HYGIENIC ASPECTS OF RECYCLING OF ORGANIC RESIDUALS AND WASTES TO AGRICULTURE

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Key words: animal by-products, organic fertilizers, hygienic safety, composting, anaerobic treatment

Introduction

Recycling of organic material containing tissues and wastes of animal origin is connected with the risk of spreading pathogens of man and animals, especially if animal by-products and catering wastes are involved. Zoonotic agents of bacterial, viral, fungal and parasitic nature can often be found in raw materials as well as under certain epidemiological conditions agents of special veterinary importance as e. g. Foot and Mouth Disease Virus too. Since the aerobic or anaerobic thermophilic process is in principle effective in inactivating most pathogens (sporeformers and TSE – agents excluded) criteria have to be set up to ensure the safety of the applied treatment processes or technologies. Since the regulations EU 1774/2002 has opened the way for recycling of certain animal by-products (fit for human consumption) to agriculture without sterilization the question arises, if moderate heating or composting at 70°C for 1h is really enough to cover the risks due to animal material which can still contain emerging animal pathogens even if it is declared as "fit for human consumption" under the given circumstances. The second open question in Europe concerns the drafted sewage sludge and the drafted composting directive. Until now it is not definitely decided how hygienic safety shall be provided for the resulting products deemed to be recycled to agriculture.

General hygienic aspects in recycling of organic wastes

Three main types of risks mainly related to pathogens for man and animals have to be considered in collection and processing of animal by-products, solid organic wastes and sludges (BÖHM, 1995; BÖHM et al., 1996; STRAUCH, 1998). Those are occupational health risks, risks concerning the product safety and environmental risks. Hygienic risks will be mainly regarded here from the point of view of veterinary epidemiology related to product safety as well as under environmental aspects. Due to the actual legal situation in the EU some special problems concerning the hygienic safety in processing and utilization of animal by - products will be discussed here too. A compilation of general epidemiological risks due to

handling and the utilization of organic wastes as fertilizers in agriculture is given in Table 1.With respect to animal pathogens and zoonotic agents those risks are not the same for every group of used wastes. There are quantitative and qualitative differences between animal by-products including catering wastes and manure, source separated biowaste, biogenic wastes of industrial origin and sludges deriving from municipal waste water purification. The basic risk factor is the occurrence of pathogens in organic waste, sewage sludge and comparable materials which gives the starting point for epidemiological reflections and necessary precautions.

Table 1.Epidemiological importance of processed wastes and residuals as well as of the resulting products

A.	**DIRECT TRANSMISSION TO FARM ANIMALS**
	CONTAMINATION OF MEADOWS
	INTRODUCTION OF PATHOGENS BY STORAGE AND PROCESSING CLOSE TO SUSCEPTIBLE ANIMALS
	AEROGENIC TRANSMISSION BY SPREADING THE MATERIALS ONTO FARM LAND
B.	**DIRECT TRANSMISSION TO HUMANS**
	HANDLING OF CONTAMINATED PRODUCTS IN THE HOUSEHOLD
	OCCUPATIONAL EXPOSURE TO CONTAMINATED PRODUCTS
	ACCIDENTAL TRANSMISSION TO IMMUNCOMPROMISED PERSONS
C.	**INDIRECT TRANSMISSION TO FARM ANIMALS**
	VIA FEED FROM CONTAMINATED SITES
	VIA LIVING VECTORS
D.	**INDIRECT TRANSMISSION TO HUMANS**
	VIA INTRODUCTION OF ZOONOTIC AGENTS INTO THE FOOD-CHAIN
	VIA FOOD CONTAMINATED BY LIVING VECTORS
E.	**INTRODUCTION INTO THE ENVIRONMENT**
	GENERATION OF CARRIERS IN THE FAUNA
	INTRODUCTION INTO THE MICROFLORA

