

GENERAL AND MICROBIOLOGICAL ASPECTS OF ENVIRONMENTAL PROTECTION AND PUBLIC HEALTH RELATED TO ANIMAL HYGIENE

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Summary

Agricultural, municipal and industrial sources are contributing to improve the positive impacts of production, processing, distribution and recycling of nutrients in the broadest sense. The conditions under which the keeping of animals, the production of food and feed, the processing of the raw materials and their distribution is done as well as the resulting by-products and wastes are used may differ substantially world - wide. Independently from the local situation the general aim is to keep man and animals healthy and to avoid negative effects to the mediate and immediate environment. As long as health protection is the direct or indirect aim of the necessary measures, hygiene is the tool which avoids the negative consequences with respect to man and animals in close cooperation between medical and veterinary hygienists. Negative health and environmental effects may be generated by the distribution organic or inorganic pollutants as well as pathogens or other microorganisms with undesired properties. Hygiene prevents their introduction or generation at every step of production, processing, distribution and utilization, therefore a survey is given how this can be achieved.

I. INTRODUCTION

Agricultural production, either the primary one (e.g. meat, milk, eggs) or the secondary production by processing by - products and wastes (e. g. feathers, bones, hides, fertilizers) is connected with biotic and abiotic risks for man and animals as well as the environment. The same applies for municipal organic wastes deemed to be recycled to agriculture (e.g. municipal waste compost, sewage sludge). Industrial processing of organic materials related to agriculture as well as agricultural products of animal origin itself are also related to the above mentioned risks. In this context the risks in all three areas are regarded separately, but it must be kept in mind, that they are closely related to each other in a lot of overlapping fields in which they mainly depend on the health status of the animals in the primary production step. Some important biotic and abiotic risk factors which are related to individual and public health problems are listed in Table 1.

2. ANIMAL HYGIENE AND PRIMARY PRODUCTION

Safe primary production is only possible if adequate measures in preventive healthcare had been taken with respect to the target animals. This starts with monitoring the mediate environment and continues by strictly controlling the feed - quality as well as applying strict hygienic measures to the immediate environment of the animals. Those methods shall be related to veterinary measures as vaccination and prophylactic antiparasitic treatment. A compilation of measures is given in Table 2. With regard to biotic factors, microbiological examination of feed for zoonotic and other pathogens as well as for related toxins is important (DFG,2000). This has to be combined with microbiological

and / or serological examination of the involved animals themselves and such measures as prophylactic cleaning and disinfection. If the animals are kept under open air conditions, access of vectors has to be controlled and hygienic regimes for the pastures and other premises for free ranging animals has to be strictly organized and kept.

Table 1. Biotic and abiotic risks related to primary production in animal husbandry

ORIGIN	BIOTIC FACTORS	ABIOTIC FACTORS
Environment	Airborne, soilborne and waterborne pathogens	Heavy metals and organic pollutants from immissions caused by traffic, household and industry or natural soilborne minerals
Feed	Pathogens from feed components or contaminations by improper processing, handling, storage and transport. Microbial toxins.	Heavy metals and organic pollutants introduced by the raw materials, processing, handling, storage and transport
Living vectors Inanimate vectors	Selected pathogens propagating and /or persisting in/on the vector or carried on the surface	Ingestion of living vectors (dead or alive) poisoned by pesticides. Due to contamination of the surface
Animal Housing	Transmission of obligatory or facultatively pathogenic organisms via faeces, air, water - supply, surfaces, equipment and installations	Uptake of toxic or persistent compounds from paints or materials by oral route or airborne.
Treatment	iatogenic transmission of pathogens, elimination of the antagonistic flora, generation of antibiotic resistance	Application of unlicensed drugs, not keeping waiting times

This means, that a combination of organisational measures, adequate animal housing /grazing grounds with selected veterinary measures are necessary to achieve, keep or improve the hygienic conditions under which the primary production is done. If a population of animals is not healthy, especially if it sheds pathogens, the epidemiological risk for man and animals is growing to get infected by contaminated products in the broadest sense as could be seen by the example given in Table 3. Thus hygienic safe treatment of effluents is necessary as long as the related flock of animals is not kept healthy by preventive health care mainly supported by the knowledge and techniques of animal hygiene. From the point of view of public - and occupational health, moreover the transmission of zoonotic agents to humans by contact or via air has to be taken into account and prevented by adequate hygienic measures.

