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MOBILISATION OF ORGANIC NITROGEN FROM EXCREMENTS OF FARM ANIMALS AND THE POSSIBILITY TO INFLUENCE THE PROCESS

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Summary

From the energetical point of view, the costs of artificial fertilizers in the countries with high intensity of manuring are twice as high as the costs of fuel associated with operation on an agricultural farm. Because of that better utilization of organic manure as a production means is inevitable for better economy.

In our study we analysed the nitrogen losses in the process of production and treatment of organic manure in relation to the available soil area and environmental aspects of mobilisation of nitrogen into the environment.

Key words: nitrogen mobilisation, organic manure, reduction of losses, economy

The essential source of ammonia emissions from animal production are excrements of farm animals subjected to natural decomposition by aerobic microflora in the process of mineralization of organic matter.

Strauch et al. (9) stated that production of ammonia is based on three chemical reactions, ammonification, reductive deamination and desulphydration.

The basic raw materials are processed by microorganisms the activity of which depends on different supply of oxygen through varying compressing of

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the initial material. Mineralization of organic matter takes place with the release of energy, CO_2, H_2O and NH_3. The decomposition processes may result in the loss of organic matter and nitrogen amounting to 30-60%.

Gábriš et al. (7) stated that with annual production of 13 tonnes of solid manure (0.4 % N) per one large-animal unit (LAU) the loss in organic matter may reach 3.9-7.8 tonnes or 15.6-31.2 kg nitrogen. When recalculated per 1000 LAU, this comes up to 15.6-31.2 tonnes nitrogen which is equivalent to 56.7-113.5 tonnes saltpetre. If we assume that the consumption of energy per 1 kg N in artificial fertilizers reaches 75 000 KJ then the losses expressed in energy units range between 1 170 and 2 340 GJ.

According to Haš et al. (8) such energy is expended to produce 68-165 tonnes of pork.

The above mentioned indicates that immobilisation of organic nitrogen contained in animal excrements is important from both environmental and economical point of view. Because of that appropriate attention should be paid to organic manure from the stage of production up to its application on agricultural soil.

One of the basic ways of immobilization of ammonia is the addition of sorbents into the bedding material.

Adsorption of water by various natural bedding materials presented by Duchoň (6) is shown in Table 1.

Table 1. - ADSORPTION OF WATER BY BEDDING MATERIALS

Bedding material	kg water/kg bedding material
Straw (uncut)	2.5
Cut straw	3.5
Peat	9.0
Leaves	2.3
Sawdust	3.5

Suchý et al. (10) used oxihumolit to adsorb ammonia in houses for fattening pigs. The sorbent was administered perorally and applied also to the floor.

The peroral administration of oxihumolit on the level representing 3% of the ration resulted in 33.6% decrease of ammonia in the air inside the animal house in comparison with the control. Application of oxihumolit to the floor at a dose of 150 $g.m^{-2}.d^{-1}$ decreased the content of ammonia in the atmosphere by 40.9% in comparison with the control.

The loss of nitrogen in the form of ammonia in the animal house may be decreased by application of superphosphate to the bedding in the proportion

of 0.5-1%. It appears useful especially in deep bedding systems. Ammonia reacts with superphosphate producing ammonium phosphate which means that the house microclimate improves and the manure is enriched with phosphorus. Gábriš (7) presented the reaction which takes place after application of superphosphate as follows:

$$Ca/H_2PO_4/_2 + 4\ NH_4OH \longrightarrow Ca\ NH_4PO_4 + /NH_4/_3PO_4 + H_2O$$

Measures towards decreasing ammonia emissions can be taken in each of individual stages of production, manipulation and disposal of organic manure. They may include proper storage of produced straw manure, hermetization of dung water storage, biofiltration of the outgoing spent air, addition of enzymatic preparations to the bedding, drying of manure (poultry dung), and other. Vargová (12) presented summary of the use of unique natural adsorption materials zeolites, exhibiting high affinity to ammonia, in the process of treatment and utilization of pig excrements.

From our point of view, in an effort to decrease ammonia emissions, one prospective way consists in blocking the chain of enzymatic reactions in organic manure by inhibitors of urease. They can decelerate decomposition processes and release of ammonia to the atmosphere of animal housings, prevent increased level of noxious gases and decrease ventilation demands. Such technology of immobilisation of organic nitrogen has no high investment, energy and labour demands.

It is interesting that this way of immobilisation of organic nitrogen has been well worked out in the crop production which is witnessed by many references while the sources dealing with technology of animal rearing are less numerous. One can mention a range of authors dealing with fixation of organic nitrogen in soil using inhibitors of both urease and nitrification (1,2, 3, 4, 5,).

The possibility of urease inhibitors in animal environment was studied by Varel (11). The author conducted laboratory experiments to investigate the limiting of ammonia emissions by means of urease inhibitors, namely phenyl phosphorodiamitate (PPDA) and cyclohexyl phosphorotriamide (CHPT). He added these inhibitors to water solution of urine and faeces of cattle and pigs in weekly intervals using 10, 40 and 100 $mg.l^{-1}$ of the treated solution. While total hydrolysis of urea to ammonia occured within 24 hours in the control solution addition of urease inhibitors resulted in decrease of ammonia production on day 28 by 38.48 - 70% in cattle excrements and by 72.91-92.98% in pig excrements. The author recommends to use these inhibitors in animal production houses owing to their extreme effectiveness and low toxicity in the environment. He foresees their highest application in the rearing of poultry.

The presented references indicate that the environmental consequences of application of urease inhibitors into the soil as the final site of disposal of organic manure are well known and recognized there are no reasons for preventing their application directly in animal houses. This scope of problems deserves attention from the point of view of fixation of organic nitrogen and the reflection of appropriate measures in the quality of microclimate of the housed animals.

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MOBILIZACIJA ORGANSKOG DUŠIKA IZ EKSKREMENATA ŽIVOTINJA SA FARMI I MOGUĆNOST UTJECANJA NA PROCES

Sažetak

S energetske točke gledišta, trošak za umjetno gnojivo u zemljama s visokim intenzitetom zagnojavanja je dvostruko veći od troška za gorivo koje se koristi pri radovima na farmi. Upravo zbog toga, te zbog zahtjeva proizvodnje, neizbježno je bolje iskorištavanje organskog gnojiva. U našoj studiji analizirali smo gubitke dušika u procesu proizvodnje i obrade organskog goriva u korelaciji korisnih zamljanih površina i aspekata mobilizacije dušika u okruženje.

Ključne riječi: mobilizacija dušika, organsko gnojivo, mogući gubitci, ekonomizacija proizvodnje

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