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# THE IMPLEMENTATION OF A BIOSECURITY PLAN ON PIG FARMS BASED ON RISK ANALYSIS AND CONTROL OF CRITICAL POINTS (HACCP)*

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*SUMMARY: Biosafety is a process on farm which aims to prevent the occurrence and spread of the disease on the farm. An effective biosecurity program consists of several elements and the need to make the whole program to ensure safety of products on the farm. This paper presents a model for the establishment of biosafety programs through the implementation of a system for ensuring product hazard analysis and critical control point (HACCP) at a pig farm. This work should be the basis for the implementation of the biosecurity program on farms, in order to develop its own program according to the situation on the farm.*

***Key words*:** *biosecurity, pig farm, HACCP.*

## INTRODUCTION

The basic principle in the definition of “Biosafety“ is the desire to prevent the onset of disease (Dargatz et al., 2002). Biosecurity on pig farm represents all the measures taken with the aim of preventing the entry of infectious agents in the farm and control the spread of infection within the farm. The aim of biosafety program is to prevent exposure to animal pathogens that are not on the farm, and to minimize the impact of endemic pathogens. Biosecurity pig farm can be defined as the planning and implementation of programs in order to minimize the different types of risks that have a detrimental effect on the farm and the animals on it. Procedures within the biosecurity are related to improving the health and productivity of pigs. Biosecurity programs can be viewed from multiple viewpoints. Frequently, biosafety is referred to as the obligation that the state implements

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Review paper / *Pregledni rad*

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its policies in order to protect their resources and protect the health of consumers (Hueston and Taylor, 2002, Uščebrka et al, 2006). General framework that is used to protect the health of consumers is adherence to the principles adopted by the Codex Alimentarius Commission (CAC, 2002). These principles are defined in Good hygienic practices in meat production (CAC, 2005). This document is required to manage these risks before slaughter and during the slaughter process, with the application of the HACCP system (CAC, 2003).

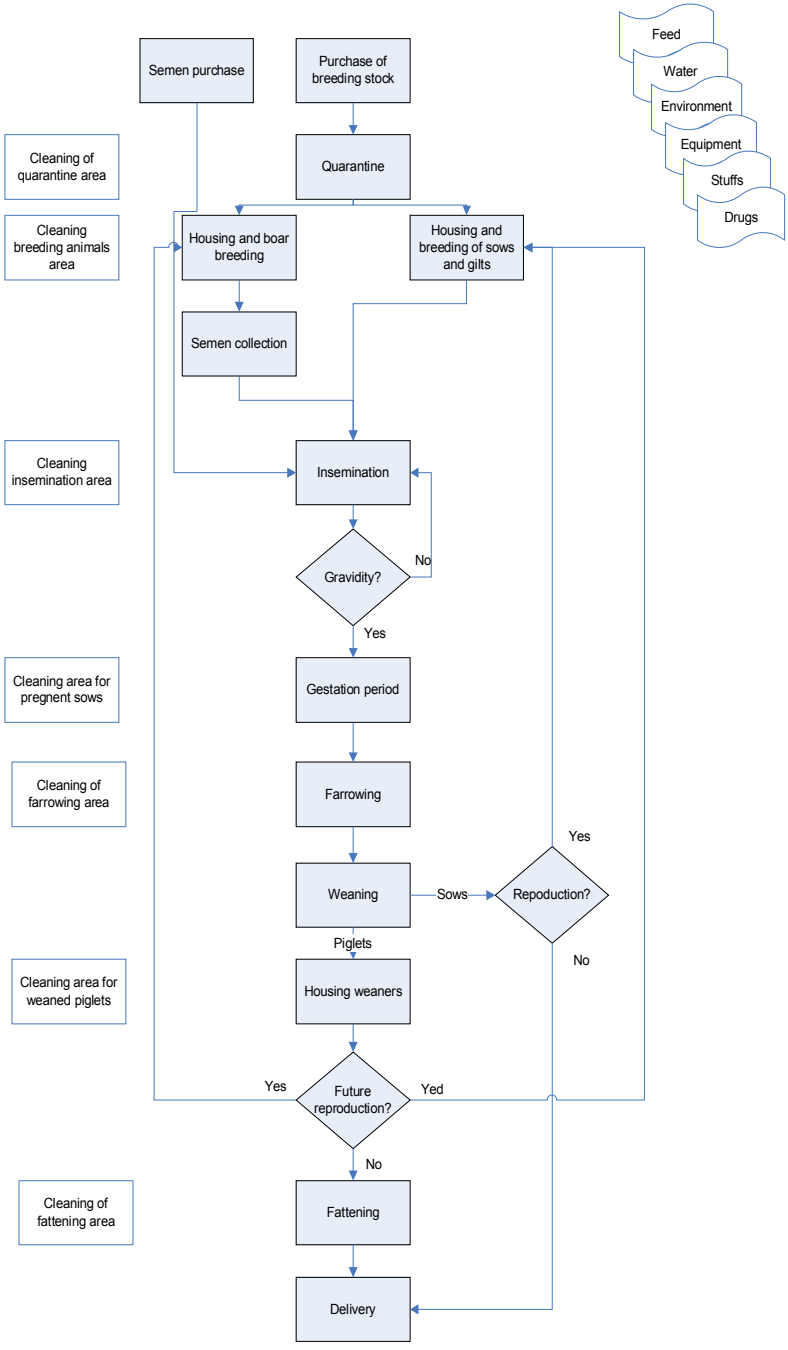
The HACCP system is based on hazard analysis and critical control point. Hazards can be divided into physical, chemical and biological. Unlike chemical hazards, which usually represent the residue in meat substances that are harmful to human health, which are clearly defined by certain rules, biological hazards, which is mainly the pathogenic microorganisms, are not clearly identified in the appropriate regulations. Therefore, not clear or control these hazards by independent auditors (Horcher and Pointon, 2011). A number of factors are involved in the development and maintenance of an effective program for ensuring food safety on the farm (Uščebrka et al, 2012a) and biosecurity program (Uščebrka et al, 2012b). All factors can be seen as a link in the joint chain, a biosafety program is only as strong as its weakest link (Levis and Becker, 2011; Uščebrka et al, 2012c; Žikić et al, 2012). Application of the Hazard Analysis and Critical Control Points (HACCP) and sanitation protocols are important measures in controlling the entry and spread of infectious in herds agents (Stanković et al, 2008; Uščebrka et al, 2009; Bojkoviski et al, 2011).