Hygienic aspects in recycling of animal by-products

Special risks are connected with animal by-products, the risks due to TSE – agents are mainly covered by the regulation EC 1774/2002, but with respect to category 3 materials it has been overlooked, that other risks as due to prions may be related to material of apparently healthy animals from the veterinary point of view. Those risks may be caused by bacteria and viruses, especially viral pathogens causing notifiable animal diseases like Foot and Mouth Disease (FMD) which may be present in meat and meat products if the animals had been slaughtered before showing clinical signs of illness. Same applies for small and heat-resistant viruses which may be present in animal by-products like Parvo- and Circoviruses. The latter

will never be inactivated in sufficient amount by the treatment given in the actual regulations. Since supervision of the final products for the emerging pathogens is practically not feasible other strategies must be found one solution will be the monitoring of indicators. But there is no scientific background which indicator shall stand for what group of pathogens in the involved materials; this is different from drinking water and food. This means, that other strategies have to be followed, the most promising is process validation. When only product monitoring is used in order to validate a process, this can provide a false believe that the process is able to control the relevant hazards in the final product. Absence of all or one of the mentioned pathogens or indicators in the final product may be caused by several other reasons:

- They were not present in the raw material
- They were present in the raw material but in a low count (less than 5 log)
- Due to ineffective enrichment procedures (e.g. bacteria), reisolation was insufficient
- Failure of isolation due to effects of the complicated matrix (e.g. viruses)

Therefore the possibility of validating a process by input-output analysis of certain indicators is in principle possible, but under practical conditions a rare event depending on the microbiological properties of the input materials processed and more sophisticated strategies must be followed, e.g. process validation with one or more representative test–organism. Either if the thermophilic process itself or if an additional thermal treatment shall provide the inactivation of pathogens belonging to the indicated level of thermo- and chemo-resistance, representative test-organisms must be exposed in a similar matrix as treated in a suitable test-body in a defined validation experiment. The relevant process parameters must be recorded during the exposure in order to define the technical conditions to be kept for safe inactivation according to the results of the survival experiments. It is desirable to follow such a strategy for processing of category 3 materials. Moreover a second problem is related to recycling of animal by-products as fertilizers to agriculture. Since the feed-ban for meat and bone-meal, the feed is routinely monitoring for animal tissues. There is a zero tolerance due to EU – legislation which must be questioned if processed animal tissue is used as fertilizer. Even due to bones from wild rodents in feed of plant origin the given limit will be exceeded, therefore a more realistic approach is necessary. Moreover a new discussion is needed in Europe if the feed ban in the present form is still justified due to ecological and economical reasons.

Hygienic aspects of recycling other organic wastes of municipal or industrial origin

As well as in the draft of the EU-compost directive as in the sewage sludge directive a strong tendency is found to rely on an indicator concept to judge over hygienic safety of the final products. There are mainly faecal indicators in discussion, but until now there is no scientific background for such a concept, because faecal indicators belong to a product of faecal origin like sewage sludge or slurry. This leads to the basic question, what shall they indicate? On the other hand there are several materials which may contain different pathogens for plants and animals which are not related to the occurrence of faecal indicators. If no indicators are found in the final product the situation will be the same as described above for animal by-products.

Therefore it must be recommended to use also only validated treatment processes in this context. Only a combination of vvalidation of treatment (disinfection by chemical, physical or biological means), continuous registration of the relevant process parameters (e.g. temperature, pH- value, water activity and exposure time), microbiological supervision of the final product (strongly selected indicators) and if necessary restrictions for the utilization of the final product will be effective in achieving hygienic safety in recycling of organic wastes. The selected indicators shall fulfill the following requirements (Böhm, 2004):

- They have to be present with a high probability in the raw materials involved
- If it is a pathogen, the transmission via products must be a factor in epidemiology
- If a biotechnical process is used, the indicator should not be involved in the process itself
- The indicator should not be an organism which is generally present in soil and soil related materials
- The method for isolation and identification must be simple, definitely and reliable if applied to a substrate with a complex microbiological matrix as compost, sludge similar materials.

Restriction in the use of compost resulting from insufficient treatment should either prevent introduction of undesired chemical residuals by contaminated crops into the food chain or direct transmission of pathogens to susceptible animals via feedstuff. This had been practiced in the past especially with sewage sludge. Such a strategy alone does not prevent the environmental risks or introduction of pathogens into vector populations that will lead to indirect transmission cycles. This has been demonstrated by several authors.

Conclusions

The present regulations concerning animal by-products as well as the drafted compost and sewage sludge directives are containing partly insufficient strategies for reaching hygienic safety of the resulting products. It is proposed to establish a three step strategy as follows:

Step I is a process validation with raw material dependant (epidemiological considerations) test organisms in order to define the parameters for a safe process and the critical control points

Step II is the continuous supervision and recording of process related technical control parameters

Step III is end product supervision designed to be a valuable component in a HACCP-concept.

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