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ARTICLE

Importance of animal husbandry and production management on food safety in livestock production systems

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ABSTRACT Production and management systems do significantly effect animal health and therewith the use of drugs and prophylactic treatments. This may lead to residues and a change for the worse in food safety. The consequent implementation and use of hygiene and management tools and measures is needed, as well as a combination of these measures with effective programmes (e.g. vaccination, procedure with cleaning and disinfection, all in all out etc.) in order to limit the use of drugs in sick animals so they are used only when absolutely necessary. A better education among producers is also an important step towards higher food safety on farm level **Acta Biol Szeged 50(3-4):109-113 (2006)**

KEY WORDS

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Food safety is a significant concern of consumers. Ironically, there is an inverse relationship between food safety and consumer concern about food safety. As the food supply has become increasingly safe, people become .... increasingly „hysterical“ about what „agribusiness“ is doing to their health“ (Cheeke 2004)

This statement seems to be really true at least for Western European countries, where food safety is of major concern for consumers, but in reality food became more safe over the last decade. For example in Denmark every year 20,000 samples are taken from fattening pigs at commercial slaughter houses and are tested for antibiotics and chemotherapeutics, hormones and growth promotants, pesticides and heavy metals. Over the last decade only 0.01 to 0.05% positive samples were found (Nielsen 2002) containing antibiotics and/or chemo-therapeutics. However consumers are reacting very sensitive to any anticipated episodic events like the BSE (Bovine spongiform encephalopathy) crises has shown. Thus consumption rates are immediately decreasing (Figure 1).

Because food production is a very complex procedure and products from animals bear a potential health risk for consumers, depending on management qualities on farm and production levels, food safety has to start on the farm. These on-farm efforts will greatly influence everything else that must be done during the processing and distribution of food.

The potential risks for consumers are mainly microbes including zoonotic bacteria (e.g. *Salmonella*, *Campylobacter*, *Escherischa coli*, *Brucella*, *Mycobacteria*), residues or contaminants of feed additives (antibiotics, antiparasitics), growth promotants and various chemicals including pesticides, disinfectants, environmental contaminants. Therefore the ways to ensure food safety have to start in principle on production level. These are:

1. the elimination (e.g. *Mycobacteria*, *Brucella*), control and/or reduction of zoonotic bacteria on farm level (e.g. *Listeria*, EHEC, *Clostridia*, *Salmonella*, *Toxoplasma*, *Campylobacter*),

2. the reduction of prophylactic and therapeutic use of drugs by improving management factors and

the reduction of chemical contamination.

If these ways are followed consequently on farm and all other production levels a number of conflicts are arising. For example the elimination or control of bacteria mostly comes along with an increase of the prophylactic use of drugs and/or of disinfectants. This conflict can be seen for example in Denmark, where antibiotics in feed have been banned -since the year 2000, which lead to an increased use of therapeutics on farms (Figure 2).

The animal husbandry and production management influences food safety in livestock production on different levels. Many factors may have a direct or indirect effect on food safety e.g. the used genotype, the type of farm (organic or conventional, low- or high-Input system), the farmers education, buildings (production technique/ procedure/ stocking rate), feed stuffs, health and hygiene management etc.. In this paper some examples are given from various production systems.

Genotype and food safety

Breeds have genetically based differences in the resistance

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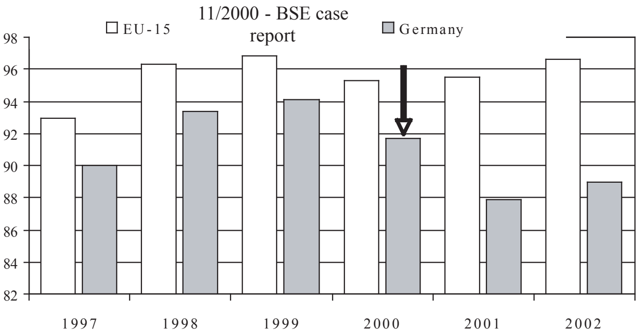

Figure 1. Meat consumption (kg) per capita in the EU-15 and Germany (incl. innards) after first case report of BSE (ZMP, 2003).