It is now known that the biosecurity, good manufacturing practices and HACCP are very important elements in intensive pig production, where a large number of animals kept at a relatively small area (Bojkovski et al, 2010a; Bojkovski et al, 2010b). However, for a well-developed HACCP model, it is necessary to establish and maintain prerequisite programs, such as good manufacturing practices, good hygienic practices, good laboratory practice (Kanački et al, 2008; Uščebrka et al, 2008; Uščebrka et al, 2011, Kanački et al, 2013). In addition to HACCP models, as well as methods at the farm level may indicate the necessary elements of biosafety program, and other models can be successfully applied in the assessment of biological risks (Uščebrka et al, 2012d).

The aim of this paper is to present the biosecurity plan on the pig farm that was made based on the analysis Risk and Critical Control Points (HACCP).

## STEPS IN THE IMPLEMENTATION OF BIO-SAFETY PLAN BASED ON HACCP

***Step 1: Establish of the HACCP team.*** In order to develop a HACCP plan, it is necessary to appoint a HACCP team which should find people who have adequate knowledge of HACCP, veterinary medicine, microbiology, epidemiology of food borne diseases, pig production. Team members should be selected based on their experience in the development of HACCP systems, implementation of preventive procedures, participation in risk assessment, access to research in the field of food safety training in HACCP systems, as well as knowledge of pig production.




**Scheme 2 Example flowchart commercial pig farms.**

***Step 2 and 3 Establishment of scale, product descriptions and intended use.*** The scope of the HACCP study should be based on the existing production process, and if the farm has a closed production cycle or participate in certain parts of the production process (breeding, production of breeding material, production of pigs, ...). The largest number of commercial farms in Serbia have the entire production chain and the end product is fattened that comes slaughterhouse and is intended for consumption by consumers

***Step 4 and 5 Defining flowchart and its verification.*** In accordance with the manufacturing processes in the pig farms flowcharts are formed. The flowchart containing all the processes and all inputs and outputs from these processes. Example of flowchart is shown in Scheme 2 and it is desirable to create a table with the given process and all activities related to these processes. After creating the flowchart, it is necessary on the farm to do its verification.

***Step 6 Identification of risk –principle 1.*** Principle 1 includes identification of potential hazards in swine production and will be the basis for determining the critical control points (CCP). Identification of potential microbiological hazards is the most important part of HACCP study. Thus, for each farm must be made to identify potential microbial hazards on the basis of the epizootic status of the farm, the occurrence frequency of certain pathogens and other relevant information. Based on the identified microbiological hazards are evaluated risks to animal health and consumer. In assessing the risk taken, the probability of occurrence and severity of the health of the people / animals when danger appears. Risk assessment is used to Table 1, the values are calculated according to the formula Risk = OxS, where O - the probability of occurrence and S - seriousness.

