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DEVELOPING EDUCATION IN GOOD PRACTICES TO MANAGE BIOSECURITY RISKS AT FARM LEVEL

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1 INTRODUCTION

The biosecurity concept is used at many levels and has several definitions (Quianlan et al. 2016). In general, biosecurity is defined as an integrated approach to prevent, control and manage risks to human, animal and plant life and health, as well as environmental risks (International Food Safety Authorities Network 2010). In the Canadian biosecurity instructions for beef cattle farms the definition reads as "a series of management practices designed to minimize or prevent and control risks by knowing how to manage infectious disease agents at farms" (Government of Canada 2016). The factors affecting the biosecurity are e.g. animal movements, movements of people, tools, equipment and vehicles, as well as proper health practices for the animals (Government of Canada 2016). Furthermore, the spread of diseases in and beyond the farm may have an adverse effect on the economy, environment, animal and human health (Niemi, Wirtanen & Kallioniemi 2020b).

Good health is an essential part of animal welfare. The prevention of diseases is an important way to ensure and improve the well-being of farm animals (Ministry of Agriculture and Forestry in Finland 2019). Animal diseases cause direct costs to farmers through treatment and medication costs, decreased efficiency of production and lost value of animals (Niemi 2002). In addition, indirect losses may be caused by restriction in international trade and other market failures.

Good biosecurity measures and prevention of diseases help to reduce the use of antibiotics in animal care (Princeton University 2019; Finnish Food authority 2019). This in turn reduces the risk of drug-resistant bacteria being developed. Health and medication of production animals are also connected to public and environmental health. In Finland, less antimicrobials are used in animal production than in many other European countries (European Medicines Agency 2019; ESVAC 2019), but some resistant zoonotic bacteria have been detected, e.g. MRSA in pigs. In the Finnish Zoonosis strategy, biosecurity is recognized as an important mean to control the risk of antimicrobial resistance (Finnish Food Authority 2019).

The study by Sahlström and co-workers (2014) revealed that the biosecurity on Finnish cattle, pig and sheep farms should be improved. According to Niemi et al. (2016), biosecurity could be promoted by sharing information on its benefits. Furthermore, practical advice on how to improve biosecurity, especially in cost-effective ways, is still needed. Currently, such information is available, but it has to be compiled from several organizations websites and publications and thus it may be difficult to obtain a full picture on all updated procedures (Niemi et al. 2020b). The School of Food and Agriculture at Seinäjoki University of Applied Sciences will in the future invest in education and training in biosecurity aspects within animal production for both Finnish and international students as well as foreign workers at Finnish farms. The background and content of this education will be discussed in this article.

2 BASICS OF BIOSECURITY IN ANIMAL FARMS

Biosecurity on animal farms is often divided into external and internal biosecurity. External biosecurity means measures taken to prevent diseases and pathogens from entering the farm and herd. Internal biosecurity means preventative measures taken to mitigate the spreading of pathogens within a herd. Measures in external biosecurity include: 1) entrance of employees and visitors, 2) purchase of live animals, embryos or semen, 3) transportation of animals including export

of animals, 4) feed and water supplies, 5) removal of manure and dead animals i.e. carcasses, 6) supply of materials, 7) infrastructure, 8) biological vectors e.g. rodents, vermin, wild animals and birds, insects and pets, as well as 9) location of the farm (Biocheck.UGent 2020a; 2020b). The main internal biosecurity elements are: 1) animal health management, 2) working organization, 3) partition, movements between compartments and use of equipment, 4) calving or farrowing management as well as 5) cleaning and disinfection (Gelaude et al. 2014; Biocheck.UGent 2018; Damiaans et al. 2020). Furthermore, FAO in cooperation with OIE and the World Bank (Good practices 2010) have stated that the three main elements in biosecurity are segregation, cleaning and disinfection. It can be stated that practical details and their mutual importance varies between the production sectors.