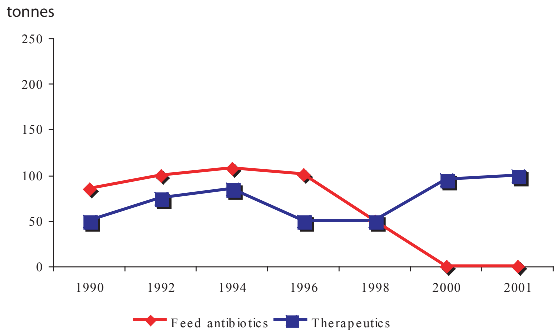

Figure 2. Application of antibiotics in Danish animal production (Danske Slagterier 2002).

against various infections like for example parasites. Pasture management and strategic anthelmintic use are the classical methods to control for example gastrointestinal nematodes. The increase of resistance of internal parasites to anthelmintic treatments and concerns over possible chemical residues, environmental impact and cost of treatments have led to an increasing interest in alternative control methods. The use of more resistant genotypes is one of them. It can lower the total amount of drugs administered and possible chemical residues. Therefore the choice of genotype directly effects the food safety on production level.

Estimated heritabilities for indicator traits of parasite resistance in different species proving the possibility to breed for these traits (Table 1).

Management systems and food safety in beef cattle

Jäger et al. (2005) examined the excretion of faecal stages of different parasites (*Giardia duodenalis*, *Cryptosporidium parvum*, *Eimeria* spp., *Strongyloides papillosus* and S. *strongyles*) and their extensities and intensities in suckler calves of beef cattle herds kept in differenthousing systems. C. *parvum* infections showed for example the highest extensities when animals were kept indoors on deep litter without run-out (Figure 3). Whereas the lowest *Eimeria* extensities and intensities were found in animals kept indoors on slatted floor and animals kept outside. Coccidiosis is one of the most important endoparasitic protozoal infections in calves. It can be a serious clinical problem, causing diarrhoea and reduced growth. Its economic importance lies mainly in the lowered productivity caused by reduced growth rates, delayed age at first service and calving, reduced live performance and total economics. Therefore it has to be treated. The paper clearly showed, that the management system influenced frequencies of subclinical and clinicial diseases and the total amount of drugs needed. Thus an increase of prophylactic and therapeutic use of drugs as consequences on food safety (residues).

Management systems and food safety in dairy cattle

Fossler et al. (2004) studied the connection between the management system and the isolation of Salmonella in dairy cows (n = 20,089) and pre-weaned calves (n = 4,673) on 129 farms. Of the faecal samples taken, 4.9% from cows and 3.8% from calves were *Salmonella* positive. The factors associated with increased odds for *Samonella* shedding were:

no routine feeding of medicated milk replacer,

use of calving pen as a hospital area for sick cows more then once a month,

not storing all purchased concentrate or protein feeds in an enclosed building,

not using monensin in weaned-calf or bred-heifer diets,

Table 1. Heritabilities of indicator traits for parasite resistance in sheep (Haemonchus contortus-resistance) and chickens (Ascaridia galli-resistance) (Gauly et al. 2001, 2002).

Species	Breed/Genotype	Indicator trait	Heritability
Sheep	Merinoland	Faecal egg count	0.17
	Rhön	Faecal egg count	0.12 – 0.35
	Rhön	Haematocrit	0.08
	Rhön	Antibody titer	0.30
Chicken	Lohmann Brown	Faecal egg count	0.10
	Lohmann LSL	Faecal egg count	0.19

Table 2. Frequency of egg contamination with bacteria (E. coli, Proteus and others) in relation to management system (Matthes 1983).

	Free range	Floor system	Cage
Shell surface	53.0 %	28.1 %	11.3 %
Inside shell (bacterial penetration)	5.0 %	2.5 %	0.0 %
Egg yolk	3.1 %	0.6 %	0.0 %