**Values for probability of occurrence are:**
1 practically impossible
2 low probability
3 can be complex but not so far happened
4 happened on our farm
economic loss can lead
5 commonplace

**Values for seriousness are:**
1 not important
2 can disrupt the delivery of products
3 can lead to economic loss
4 can lead to disease or significant

5 closure of production

Table 1. Significance of risk on the base of probability of occurrence and seriousness

| | | Seriousness (S) | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| Probability of occurrence | 1 | 1 | 2 | 3 | 4 | 5 |
| | 2 | 2 | 4 | 6 | 8 | 10 |
| | 3 | 3 | 6 | 9 | 12 | 15 |
| | 4 | 4 | 8 | 12 | 16 | 20 |
| | 5 | 5 | 10 | 15 | 20 | 25 |

All values of 8 to 25 are significant risks and must be taken into account when establishing CCPs. CCP is determined through a decision tree. HACCP team should assess and establish appropriate control measures in order for the hazards which are significant further reduce risks. Potential hazards and diseases in swine production, mode of spread and control measures used in the prevention of these diseases are given in Table 2.

Table 2. Potential diseases on the pig farm, means of spread and control measures (modification of Horcher and Pointon, 2011)

| Disease | Means of spread | Control measures |
|---|---|---|
| Aujeszky's disease (AD) | Direct contact, semen, aerosol, contaminated food dead rats, mice and cats. | Control the movement of pigs and semen. Filters in places where grain food enters the silo. |
| Vesicular stomatitis (VS) | Insect bites, infected objects and equipment (catheters, needles, clothing, boots, ...). | Control the movement of pigs and semen. |
| Swine vesicular disease (SVD) | Direct contact between pigs, semen, meat products, food swill , infected objects. | Control movement of pigs, semen, people and objects from different farms and different animals. Ban on use of swill. |
| Foot-and-mouth disease (FMD) | Direct contact between pigs, semen, meat products, food, swill, through people or heavily contaminated water. | Control of animal movements, semen, people and objects from other farms and within farms. Ban on use of swill. Chlorination of water or the prevention of direct access to animal source of drinking water. |
| African swine fever (ASF) | Direct contact between pigs, semen, meat products, swill feeding, infected items and equipment. | control movement of animals, semen people and objects from other farms and within farms. Prohibition of use of swill feeding. |
| Classical swine fever (CSF) | Direct contact between pigs, semen, meat products, feeding swill through infected objects and equipment (catheters, needles, clothing, boots, ...) | Control the movement of pigs, semen and people. Ban on feeding of swill. |
| Rabies (B) | Dog or bat bites. | Enclosure in order to prevent the arrival of dogs. |
| Trichinosis (T) | Contact with infected rats or swill. | controls the movement of pigs and meat products. |
| Swine flu (SI) | Direct contact between pigs. The theoretical danger that people can transmit. | Control the movement of pigs. Disease control policy employed on the farms. |
| Porcine respiratory coronavirus (PRCV) | Direct contact between pigs. | Control the movement of pigs. |
| Pigs reproductive and respiratory syndrome (PRRS) | Direct contact between pigs, semen, aerosol. | Control the movement of pigs and semen. |
| Transmissible gastroenteritis (TGE) | Direct contact between pigs. | Control the movement of pigs. |

Results of significance assessment of risk in accordance with Table 1 are shown in Table 3, these are only approximate values, responsible person, based on their experience and the situation on the farm to determine the probability of occurrence and severity.

Table 3. Potential diseases, probability of occurrence (O), seriousness (S) and risk.

| Disease | Probability of occurrence | Seriousness | Risk(OxS) |
|---|---|---|---|
| Aujeszky's disease (AD) | 3 | 5 | 15 |
| Vesicular stomatitis (VS) | 1 | 5 | 5 |
| Swine vesicular disease (SVD) | 3 | 5 | 15 |
| Foot-and-mouth disease (FMD) | 3 | 5 | 15 |
| African swine fever (ASF) | 3 | 4 | 12 |
| Classical swine fever (CSF) | 3 | 4 | 12 |
| Rabies (B) | 2 | 4 | 8 |
| Trichinosis (T) | 2 | 4 | 8 |
| Swine flu (SI) | 4 | 3 | 12 |
| Pig respiratory coronavirus (PRCV) | 3 | 3 | 9 |
| Pigs reproductive and respiratory syndrome (PRRS) | 3 | 4 | 12 |
| Transmissible gastroenteritis (TGE) | 3 | 4 | 12 |

In accordance with the results shown in Table 3 only vesicular stomatitis not to be taken in a further analysis of the threat and determining the CCP. But for all the potential hazards in accordance with the flow chart, it should make a table of hazard analysis, for all inputs in the individual processes (Table 4).

