Tropentag 2011
University of Bonn, October 5 - 7, 2011
Conference on International Research on Food Security, Natural Resource Management and Rural Development

The Use of a Non-corrosive Acidified Preservative for Moist Corn Storage under Philippine Conditions

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Introduction

Spoilage of raw materials as major compounds for feed manufacturing is a serious threat to agriculture worldwide. In temperate climate zones and in the tropics more so, valuable raw materials are exposed to deterioration and spoilage, brought about by omnipresent development stages of a wide variety of microorganisms. Particularly for the tropics, moisture and high temperatures provide ideal growth and reproduction conditions for moulds and yeasts, which are responsible for the loss of millions of dollars through harvest losses.
Another major concern in connection with the storage of raw materials like corn is the development of aflatoxins, metabolites of certain fungi, particularly from the Aspergillus genus (*A. flavus* & *A. parasiticus*). Aflatoxins are known to have a detrimental impact in lifestock, from low nutrient utilization in feeds through a negative impact on reproduction in life stock. Fatal incidents are uncommon though. For human nutrition, the accumulation of aflatoxin, derived from the food chain has been shown to be cancerogenic.
In Philippines frequent typhoons often devastate vast areas of productive arable land in the Northern part of the country. In November 2009, Super - Typhoon 'Ondoy', shortly followed by 'Peping' caused great losses in terms of human lives but also with regards to economic aspects, agriculture as one of the directly and hardest hit sectors. Corn as one of the major agricultural commodities for animal feed manufacturing experienced heavy losses due to lacking capacity to deal with moist corn grains, particularly to preserve moist corn at a high quality level.
Even under 'normal' weather conditions and without negative impacts of typhoons or other natural calamities, corn preservation is a challenge.
The potential action of organic acids under farm conditions in feed preservation and protecting feed from microbial and fungal destruction is already widely accepted in the agricultural business (LÜCKSTÄDT, 2007). The use of these acids will significantly reduce the microbial contamination of treated corn. This decontamination will furthermore secure the nutritional value of the stored corn and can therefore lead to healthy animals, good animal performance and ensure overall economic animal production. However, most of the currently available preservatives for grain- and corn-storage are corrosive and therefore dangerous to handle on farm level (AUERBACH, 2011).
In order to validate the efficacy of a non-corrosive preservative based on propionic acid, sodium propionate and sodium benzoate (ADDCON, KofaGrain pH5) a trial was conducted at a Southern Luzon Feed Manufacturing Company.

Material and Methods

Six galvanized iron drums were prepared in a way that they closely resembled commercially used silos. All drums were equipped with a silo-like ventilation system at the bottom that allowed passive air circulation in the drum. They had a volume of 200 litres and were covered with a lid; a space between drum and lid of ½" was maintained through spacers. To obtain information on the efficacy of the preservative for corn, which is related to current Philippine storage conditions, a moisture content of 13% was chosen. Each drum was filled with 150 kg of this corn. For both groups there were 3 replicates.
The inclusion rate of the preservative (3.5 litre t^{-1} of corn) was calculated based on the recommendation given from the supplier (ADDCON) based on actual moisture content, ambient temperature, desired storage period and the content of broken corn kernels/ other impurities and was mixed with the corn in a micro-mixer (250 litre volume/ capacity).

