 µg/kg; ZON <10 µg/kg; DON <150 µg/kg; T-2 toxin <30 µg/kg and FUM <25 µg/kg.

Table 1 - Results of mycotoxin analyses

	AfB_1	**ZON**	**DON**	**FUM (B_1+B_2)**	**T2-Toxin**
Number of Analyzed Samples	103	103	103	103	103
Positive Samples	8	95	66	90	27
% Positive Samples	8	92	64	87	26
Max. Contamination level [ug/kg]	89	8107	12000	9042	218
Ave. of Cont. samples [ug/kg]	24	333	2130	596	113

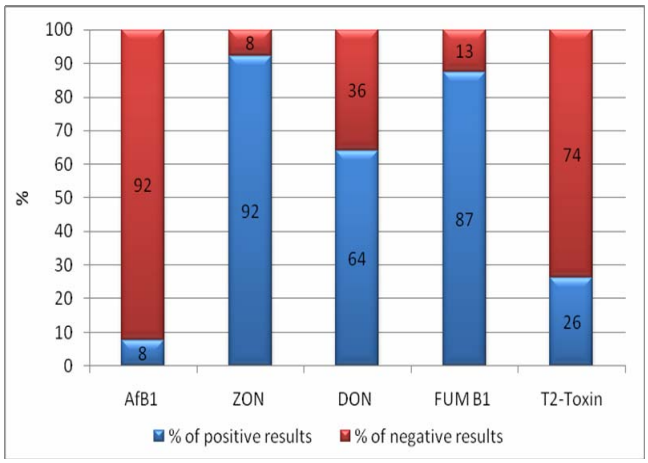

Figure 2- Results of mycotoxins analyses

99% of DDGS samples were contaminated with at least one mycotoxin. 92, 64, 87 and 26% of the samples were contaminated with the "field mycotoxins" ZON, DON, FUM and T-2 toxin produced mainly by *Fusarium sp.*. The average contamination levels found in the DDGS samples which tested positive for these mycotoxins were 333, 2130, 596 and 113 µg/kg which can already be considered as high contaminations. Nevertheless, for the abovementioned mycotoxins, contaminations as high as 8107, 12000, 9042 and 218 µg/kg could be detected. Aflatoxin B_1, produced by *Aspergillus sp.*, was present in 8% of the samples. The average contamination of the positive samples was 24 µg/kg. The highest concentration found for this mycotoxin in the analyzed samples was 89 µg/kg. 96% of the samples have shown a simultaneous contamination of 2 or more mycotoxins. The only sample which tested negative for all analyzed mycotoxins was a wheat distiller.

The quality of the resulting by-products such as DDGS, in terms of mycotoxins' contamination depends in a great extent on the quality of the grains purchased by the ethanol plant. If damaged grains are the most prevalent raw material, higher mycotoxin contamination levels will be found in the by-product, as these are preferred locations for fungi development and subsequent mycotoxin production.

As seen from the results above, the fermentation process for the production of DDGS does not destroy mycotoxins. On the contrary, it makes them readily available to be absorbed by animals as the maximum inclusion rates for DDGS range from 5% for nursery pigs' to 20% in finishing pigs, developing gilts, gestating sows and lactating sows' diets. In the case of poultry, these rates go from 10% in broilers' (starters) to 20% in breeders' diets. If we consider to be dealing with DDGS with a high mycotoxin contamination such as the maximum levels found on this study, and assuming an average of 15% DDGS inclusion rate, this would mean that the animals might be fed diets containing up to 1216 µg/kg ZON, 1800 µg/kg DON, 33 µg/kg T-2 toxin, 1356 µg/kg FUM and 13 µg/kg AfB1, most of the times even concomitantly.

Summary

Although DDGS may be seen as a practical solution for animal producers, enabling them to counteract the rising prices of feedstuffs and feed, the widespread carefree use of these products is still far from reality. DDGS are a dangerous source of mycotoxins which are toxic compounds with hazardous effects to animal health and productivity. Monitoring the mycotoxin content of DDGS prior to its inclusion in animals' diets is crucial to avoid the exposure of animals to the negative effects of mycotoxins. Counteracting mycotoxins' effects can be later on accomplished by adding mycotoxin deactivating products to the problematic feeds to ensure successful animal production.