Table 4. Hazards, mode of entry in the heard and control measures (modification of Horcher and Pointon, 2011)

| Entry | Hazards | Control measures |
|---|---|---|
| Animals supplying | AD, VS, SVD, FMD, ASF, CSF, B, T, SI, PRCV, PRRS, TGE | Animals supplying from proven sources. Quarantine and validated by trained personnel. |
| Sperm | AD, VS, SVD, FMD, ASF, CSF, PRRS | Getting semen from proven suppliers |
| Food | AD | Grilles to prevent contamination of food with dead animals (rats, ....) |
| Water | SVD, FMD, ASF, CSF | Preventing contact of wild or domestic animals with a source of water to be used by the animals on the farm, chlorination. |
| Staff and visitors | AD, VS, SVD, FMD, ASF, CSF, B, SI, PRCV, PRRS, TGE | Privacy visits, entry control , the use of boots and protective clothing equipment. |
| Equipment | SVD, FMD, ASF, CSF | Only approved and / or disinfected equipment can be used. |
| Litter | FMD, SVD | Litter procured from farms where there is no doubt that animals infected with contagious diseases. |
| Vehicles | FMD, SVD, VS, AD, ASF, CSF, B, SI, PRCV, PRRS, TGE | Disinfection of vehicles. Drivers do not leave the vehicle or use special footwear and clothing. |
| Pests and other animals | AD, VS, SVD, FMD, ASF, CSF, B, T, SI, PRCV, PRRS, TGE | Disinfection of vehicles. Drivers do not leave the vehicle or use special footwear and clothing. |
| Aerosol | AD, SVD, FMD, SI, PRRS | Farm is geographically isolated. |

***Step 7 Determination of critical control points (CCP) - principle 2***. A critical control point is a stage process in which the application of control measures necessary to prevent, eliminate or reduce risk to an acceptable level of risk. CCP is the place where control measures must be applied. Based on Table 4, which show the hazards of depending on the input in the process, forming a list of processes in which there is hazards exist, control points that are controlled in these processes and critical limits (Table 5).

Tabe 5. Processes, hazards, crtical control poins (CCP) and critical limits (modification of Horcher and Pointon, 2011)

| Process | Hazards | CCP | Critical limits |
|---|---|---|---|
| The introduction of pigs to the farm | AD, VS, SVD, FMD, AKS, CSF, SI, PRCV, TGE, PRRS | Pigs order. Check on arrival by trained personnel. | Purchase only from trusted suppliers. Only qualified personnel may decide to enter the pigs on the farm Only healthy animals without signs of the disease may enter the pig farm. Inputs to the farm with the prior use of quarantine. |
| Semen supplying | AD, VS, SVD, FMD, AKS, CSF, SI, PRCV, PRRS | Semen ordering | Ordering semen only from farms that are available on the above mentioned diseases and have developed system of biosafety. |
| Entering of equipment on farm | AD, VS, SVD, FMD, AKS, CSF, SI, PRCV, TGE, PRRS | When entering | Equipment visual clean and disinfected appropriately. |
| Entry of employees and visitors | AD, VS, SVD, FMD, AKS, CSF, SI, PRCV, TGE, PRRS | When entering | When entering only healthy employees and visitors were allowed to enter. They must be provided with a clean farm boots and clothes to be washed and sanitized hands on the entry |
| Transport of pigs | AD, VS, SVD, FMD, AKS, CSF, SI, PRCV, TGE, PRRS | Order of means of transport and arrival at the place of loading. | Only selected carriers can sort shipping. Transport means visually clean and with a certificate of disinfection. |
| Litter entrance | FMD | Litter order | Only selected vendors, visual inspection of litter. |

***Step 8 Establish critical limits - principle 3.*** Critical limits are established for each control measure and represent the limits that are acceptable for the control measure (Table 5 and Table 6).

