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RISK ASSESSMENT ON PIG FARMS AND INTERACTION OF CCP AND FREQUENCY *Rattus norvegicus*

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ABSTRACT

Risk assessment on pig farms aims to determine the presence, spreading and influence of *Rattus norvegicus* on pig health, identifying certain important points in the technological process and on different locations designated as CCPs. Thresholds in assessment criteria are defined for these points, considering animal welfare and initial rodent control data. Gray rat (*Rattus norvegicus*), is a synanthropic rodent species and a regular inhabitant of pig housing facilities. The present study assessed animal health risks, and identified critical control points (CCPs) in production facilities. The criteria for risk assessment were: pig feeding and watering, maintenance, animal health, behaviour and risk assessment records.

The results show a close association between the number of identified CCPs and the number of trapped animals (20 CCPs and 29 trapped rats in facility A, and 9 CCPs and 7 rats in facility B).

Key words: pig production risks, CCP, *Rattus norvegicus*, anticoagulants, traps

INTRODUCTION

Programs for quality pig breeding incorporate physical, chemical and biotic factors, farming technology, feeding and watering, and social aspects for individual treatment and health care, defined as CCPs. The most immediate environment may influence animal welfare (Von Borell and Mitloehner, 2004) in a positive way when the important requirements are met or in a negative way by exposing animals to various risks that lead to diseases.

The presence of *R. norvegicus* on pig farms is unacceptable, and their monitoring is neccessary all year round. Rats are sighted inside pig farms more often during the winter season, when they seek warm habitat. They are able to quickly spread disease from contaminated to uncontaminated spots by feces, hair, blood, urine and spit. Their favourable habitats are pig production farms and feed storages. Rodent control strategy is to be chosen carefully in order to balance the risks caused by pests and those resulting from control applications. It requires environement control, such as higiene and sanitation with well chosen rodenticides. Pesticides with low mamel toxicity may be used to reduce direct toxic risks for humans and the environment.

The very quantities of food, water, heat and shelter free of predators make control of *R. norvegicus* difficult.

The present study aimed to determine the risks, and identify threats in two farms, to propose preventive rodent control measures, considering rodent mobility and reproductive capacity under conditions of virtually unlimited food sources, to reduce *R. norvegicus* counts on the farms, and to determine additional control measures.

MATERIAL AND METHOD

Experiments were conducted on two comercial pig farms, A and B. Risks for pig farming and animal welfare criteria were assessed, and CCPs were suggested based on defined principles (Von Borell and Mitloehner, 2004), adapted to our conditions. A working group (Von Borell et all., 2001) elaborated the CCPs for all stages of pig farming from raising to fattening. Categories such as

animal behaviour, health and influence of the environment are interdependent and are considered as a whole, even though they belong to different research disciplines.
To assess the degree of invasiveness, population density of *R. norvegicus* was assessed based on the PP 1/114(3) standard methodology (OEPP/EPPO,1999). Bromadiolone (0.005 %) was used as the active ingredient in different bait formulations tested (BB, GB, AB i PB) on both locations.
Rats were baited after treatment to assess their density. Cage traps with fresh fish bait fixed on springs were used.

RESULTS AND DISCUSSION

The results of this investigation show differences in feeding and waterning technology, animal living conditions, health and behavior, and records kept in farms A and B (Table 1). Risk assessment methods enabled identification of potential threats and control points on both farms (Table 1), as well as *R. norvegicus* control (Figure 1, Table 2). Critical thresholds were determined and confirmed for each CCP, as well as supervision and corrective measures in case CCP limits are exceeded. CCPs were determined based on a concept of threat analysis to enable objective research-based assessment of risks for animals.
Control points and goals (yes or no) are listed as a sequence to be followed in assessments, and determined based on the intervals of basic requirements to be controlled from pig entrance on the farm to the end of production process.

Table 1. Criteria for risk assessment in pig farming and CCPs in specific farm and production goals

RISKS	**CRITERIA FOR ASSESSMENT OF ANIMAL WELFARE**	**CCP A**	**CCP B**	**GOAL**
Feeding and waterning	1. Drainage of slurry at the back of bedding area	CCP_1		YES
	2. Capacity of slurry pit (over a period)	CCP_2		YES
	3. Trough size fitting flock size	CCP_3		YES
	4. Feed composition adapted for fattening period	CCP_4		YES
	5. Higienic water trough design	CCP_5	CCP_1	YES
	6. Water quality and quantity ad libitum	CCP_6	CCP_2	YES
Maintenance	7. Cleaning and disinfection are based on specific farming conditions	CCP_7		YES
	8. Monitoring and control of rodents	CCP_8	CCP_3	YES
	9. Climatic conditions based on regulation and specific requirements on the farm	CCP_9	CCP_4	YES
	10.Ventilation on farm at maximum 900 revolutions (slow ventilation)	CCP_{10}	CCP_5	YES
	11. Separation of fettening pigs	CCP_{11}		YES
	12. Slurry on ground surface (transfered by dragging hose) or in soil	CCP_{12}	CCP_6	YES
	13. Feces passing floor grids	CCP_{13}		YES
	14. Sufficient space according to regulation	CCP_{14}		YES
	15. Clean hard flooring in pens	CCP_{15}	CCP_7	YES
Health	16. Heating effective for pigs	CCP_{16}		YES
	17. Fear	CCP_{17}		NO
Record keeping	18. Technical installation functional	CCP_{18}		YES
	19. Feedback information on health inspection of lung and liver of pigs	CCP_{19}	CCP_8	YES
	20. Data documentation and analysis	CCP_{20}	CCP_9	YES
∑		**20**	**9**	