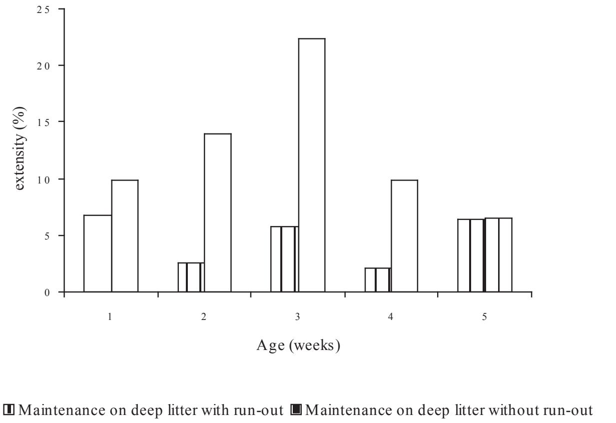

Figure 3. Age dependent extensity of Cryptosporidium spp. oocyst excretion of German Angus beef cattle calves maintained in housing on deep litter with (n = 50) and without run-out (n = 73) (Jäger et al. 2005).

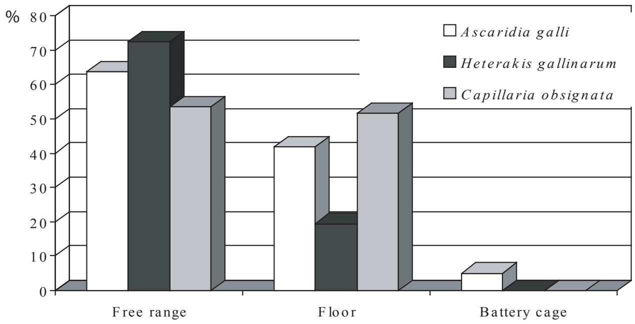

Figure 4. Prevalence (%) of gastrointestinal helminths in relation to production system (Permin et al. 1999).

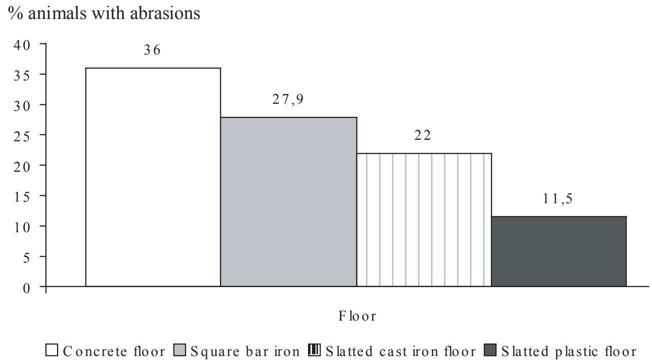

Figure 5. Frequency of intense abrasions in nursery pigs caused by floor system (Hoy 2003).

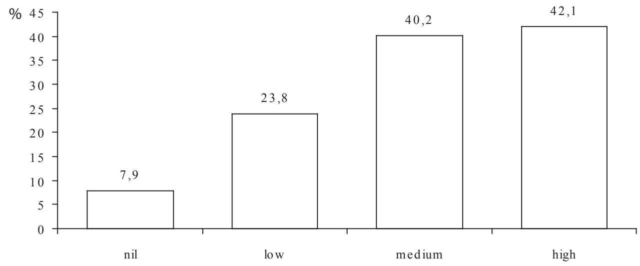

Figure 6. Relationship between degree of abrasions in nursery pigs and the frequency of arthritis treatments (Hoy 2003).

cow access to surface water,

disposal of manure in liquid form on land and

eating or grazing roughage by cows from fields having surface application of manure during the growing season.

Factors not associated with increased odds for *Samonella* shedding were herd size and farm type (organic/conventional). The authors concluded that management factors do influence the prevalence of *Salmonella* and therewith food safety.

Shitandi and Sternesjo (2004) evaluated the prevalence of multidrug resistant Staphylococcus aureus in Kenyan milk and investigated the differences in antimicrobial resistance between large- and small- scale producers. Susceptibility profiles for penicillin G, tetracycline, erythromycin, trimethoprim/sulfamethazine, and chloramphenicol were determined for *Staph. aureus* (n = 402) isolated from cows with subclinical mastitis. There was a significant difference in the overall mean resistance profile between large- and small-scale farm isolates. The overall prevalence of multidrug resistance differed significantly between isolates from small (34.3%) and those from large farms (18.0%). Additionally, the producers were interviewed about their usage of antimicrobial drugs and their attitudes towards education in related fields. There was an evident difference between the producer types in their documentation of the use of antimicrobial drugs. Small-scale farms were less inclined to documentation, and treatment records were available from 22% of the small-scale farms, compared with 73% of the large-scale farms. Farmers expressed a need for more information in 5 areas, ranking preventive management highest; followed by affordable tests to control residues in milk; preparation of antimicrobial drugs; public health concerns; disposal of surplus antimicrobial drugs; and antimicrobial drug residue persistence in milk. It was concluded that herd size might be an indirect risk factor in the development of antimicrobial resistance in Staph. aureus within the region. The results further suggested that lack of understanding of risks related to antibiotic contamination of food, poor or no treatment records, and lack of a monitoring system were the major risks for contamination. In conclusion the education among dairy producers greatly affects the occurrence of antimicrobial residues in milk (Shitandi and Sternesjo 2004).

