POSTER PRESENTATIONS

COMPARATIVE HYGIENE ASSESSMENT OF TECHNOLOGIES FOR ORGANIC MANURE UTILIZATION WITH HIGH CONTENT OF DRY MATTER 2. TOXIC CHEMICAL ELEMENTS

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SUMMARY

Comparative research is carried out with 3 technologies for utilization of organic manure with high dry matter content: manure from no litter breeding of animals and immovable litter from broilers. The first technology is studied at a laboratory for compost. The second technology is methane fermentation, which is conducted with laboratory bioreactor with microprocessor control and the third technology is a combination of the two.

The comparative analysis showed that the highest losses of nitrogen, calcium and phosphorus are in composting, and the lowest in the third technology. For all 3 technologies the content of toxic microelements is under the MRLs registered in regulation 22/2001 for animal biological production.

Keywords: methane fermentation, compost, manure

INTRODUCTION

Litter from broiler production is a source used for increasing soil fertility. Baykov /2003/ proves that there are possibilities for decontamination of litter by temperature treatment and its following utilization as supplement in ruminants' ratio or for increasing soil fertility, including organic production. Methane fermentation technology for litter treatment is very prospective. Some of our research shows that manure obtained from 150 000 laying hens per year is a source of energy equal to the energy obtained from 91,25 t of petroleum /Baykov & Tyrawska, 1991/. During the last few years greater attention is paid to compost as a source of biogenic chemical elements in optimal ratios for plants /Baykov et al., 2003/. Among the admissible soil fertility products, in Ordinance №22/2001 of the Ministry of Agriculture and Forests for organic production of plants, is listed the product obtained after methane fermentation of manure which is known as compost in the United States and as bioslime in Europe.

The aim of the present research is to make an ecological assessment of compost according to the requirements of Ordinance №22/2001 for the MRL/Maximum Residue Level/ values of toxic elements and according to the Norms of the Canadian Ministry of Agriculture/2002/ and to

compare the obtained results to the results obtained in composting and those from the new technology developed by our team.

MATERIAL AND METHODS

Research is carried out with litter from broiler production of four-line hybrid broilers for 45 days. The obtained litter is treated with water – the dry matter in the suspension is 7%. The suspension is then placed in a microprocessor controlled laboratory bioreactor, where a temperature of 33^0C is maintained and the fermentation time is 15 days as determined by the model of Chen & Hashimoto /described in details by Baykov & Tyravska, 1991/. The obtained compost is analyzed for dry weight and for content of toxic chemical elements by applying the methods described by Jorchem /1993/ with AAS "Perkin-Elmer-4100". Parallel to the results in table 1 are listed the results of the analysis of toxic elements in litter after composting as well as results from the developed technology by our team for litter treatment together with calcium oxide and water in the ratio: 75% litter, 20% $Ca(OH)_2$ and 5% water. Table 1 indicates the results of 12 experiments with methane fermentation of manure from laying hens.

Table 1. Content of toxic elements in products after litter treatment

Element Group	Ca mg/kg	Mg mg/kg	Pb mg/kg	Cd mg/kg	Hg mg/kg	As mg/kg	Cu mg/kg	Cr mg/kg	Zn mg/kg
1st group x ± SD	48519.99 ± 11312.00	9399,24 ± 900,43	1,49 ± 0,6	0,27 ± 0,01	0,15 ± 0,06	0,69 ± 0,33	96,7 ± 8,86	28,5 ± 44,1	407,1 ± 38,6
2nd group x ± SD	66659,01 ± 19342,75	11502,13 ± 1427,33	2,05 ± 1,67	0,62 ± 0,25	0,22 ± 0,05	1,02 ± 0,30	213,8 ± 21,4	49,3 ± 72,4	477,7 ± 159,1
3rd group x ± SD	35439,296± 7320,08	8616,92 ± 1007,65	0,91 ± 0,31	0,36 ± 0,16	0,036 ± 0,01	0,23 ± 0,05	125,5 ± 20,8	146,3 ± 224,4	587,8 ± 187,8
4th group x ± SD	25173,996± 3913,15	4466,44 ± 392,70	0,42 ± 0,09	0,08 ± 0,03	0,022± 0,002	0,16 ± 0,07	54,4 ± 3,6	10,4 ± 5,7	195,5 ± 13,8

Key: 1st group – untreated litter, 2nd group – compost obtained after methane fermentation, 3rd group – compost, 4th group – mixture of litter

RESULTS AND DISCUSSION

The results of the experiments are presented in Table 1. Our previous research /Baykov and Chukanov, 2004/indicates that diluting the substrate to 7% is rational with a view to optimizing methane fermentation. 49.2% degradation of organic substance is reached, i.e. a reserve of biogenic chemical elements in accessible/inorganic/ form and in organic compounds is obtained. This characteristic makes the long impact on soil fertility possible.

This research allows us to make an ecological assessment of the content of toxic chemical elements in compost. For 7 of these elements there are normative documents for MRL values in Ordinance №22/2001. The quantities of the analyzed chemical elements for the three technologies are below the MRLs for toxicity. Requirements do not exist in Ordinance №22/2001 for some toxic chemical elements which are important for soil fertility and for the proper function of soil

biocenoses. According to Stancheva/2000/ the phytotoxicity of toxic elements is expressed in the following order: Cu>Ni>Co>Mn>Zn. The acquired results should be interpreted according to the normative documents of other countries, too. We point out the requirements in the normative documents of the Ministry of Agriculture in Canada, which are analogical to those in the United States. It is evident that the requirements for the content of toxic elements in compost are lower in these two countries in comparison with Bulgarian requirements. So if we produce organic plant production, on the basis of these requirements, the quantities of the 10 toxic elements in compost are considerably lower than the MRL values.

The research that was carried out indicates that, in the conditions of the used technology, which parameters are determined by mathematical modeling preceded by laboratory experiments, a certain level of degradation is reached and all small molecules of organic compounds, which characterize the odor of manure, are mineralized. According to other research of ours it is determined that, at the same fermentation regime, all pathogenic microorganisms and eggs of helminthes are exterminated. The consistence of the manure also changes and this makes it possible to disperse it with machines used for fertilizer dispersion. Our results and the experiments of other countries /Al Seadi & Bo Holm – Nielsen, 2002/ are in the same direction: utilization of manure for biogas production solves the energy problems, but in the last few years the qualities of compost are of equal importance as well. According to our research, carried out for the first time in Bulgaria, it is determined that the compost, obtained from the methane fermentation of the laying hens' manure, contains lower quantities of toxic chemical elements than the MRL quantities mentioned in Ordinance №22/2001, that's why this compost can be used in organic plant production.

This study shows that in the two alternative technologies (composting and $Ca(OH)_2$ treatment) we obtain product suitable for increasing soil fertility that meets the toxic element requirements for organic production.

CONCLUSIONS

1. Methane fermentation of laying hens' manure, with 7% dry matter content, allows a high mineralization level to be reached, where the content of dry matter decreases to 4.4%.
2. Compost, obtained by methane fermentation of manure, contains lower levels of 7 basic toxic elements (Pb, Cd, Hg, As, Cu, Cr, and Zn) than the MRLs for organic plant production according to Ordinance №22/2001 of the Ministry of Agriculture and Forests.

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