The first step to an internal biosecurity plan is risk assessment i.e. identifying the particular disease transmission risks for individual animals, the animal herd and the people working in the premises. For this purpose, checklists containing details relevant in the production sector of the farm are useful (Niemi et al. 2019; 2020b). Checklists are available e.g. from dairy and slaughter companies, Animal Health ETT association and the authorities (Eläinten terveys 2020). Scoring protocols for biosecurity have also been developed (Biocheck.UGent 2018). After the assessment, most critical measures are chosen and proper improvements for these are scheduled (Niemi et al 2020b).

The biosecurity plan must be practical so that people working at the farm can adhere to it easily. Farms are obliged to have own-checking descriptions to analyse and control risks in the production. This description must include cleaning procedures of premises, equipment, tools and animals. Measures ensuring the quality of water and feed, vermin control, processing of waste and traceability of animals must be implemented. Precautions taken in use of chemicals, medicines and other biocides must also be available. This own-checking system and quality control programmes are possible tools in applying a biosecurity plan in practise e.g. written work instructions can be checked. (Regulation (EC) 852/2004.)

3 MEASURES TO COMBAT PATHOGENS IN ANIMAL SHEDS

The animal disease situation in Finland has remained at a good level, because Finland is free from the most highly contagious animal diseases. Many infectious diseases, which are common elsewhere in Europe, are not an issue in Finland (Ruokavirasto 2020). Even though *Salmonella* has been detected in cattle, pig and poultry farms in recent years, the incidence has remained at a low level, i.e.

below 1 %. Animal diseases are commonly not spread from wild animals, wild birds, vermin, rodents and insects to production animals, although these pathogens are observed in wild animals. Besides the wild animals, the most significant threats in spreading animal diseases are contaminated feed, animals bought from breeding stables infected with contagion diseases and import of infected animals (see also Text box 1). Prevalence of *Salmonella* is monitored in animal feed and the feed should be bought from entrepreneurs on ETT's Positive List (Eläinten terveys 2020). Zoonoses, animal diseases spreading animal-to-human and human-to-animal, in Finland include e.g. salmonellosis, campylobacteriosis, listeriosis, yersiniosis, cryptosporidiosis and EHEC (Ruokavirasto 2019; 2020). Other animal diseases monitored are e.g. bovine tuberculosis, brucellosis, rabies, avian influenza and BSE (Ruokavirasto 2020). In Finland, Animal Health ETT provides guidance and advice in how to combat animal diseases e.g. *Salmonella* (Ruoho 2016; Eläinten terveys 2020).

Text box 1. Pathogens can spread at farm level through (Biocheck.UGent 2020a; 2020b).

- people, rodents, vermin, insects, wild birds and animals,
- trade with and transportation of production animals,
- transportation of carcasses,
- manure, urine and other excretion,
- feed, water and bedding,
- coveralls, caps, gloves and footwear of personnel and visitors,
- instruments, tools, equipment, vessels and vehicles

3.1 Hygiene locks and personal biosecurity practices

The barriers in the hygiene locks clearly distinguish the outdoor area from which workers and visitors enter the animal shed i.e. the production facility (Picture 1). The barrier can be e.g. a bench, a grating, a low wall or a wooden plank fixed in the floor/wall. It can be as simple as a floor-taping showing where you leave the dirty area and enter the clean area. As shown in figure 1, people arriving to the hygiene lock in the animal shed should properly wash, disinfect and dry their hands as well as change clothing and footwear. The protective clothing must be provided by the animal farm. It should include coverall, footwear, caps and gloves and when needed respiratory protective mask. When moving from one animal department to another the persons should change protective clothing according to the farm's own-checking system. Visiting persons carrying out professional service task should start with the youngest animals, thereafter the visitor should proceed to older ones, which are more resistant than the young animals,

and finally treat the animals in the sick cubicle. The worker should always use the department's own tools, which have been cleaned properly. Furthermore, the tools and equipment in-use at various farms must be washed properly and disinfected before they are brought into the animal shed. The farm owner should have hand-washing points installed between the departments besides those installed in the hygiene lock. Moreover, when the persons leave the shed, they should again wash, disinfect and dry their hands properly and change to own cloths. (Niemi et al. 2020b.)