Table 3. Antibiotic residues in eggs in relation to management system (Hafez et al. 1988; Friedrich et al. 1985).

		Residues in egg after treatment (days)	
Antibiotic, concentration	Days of treatment	Cage	Floor system
Nicarbazin (2 mg/kg Futter)	29	16	> 60
Tetracyclin (500 mg/l water)	7	26	37
Enrofloxacin (50 mg/l water)	4	8	> 46

Table 5. Effects of cleaning and disinfection on performance and health in pigs (Anonymous 1998).

	Cleaning and disinfection yes	Cleaning and disinfection no
Farms (%)	47.9	52.1
Daily weight gain (g)	683	649
Costs for vet and disinfection/animal (€)	0.97	0.94
Mortality (%)	3.08	3.4

Management systems and food safety in chickens

It has been proved in many systems that excellent hygiene management can significantly lower the use of drugs. In industrialised countries most laying hens are kept in cages where they are separated from their faeces. Faeces are the main source of many infections. As a result the prevalence and economic importance of infections in chickens has been very low in recent decades (Permin et al. 1999). Besides positive hygiene effects, cages had other major advantages like economical factors, productivity (eggs, food conversion rate etc.), less stress for the animals because of smaller group sizes, less bird aggression and cannibalism and low mortality rates. The major disadvantage of cages is that the expression of some essential behaviour forms is limited or not possible including nesting behaviour, dust bathing and stretching. Therefore lately, animal welfare issues and changes in consumer demands have resulted in new upcoming EU-regulations. These include a ban of conventional cages after the year 2012. Only so called enriched cages (claw abrasives, nests, dust bathes, perches) and floor housing systems will be allowed in most European countries (Germany will ban all forms of cages) after the new regulations. The use of floor systems will result in a renewed importance of different diseases. It was demonstrated by various authors that in floor systems there is an increase of bacterial and viral diseases (Table 2), parasite infections (Figure 4), mortality, total drug treatment, dirty and cracked eggs and chemical residues in food products (Table 3) as well as in the environment. Therefore floor systems are negatively correlated with food safety!

Table 4. Effects of vaccination against Mycoplasma hyopneumoniae on fattening performance in pigs (Welp et al. 1999).

Vaccination	Yes	No
n =	12.000	20.000
Daily weight gain (g)	697	682
Feed conversion rate 1 :	2.97	3.03
Mortality (%)	2.54	3.54

Management systems and food safety in fattening pigs

Hoy (2003) showed that the frequency of intense abrasions in nursery pigs are related to the quality of floor systems (Figure 5), which is correlated with the frequency of arthritis treatments needed for the subsequent life of the animals (Figure 6).

The major ways to improve hygiene on pig farm level are vaccinations, all in-all out management, cleaning and disinfection and the control of the transfer of animals, staff ,feed stuff etc.. The effects of vaccination against Mycoplasma hyopneumoniae on fattening performance in pigs and the effects of cleaning and disinfection on performance and health in pigs are shown in tables 4 and 5. It was clearly shown that housing and management influence pig health, which is directly correlated with food safety!

Overall conclusions

Production and management systems do significantly effect animal health and therewith the use of drugs and prophylactic treatments. This may lead to residues and a change for the worse in food safety.

The consequent implementation and use of hygiene and management tools and measures is needed, as well as a combination of these measures with effective programmes (e.g. vaccination, procedure with cleaning and disinfection, all in all out etc.) in order to limit the use of drugs in sick animals so they are used only when absolutely necessary. A better education among producers is also an important step towards higher food safety on farm level.

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