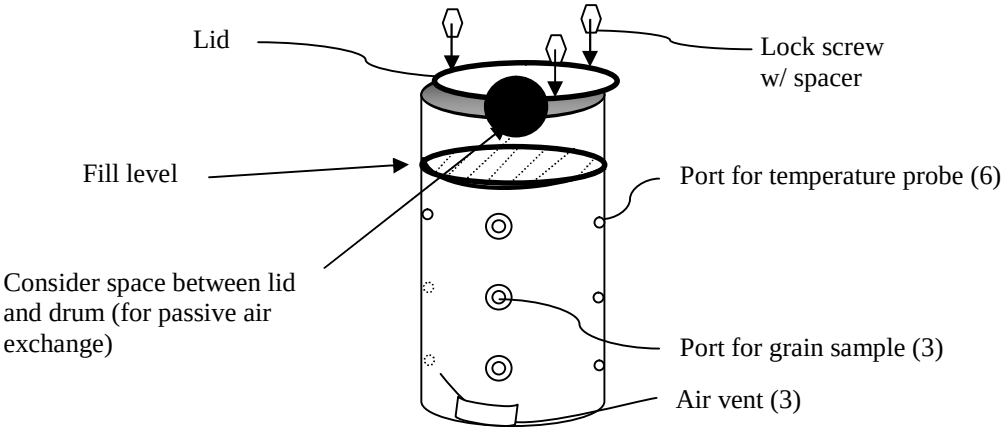

Figure 1: Sketch of trial drum

Mould- and yeast count of the freshly delivered corn was determined at the start of the trial as well as the aflatoxin content. Initial moisture content was determined for every drum (three replicates per drum). During the trial period (90 days), mould-count, yeast-count and moisture content were determined at the beginning, midterm and end of the trial period. All samples were submitted to an independent analytical laboratory. The temperature was controlled twice daily, always at the same time; accurate measuring points were given through three ports allowing standardized measurement, allowing access to the different layers of corn in the drum (Fig. 1).
To test the aflatoxin content, samples were taken at the end of the trial form the control group as well as from the treatment.

Results and Discussion

The measured temperature in all groups followed the ambient temperature level between 27°C and 29°C. For the treatment group, the initial mould and yeast count was 332,000 and 85,300 CFU/g, respectively. The preservative treatment at yielded in a mould reduction of 82.9% (Fig. 2). This tended to be different compared to the control group (P=0.06). At the same time, the application of the preservative on the corn yielded for the yeasts a reduction of 95.1% (Fig. 3). This reduction level was significantly different (P=0.03) from the control group. No corrosion was observed in the drums that were directly exposed to the preservative.

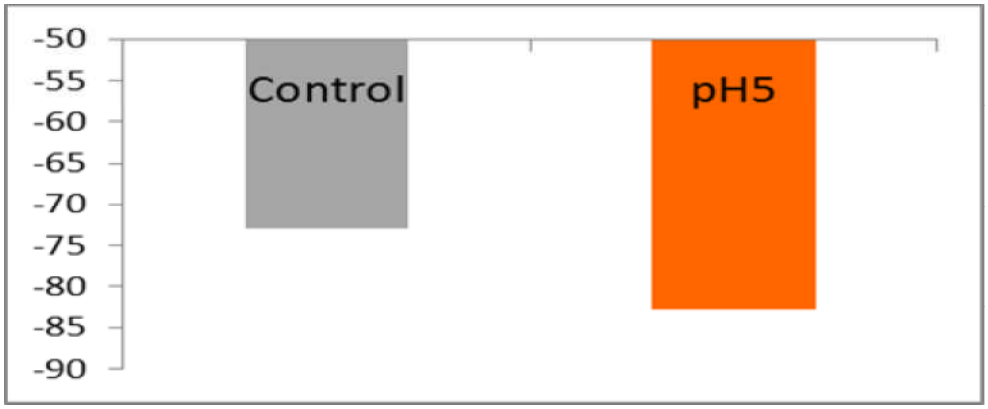

Figure 2: Reduction of mould-count in percent in control and preserved corn during 90 days of storage at 13% moisture content

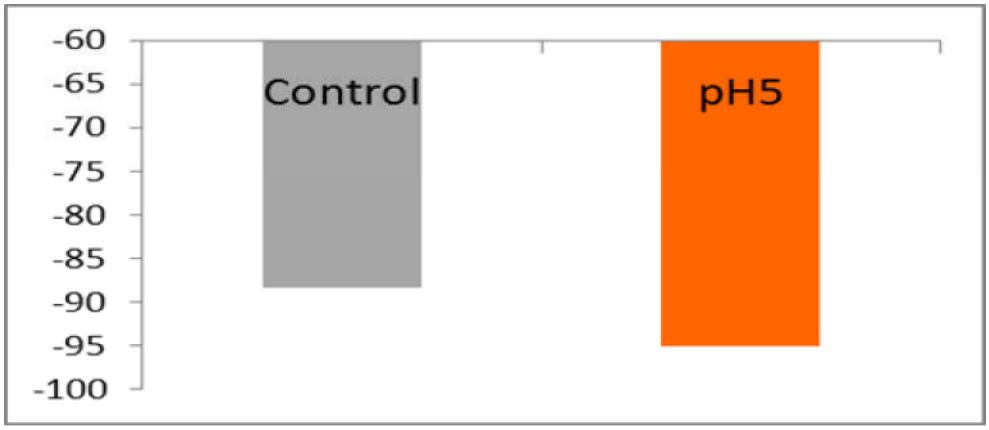

Figure 3: Reduction of yeast-count in percent in control and preserved corn during 90 days of storage at 13% moisture content