Not only obligatory pathogens originating from animal husbandry may represent a risk for human health, multiresistant bacteria resulting from uncontrolled application of antibiotics may be introduced in the environment and via products into human populations with the already known negative consequences for medical health care (Tschäpe, 1996).

3. ANIMAL HYGIENE AND RECYCLING OF ORGANIC WASTES

Recycling of organic wastes and residuals is a common way of recycling nutrients to agriculture. For this purpose solid materials as municipal - or source separated bio - wastes are mainly processed to compost while liquid organic wastes like sewage sludge is mainly used in the original state or also

processed by composting together with solids. Mainly three general hygienic risks exist in handling such wastes

- Occupational health risks
- Environmental risk
- Risk concerning product safety

Table 2. A compilation of selected measures to be taken for safe animal production

TARGET	MEASURE
<u>Animal population</u>	<ul style="list-style-type: none"> • Monitoring for pathogens on farm level • Serological monitoring on farm level and in slaughterhouses • Allergic probes for detection of chronic proliferating infections • Vaccination • Preventive treatment
<u>Feedstuff</u>	<ul style="list-style-type: none"> • Monitoring for pathogens and spoilage organisms • Monitoring for selected microbial toxins • Monitoring for organic and inorganic pollutants • Monitoring for presence of living vectors (e.g. <i>Alphitobius diaperinus</i>) • Safe transportation and storage • Regular examination, cleaning and disinfection of storage facilities (e.g. silos) • Careful and professional preparation of feed on farm level
<u>Animal houses</u>	<ul style="list-style-type: none"> • Careful selection of the building site under hygienic aspects (animal and environmental hygiene) • Construction of animal houses with materials supporting hygienic measures and in a way preventing environmental pollution • Avoiding construction materials and paints generating residues in animal tissues • Safe handling and storage of manure, losses and wastes • Regular cleaning and disinfection • Regular monitoring of the hygienic status of the building including occurrence of living vectors (e.g. rats and mice) • Taking preventive measures to avoid introduction of pathogens, rodents and insects into the building
<u>Premises for free ranging animals</u>	<ul style="list-style-type: none"> • Hygienic safe management of pastures and grazing grounds • Regular cleaning and disinfection of outdoor hard surfaces • Control of living vectors (e.g. ticks, tabanides) • Supply with hygienic safe and non polluted water (drinking water quality) • Hinder access of closely related game and according to the region also of vultures

Table 3. Examples of outbreaks of foodborne illness in the US associated with fresh produce or produce products (Doyle, 2002)

PATHOGEN	FRESH PRODUCE
<u>E. coli O 157:H7</u>	<ul style="list-style-type: none"> • Apple cider • Coleslaw • Lettuce • Sprouts
<u>Salmonella</u>	<ul style="list-style-type: none"> • Apple cider • Cantaloupe • Orange juice • Sprouts • Tomatoes • Watermelon

In this connection only the risks concerning product safety and the environmental risks in the framework of agricultural utilization with respect to the existing epidemiological background are regarded. A compilation of general epidemiological risks due to handling and the utilization of organic wastes as fertilizers in agriculture is given in Table 4. 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 manure, source separated biowaste, biogenic wastes of industrial origin and sludges deriving from municipal waste water purification.

The role of animal hygiene in this connection is additional to the general aim of keeping the primary production free of emerging organisms to set up rules for hygienic safe treatment of the involved materials as well as for the utilization of the resulting products in agriculture.

Biological, chemical and physical methods may be applied in order to inactivate pathogens. All methods may be successful in order to reach this purpose but some have special limitations. Nature and number of pathogens basically determines the requirements concerning the applied process, as well as the epidemiology, e.g. the occurrence and distribution of the relevant pathogens in the target region. One of the most important tasks of animal hygiene in this connection is to determine the key pathogen which may be found regularly in organic wastes, wastewater and in sludge. In western Europe and North America this are the Salmonella, thus treatment must inactivate those types of pathogens with sufficient safety e.g. by reducing them at least for 5 log steps. This may apply to other key - pathogens under other epidemiological conditions also.