Picture 1. Examples of areas in the contagion protection (Photos: Kimmo Nissinen / Sedu & Vacca Oy).

Figure 1. This drawing shows the correct phases in hygienic working routines (Picture: Tussitaikurit).

The farmer is responsible for that the hygiene lock area is properly equipped. Persons entering the animal shed should be approved by the farmer or by another person responsible for the workers in the shed. The responsible person must correct the visitors' behaviour, when they are moving wrongly in the hygiene lock or the animal shed. Note, that the visitors should touch the animals only just in cases when they are carrying out tasks related to animal treatments. (Niemi et al. 2020b.)

3.2 Hygienic design of internal areas and barriers in the animal shed

Hygienic building design is essential in areas related to production of food in the whole food chain. The three hygiene levels in food production are basic, medium and high hygiene areas (EHEDG 2014). Building design in the basic zone may be simple with e.g. smooth concrete floors, exposed steel work and natural, screened ventilation and lightning. Basic physical segregation is applied with walls and doors. The basic hygiene barrier level apply for primary production and shall include correct tool and feed flows, personal hygiene facilities with hand washing and potable water supplies, support for cleaning, maintenance and waste control (EHEDG 2014). The personnel's hygiene is supported with a clearly conceived and well-equipped hygiene lock. Furthermore, there should be proper places for tools to be placed during storage (Niemi et al. 2020b). In dairy cowsheds there should be hygiene locks in areas at all hygiene levels. There should be information for the personnel, when he/she is entering/leaving the different areas e.g the milk kitchen, which is medium-level area, and the farm tank, which is high-level area. Utensils, tools, equipment etc. should be properly decontaminated before they are brought into these areas. Hand washing is required upon entry from lower to higher hygiene areas. Requirement for operatives to change footwear and/or clothing is based on hazard analysis performed in the farm's quality system. (EHEDG 2014; Niemi et al. 2020b.)

3.3 Cleaning and disinfection of cubicles

The person performing cleaning in the shed must use necessary protection. Electrical installations, motors etc. are to be sealed and cleaned manually. Thereafter the cleaning procedure continues with a thorough removing gross soil. Both the cleaning and disinfection starts from above, then walls and thereafter the floor and last at last vessels and equipment used e.g. in feeding. The surfaces are soaked with detergent for 2 - 3 hours to dissolve the dirt; here a low-pressure nozzle can be used to apply the foam. Concentration of agents and duration of cleaning are important. The manufacturer's instructions should carefully be followed. As much dirt as possible are to be removed using low-pressure cleaning. Note that high pressure spread pathogens through bioaerosols i.e. microbes in small water droplets, which stay in the air for a long time after cleaning, and contaminate already cleaned surfaces. If hot water (60°C) with a suitable detergent can be used, the cleaning effect may increase. The cleaning is completed, when dirt is no longer visible. See information in Text box 2. (Ruralia Institute 2018; Niemi et al. 2020b.)

Text box 2. Steps in cleaning and disinfecting cubicles (Niemi et al. 2020b).

- Shield the electrical installations.
- Remove litter, manure and other dry material.
- Remove all detachable parts, which must be cleaned separately.
- Clean and seal the electrical installations.
- Soak the surfaces with a cleaning solution containing water detergent in hot water.
- Wash manually with a brush or low-pressure device until all visible soil is gone.
- Dry the structures until they are completely dry. Sunlight helps in killing certain microbes.
- Disinfect structures using the low-pressure device. Let the disinfectant to act on the surfaces according to the fact sheet of the agent producer.
- Remove the cover from electrical installations and equipment. Disinfect these using a cloth soaked in disinfectant.
- Clean and disinfect the watering vats/basins and feeding trays separately.
- Launder textiles at a 60 °C or higher (temperature depends on the textile material).
- Use additional procedures in case the animals are sick in e.g. coccidia or cryptosporidia.