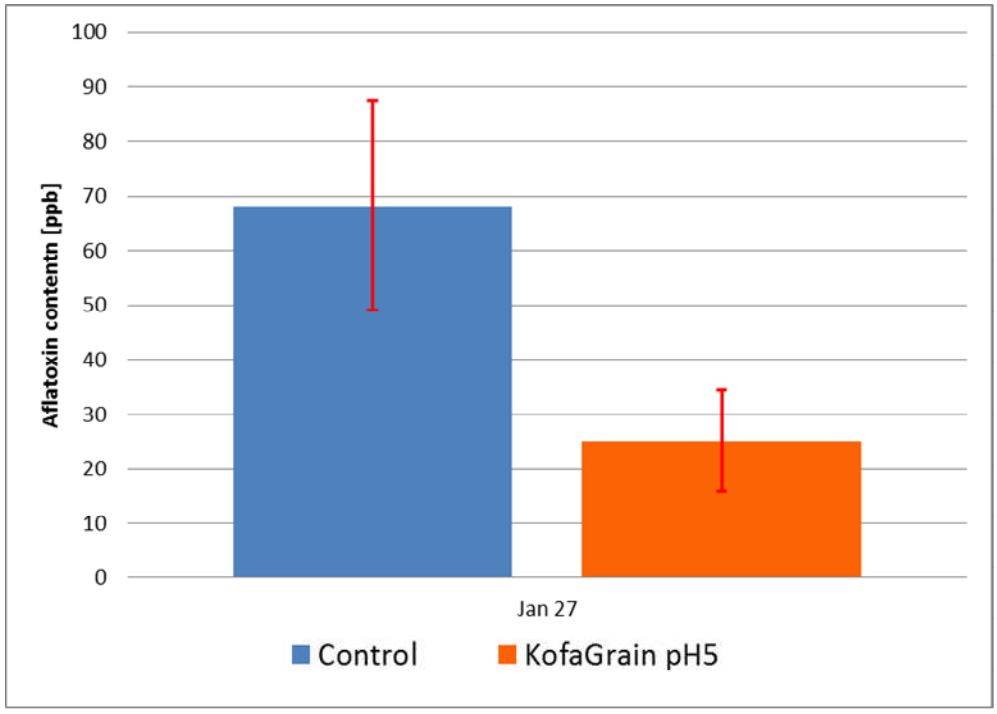

Figure 4: Aflatoxin content (ppb) in control and preserved corn (KofaGrain pH5) after 90 days of storage at 13% moisture content

Finally, for the aflatoxin content after the trial period the treated corn showed a highly significant ($P<0.01$) lower aflatoxin content compared to the control group (Fig. 4).
The trial outcome suggests that the preservative offers a viable system for long term storage under tropical climate conditions for small to large commercial traders, feed manufacturers and integrators. Through this novel and unique technology corn producers can become weather independent and can harvest at any reasonable weather situation, with the assurance that even corn with high moisture contents can be reliably preserved. This is further acknowledged by the scientific committee of the European Food Safety Authority (EFSA), who published several statements on the safety and efficacy of the preservative (SCAN, 2002; FEEDAP, 2006).

Conclusions and Outlook

Provided that there are market structures in place that will warrant the proper treatment and application of the preservative (KofaGrain pH5) for the corn, there is a clear benefit in terms of maintained corn freshness and farmers can be assured that the nutritional value of the corn will be higher due to appropriate storage under controlled conditions compared to roadside drying facilities. For these actors in the product flow and particularly for integrators, the economic viability of maintaining the high quality of corn in the feed manufacturing is expressed as improved feed quality, leading to better health status and growth performance of farmed animals. This has been widely proven over many years of application in many countries around the world.

References

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