Table 4. Epidemiological and environmental risks related to processing and utilization of organic wastes and residuals as well as to 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 IMMUNOCOMPROMISED PERSONS
C.	INDIRECT TRANSMISSION TO FARM ANIMALS
	VIA FEED FROM CONTAMINATED SITES
	VIA LIVING VECTORS
D.	INDIRECT TRANSMISSION TO HUMANS
	VIA INTRODUCTION OF ZOO NOTIC 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

Such strategies require input from experts in animal hygiene which have to feed the following strategy to assure product safety for agricultural use of the recycled materials consisting of:

- | Validation of treatment (disinfection by chemical, physical or biological means)
- | Continuous registration of the relevant process parameters (e.g. temperature, pH-value, exposure time)
- | Microbiological supervision of the final product (indicators)
- | Restrictions for the utilization of the final product.

While the first step requires the determination of a key-pathogen as mentioned above, the third step requires the selection of a representative indicator and the application of reliable reisolation methods. The third step also needs input from experts: what is hygienic safe utilization on farm level and what not? In the past, research in the field of animal hygiene has filled in most gaps in the European context, while still research is needed in other regions of this world.

4. ANIMAL HYGIENE AND RECYCLING OF ORGANIC MATERIAL FROM INDUSTRIAL SOURCES

Recycling of organic industrial by - products and wastes has a long tradition. General there are two levels from the economical point of view.

- Recycling as feed
- Recycling as fertilizer

Both ways require the input of expertise from the point of view of animal hygiene. The epidemiological situation is significantly different, because pathogens in feed either originating from insufficient processed materials of animal origin or from contamination during false storage, handling and transport of feed prepared either from animal or plant residues are directly transmitted to the host mainly in the natural way of transmission without any dilution. As can be seen from Table 4 transmission of pathogens via fertilizers is mainly an indirect one, often connected with a drop in concentration of the agent. Nevertheless there is a substantial difference concerning the epidemiological risk for susceptible animals if recycling of catering wastes is compared with that of normal biowastes. Those risks are connected with the occurrence and survival of certain viral pathogens causing notifiable diseases in animals like classical swine fever or food and mouth disease. The first factor of special epidemiological importance is the longtime survival especially in frozen meat or in meat products. The second factor is that they may contain high amounts of infective viruses, because they may have been purchased in an epidemiological connected lot of meat and processed together in the catering facilities resulting in relatively high

concentration of pathogens present in the material. Special care has to be taken therefore if such residuals, are used as feed (swill) or are treated in biotechnical aerobic or anaerobic processes.

It is the task of animal hygiene to prevent spreading of pathogens by this route and to set the requirements for safe recycling of such materials. Recently it has been learned that the consequences of not following strict hygienic rules may be severe, especially with respect to the higher level of recycling the residues as feed, as can be taken from the European example. For raw materials of plant origin this way of recycling still exists, while the situation has changed dramatically for those of animal origin in the last years in Europe. In 1995 the EU recycled 2.500 000 Mg of meat and bone meal. After not applying already existing knowledge, the state of technique and the strict rules of animal hygiene in the rendering process, a transmissible agent of spongiform encephalopathia had been introduced into the susceptible populations of ruminants in Great Britain via feed, which affected several other countries too. This finally lead to the feed ban for meat and bone meal in Europe instead of setting legal requirements for a safe rendering process in all member states. After this development the only existing way is recycling of organic wastes of animal origin on the second and lower level as fertilizers, under conditions fixed in the European Animal By - Product Regulations (2002).

The general requirement of this regulation is, that the material allowed for recycling must come from animals fit for human consumption. This is the next dramatic error from the point of view of animal hygiene and epizootology, because in recycling to agriculture the targets are mainly the animals and not the human population. It is the task of experts in animal hygiene to correct errors of politicians and to prevent similar developments in other regions by elaborating and distributing relevant data which will be helpfull for a realistic approach in solving actual problems in public and veterinary health care.

5. REFERENCES

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