Pay particular attention to corners, cracks, joints and materials e.g. wood and concrete which may contain pathogens. At temperatures below the freezing point, the cleaning solution can be mixed with an antifreezing agent so that the water does not freeze during cleaning. In case the pathogens are hidden in soil layers, the disinfectants have poor or no effect, when the disinfection is performed after the cleaning procedures. All surfaces are left to dry completely, which can take several days. (Ruralia Institute 2018; Niemi et al. 2020b.)

In disinfection either chemical or physical (often heat) methods are used to reduce the number of pathogens. When applying the disinfectant, use the low-pressure washing nozzle. Many disinfectants are not effective at temperatures below 20°C. Thus, the duration of the disinfection will be prolonged. Allow surfaces to dry before resetting the cubicle. Remember to launder textiles, e.g. calf blankets, for at least 20 minutes at 60°C. (Ruralia Institute 2018; Niemi et al. 2020a.)

4 COURSES IN THE DEVELOPED CURRICULUM

Biosecurity at animal farms 15 ECTS consists of three courses. The first course, Good hygienic practises in animal production 5 ECTS, is the core of the entity. During this course, the students learn to apply hygienic practices to prevent the spreading of pathogens, to minimize disease pressure and to promote animal health. The use of quality systems and own-checking descriptions is also included. Both lectures and guided assignments are used in teaching.

The second 5 ECTS course, Pathogens in primary production, starts with view of basics in microbiology followed by information about the most important pathogens and their metabolic products. The students will also get familiar with one health concept i.e. connections between animal, human and environmental health. Work in the laboratory is included in this course.

During the last course, Biosecurity project 5 ECTS, the students will work more independently with subjects connected to biosecurity both in real life and based on literature. This will deepen the students' knowledge and skills in biosecurity.

Studies can be done as part of Degree Programme Agriculture or as further education. Studies are also suitable for entrepreneurs and workers at animal farms to expand their knowledge in biosecurity at farms and within the Finnish food system. As pedagogical approach education is carried out as classroom teaching, laboratory experiments and case studies based on literature. Part of the theoretical studies will be distance learning using the platforms Moodle and Teams. Distance learning gives possibilities to take part in course without travelling. Laboratory practices are performed in the brand new Frami Food Lab at Frami Campus of Seinäjoki University of Applied Sciences.

5 SUMMARY

Biosecurity is at a high level in the Finnish food system. Control of biosecurity at animal farms is a key factor in this chain. Prevention of infectious diseases is important at both farm and national levels. Increased risks require developing and adopt good practices for the producers and improving their own-checking programs. This is especially important at farms of increasing size and with specialized production, because the economic effects can be serious, when the biosecurity measures are inadequate. Investments may be needed, but a

failure in maintaining animal health can be disastrous for the farm. The farmers and their workers of tomorrow must be aware of the risks and their costs. Thus comprehensive material promoting the awareness of biosecurity has been developed during recent years (Quianlan et al. 2016; Dewulf & Van Immerseel 2020; Niemi et al. 2020b).

Food safety in the whole food chain from field to fork is a profile area at Seinäjoki University of Applied Sciences. Studies in biosecurity are important in the study programme of agriculture, thus deeper knowledge in controlling biosecurity at animal farms is given as a 15 ECTS study Biosecurity-entity consisting of three courses each 5 ECTS. The topics are Good hygienic practises in animal production, Pathogens in primary production and Biosecurity project. The teaching is performed in classroom, in Frami Food Lab and through distance learning using the platforms Moodle and Teams. The teachers of the courses are experts in their subjects.

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