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THE INFLUENCE OF HALLOYSITE ON THE CONTENT OF BACTERIA, FUNGI AND MYCOTOXINS IN FEED MIXTURES

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Introduction

The use of natural and synthetic aluminosilicates in animal production is a frequent subject of numerous interdisciplinary researches. The substances are characterised by the ability to prevent the growth of fungi, including toxigenic fungi (Kolacz *et al.* 2004), decrease the bioaccumulation of heavy metals in animal organisms (Dobrzanski, 2004) and enrich the diet with trace elements (Yablonska, 2003). Moreover, they may influence the processes of digesting and bonding of metabolites (Korniewicz *et al.*, 1996), which decreases the emission of toxic gases from bedding (Tymczyna, 1993) and does bring about negative changes in the physiological parameters (Kolacz *et al.*, 2004).

Natural and synthetic aluminosilicates are a porous, negatively charged material and their chemosorptive and ion-exchanging qualities depend on their structure, degree of the polarisation of particles and the diameter of the pores. Zeolites, kaolins, bentonites, vermiculite, perlite, saponite and halloysite are the best known aluminosilicates. Positive effect of some aluminosilicates used in animal feeding has been proved by numerous authors (Dobrzanski *et al.*, 1994; Rudzik, 1998; Kyriakis *et al.*, 2002)

The aim of the present research was to study the effect of using halloysite as a feed additive on the development of microorganisms during storage period.

Material and methods

The halloysite used in the research was obtained from deposits in Lower Silesia which so far have not been economically used. The mineral was roasted and ground.

The chemical formula of halloysite is $Al_2Si_2O_5(OH)_4$, molecular weight is 258.1g, and the chemical composition is as follows: Al – 20.90 % mass (39.50% mass Al2O3); Si - 21.76 % mass (46.55% mass SiO2); H – 1.56 % mass (13.95% mass H2O2) (Hoffman *et al.*, 2004).

Granulated feed mixture for fattener pigs, ø 6 mm, supplemented with 1% and 2% halloysite was used as experiment material.

All feed mixtures were packed in bags 25 kg each. The mixtures were stored for 5 weeks in a room with the following parameters of microclimate: air humidity – ca. 70 %, air temperature – ca. 20 °C, no access of day light. Samples were taken from each group during the experiment to analyse the following: 1) total count of mesophylic aerobic bacteria, 2) total count of fungi, 2) the content of aflatoxin B1. The samples were taken from each group after 1, 3 and 5 weeks of storing. Determinations were performed in a microbiological laboratory ZHW using standard methods.

Results and discussion

After the first week of storing, a triple fall in the count of aerobic bacteria was observed in the mixture with 1% halloysite (Group II) and in the mixture with 2% halloysite (Group III) the count of bacteria was 66% lower than in Group I. No differences in the total count of fungi were observed between the groups.

After three weeks of storing, the count of bacteria in the experiment groups was significantly lower than in the control group. The count of bacteria in Group I and Group II was similar, whereas in Group III, the content was 72.23% lower.

The results of analyses conducted after five weeks of storing show that the count of bacteria was 66% lower in Group II and 98.73% lower in Group III than in the control group. The content of fungi was also lower, 66.67% and 50%, respectively. According to the norm, the count of mesophylic aerobic bacteria in 1g of mixture may not exceed 3×10^6, whereas the count of fungi may not exceed 2×10^5.

The results of the analysis of the content of aflatoxin B1 were similar and did not depend on the storage period. The content of aflatoxin B1 in the control mixture was at the level of 3.0 µg / kg - much less than acceptable according to the norm issued by the Minister of Agriculture and Rural Development. In experimental mixtures, the content of aflatoxin B1 did not reach the level of traceability. The antibacterial and antifungal activity of halloysite may result from its physical and chemical properties although the mechanisms have not been thoroughly studied yet.

The contamination of feed with microorganisms and their toxins is still a major problem in animal feeding. Many presently used methods of decontamination (Karlovsky, 1999) do not fulfil their role, mainly in the aspect of toxicological safety and health quality of

fodder, which indicates the need of searching for new methods. The results of numerous researches on the use of aluminosilicates as a feed additive indicate their high efficiency (Kolacz, 2004). Positive influence on production results (Kolacz, 2005) and no threat to the health of pigs if proper concentrations are used (Papaioannou, 2002) were observed. The comparison of the results obtained in the present study is difficult to perform due to the lack of research in the matter. Afriyie-Gyawu (2005) showed that the use of modified montmorillonite (CP-LPHM) in feed gives 58% better results than the use of zearalenone. The results of Dobrzanski *et al.* (2000) show that adding a preparation containing 2.5% or 5% of bentonite resulted, after 2 weeks of storing of the feed for broiler chickens, in significant decrease of the content of mesophylic aerobic bacteria - 70% and 30%, respectively. A significantly lower content of fungi was also observed.

Conclusion

The results of the present research indicate high decontaminating efficiency of halloysite, both towards bacteria, fungi and aflatoxin B1, which proves that aluminosilicates may be used to reduce the contamination of feed mixtures.

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Specification	Period (weeks)	Groups		
		I control	II halloysite 1%	III halloysite 2%
Total count of mesophylic aerobic bacteria in 1 g [jtk / g]	1 3 5	1.7×10^3 1.0×10^5 4.3×10^3	5.5×10^2 3.7×10^3 3.2×10^2	5.9×10^2 1.2×10^2 5.5×10^1
Total count of fungi in 1 g [jtk / g]	1 3 5	1.0×10^2 3.6×10^1 3.0×10^1	1.0×10^2 3.6×10^1 1.0×10^1	1.0×10^2 1.0×10^1 1.5×10^1
Aflatoxin B1 [µg / kg]	1 3 5	3.0 3.1 3.0	below the level of traceability	below the level of traceability

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