Table 6. HACCP Plan (modification of Horcher and Pointon (2011))

| Hazards | Control measure | Critical limits | Monitoring | Corrective actions | Records |
|---|---|---|---|---|---|
| AD, VS, SVD, FMD, ASF, CSF, SI, PRCV, PRRS, TGE | Supply of pigs tested settings from herds with known health status | The supplier shall make available to the veterinarian for consultation | What: pigs<br>Where: at the herd<br>How: questionnaire<br>When: when ordering<br>Who: trained staff | Refusal of orders. | A list of selected suppliers. |
| AD, VS, SVD, FMD, ASF, CSF, SI, PRCV, PRRS, TGE | Checking pigs by trained staff | Pigs must be healthy | What: pigs<br>Where: at the entrance<br>How to: check and questionnaire<br>When: at arrival<br>Who: trained staff | Refusal of pigs. | Date of checks, copies of documents and a copy of the action taken |
| AD, VS, SVD, FMD, ASF, CSF, SI, PRCV, PRRS, TGE | Getting sperm from selected suppliers | Supplier of sperm works in accordance with high standards of biosecurity | What: supplier of sperm<br>Where: at the entrance<br>How: questionnaire<br>When: when ordering<br>Who: trained staff | Refusal of semen. | Date of checks, copies of relevant documents, the action taken |
| AD, VS, SVD, FMD, ASF, CSF, SI, PRCV, PRRS, TGE | Only previously announced Visitors necessary for the operation of the farm can enter the farm | For previously announced visitors provided clean boots and clothing. Visitors to wash their hands before entering | What: visitors<br>Where: at the entrance<br>How: by filling records<br>When: on arrival<br>Who: trained staff | No entry | Diary of visits; activities undertaken |
| AD, VS, SVD, FMD, ASF, CSF, SI, PRCV, PRRS, TGE | Means of transport must be clean and disinfected | The selected carrier that operates in accordance with good practice Vehicles must be visually pure certificate of cleaning and disinfection | What: vehicle<br>Where: at the entrance<br>How to: Verify a certificate, a questionnaire and a list of approved carriers<br>When: on arrival<br>Who: trained staff | No entry | A list of approved carriers, date checks, certificates of disinfection and activities undertaken |
| ... | ... | ... | ... | ... | ... |

***Step 9 Establish a monitoring system - principle 4.*** Observation or monitoring of critical limits is a check that the threat under control at this stage of the process. For each critical point, it is necessary to answer the five questions and the what, how, where, when and by whom. These questions and answers are entered in the HACCP plan, which is shown in Table 6.

***Step 10: Defining corrective action - principle 5.*** Corrective measures represent actions to be taken when it is determined that the critical limits are not respected, and that the hazards is not under control. The goal is to apply corrective measures correcting a mistake at this stage and tried to prevent in the future. Corrective measures are entered in the table HACCP plan (Table 6). The table entries are HACCP plan and records should document the fulfillment of requirements in terms of achieving and maintaining critical limits.

In this way the HACCP plan is also unique biosafety document. Applying all entries HACCP plan establishes an efficient and effective biosecurity plan.

***Step 11: Establish verification procedures - principle 6.*** HACCP plan that contains all the elements of biosecurity should be verified and the verification can be done in one of these ways:

- independent verification of control measures by the management of the farm or independent vocational entities;
- independent review of critical limits for all CCPs by management or independent professional person;
- checking by a third party that will require a detailed review of the documentation on the functioning of the various elements of the HACCP plan.

***Step 12 Establish a system of documentation and record keeping - Principle 7.*** For the successful functioning HACCP system is one of the most important activities is the proper documentation. Accordingly, it is necessary to develop procedures for maintaining documents and records.

## INSTEAD OF A CONCLUSION

From the above it can be concluded that biosecurity is one of the most important activities on the farm. Biosafety is impossible to separate from the integrated system for ensuring food safety and is an important part of his. Since the program biosecurity prevent, eliminate or reduce to an acceptable level only biological hazard and to those that cause animal diseases and / or consumers, food safety assurance system at the farm is a broad term. However, for an efficient and effective biosecurity plan is necessary to do all the steps necessary to establish a system for ensuring food safety.

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## IMPLEMENTACIJA PLANA BIOSIGURNOSTI NA OSNOVU ANALIZE RIZIKA I KONTOLE KRITIČNIH TAČAKA (HACCP) NA FARMI SVINJA

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### Izvod

Biosigurnost je proces na farmi koji ima za cilj da spreči pojavu i širenje bolesti na farmi. Efikasan program biosigurnosti sastoji se iz više elemenata i treba da čini celinu sa programima za obezbeđenje bezbednosti proizvoda na farmi. U ovom radu biće prikazan model uspostavljanja programa biosigurnosti kroz primenu sistema za obezbeđenje proizvoda analizom opasnosti i kontrolom kritičnih tačaka (HACCP) na farmi svinja. Ovaj rad treba da bude osnova za implementaciju programa biosigurnosti na farmama, sa ciljem razvoja sopstvenog programa u skladu sa situacijom na samoj farmi.

**Ključne reči:** biosigurnost, farma svinja, HACCP.