Control points (Von Borell et al., 2001) refer to certain limitation that has been regulated or to measures for reducing risks and threats to animal welfare. Regarding feed and water accessibility, farm A was assigned grade 6 and farm B grade 2 in CCPs. Feed higiene and water trough design, designated as $CCP_{4,5,6}$ (A) and $CCP_{1,2}$ (B), had negative effects on pig maintenance, feeding and waterning.

Poor hygiene on the farms attracted brown rats and increased their population (29 and 7 animals on farms A and B, respectively)(Table 2). Continued presence of rodents in large numbers results in higienic/epidemiological risks (Figure 1, Table 2). Plentiful food sources on pig farms make it impossible to eliminated rodents totally. Every opening on the farm is to be sealed because rats are able to get through some 6 cm wide holes ($CCP_{7,11}$ on farm A,). Animal metabolism changes the chemical composition of ambient air, so that carbon dioxide, ammonia and methane gases attract a large number of rodents (CCP_8 on farm A and CCP_3 on farm B). Heat is the main microclimatic factor (CCP_{16} on farm A), itself affected by other microclimatic factors (space, humidity), designated as $CCP_{10,12}$(A) and CCP_5(B). The effect of light and duration of intensive light affects the growth, development, reproduction and production of animals. Noise causes stress in animals. Breeding technology may not only influence the physical and psychological welfare of animals, it may be a threat to their health and lives.

The third group of risks refers to control and monitoring of animal health, and the small number of CCPs assigned indicates that veterinary inspection is regular. General epidemiological measures are applied to diminish contamination risks on the pig farms. Fear (CCP_{17} on farm A) should be fully eliminated by staff practicing a kind attitude towards animals and fostering their social behaviour.

Pig welfare documentation is kept on adequate forms on both farms. Both farms trasport their pigs to slaughterhouses, and relevant formal records are kept about it, but data are not analysed as requested ($CCP_{19,20}$ on farm A and $CCP_{8,9}$ on farm B).

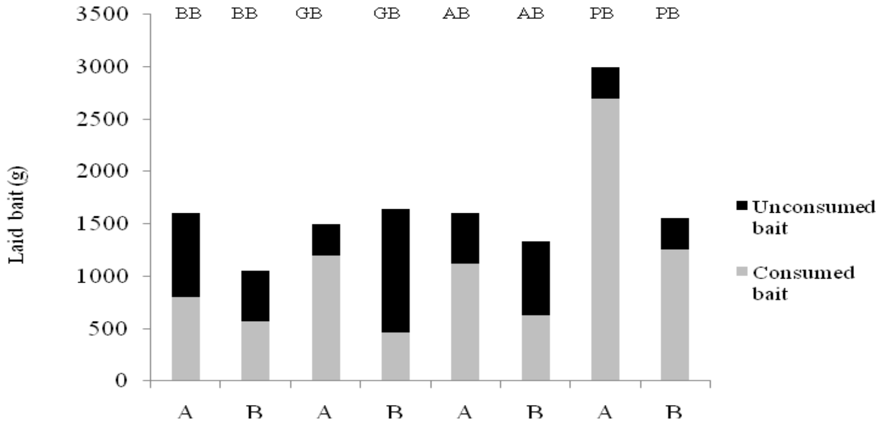

Fig. 1. Consumption of different formulations of bait (BB, GB, AB and PB) on farms A and B

Plate baits (PB) (Vukša et al, 2011) retain their freshness longest and their consumption is highest (2700 g on farm A and 1260 g on farm B), and they are easy to lay in holes and various other cavities and sites. Block bait (BB) had the lowest consumption on farm A (800 g of the laid amount of 1600 g). On farm B, only 464 g of granular bait (GB) and 570 g of BB of the total amount of 1640 g were eaten. BBs are mostly used on farms with plenty of waste material under high moisture (A $CCP_{7,13,14}$) (Table 1). Grain bait (AB) is suitable for pouring but there is no full certainty that the weighed amount was acctually eaten rather than merely lost by dispersion. A total amount of 1600 g was laid on farm A, and 1330 g on farm B.

Rodent control has to be regular and a continuous part of technical and technological processes (Đedović et al, 2013) on farms (CCP_8 on farm A and CCP_3 on farm B), and it is important to continue filling bait boxes after control and checking for new signs (Tabela 1).

A month after treatment, *R. norvegicus* rats were counted based on live trapping (Figure 1). Traps were laid against walls, in dark corners at the back of each farm and in places where rodent activity is high, so that rodents may activate springs within the traps on their routes (Table 2).

Table 2: Ten-day catch of *Rattus norvegicus* in live traps on farms A (Pančevo) and B (Surčin)

	D A Y S										∑
Farm A	1	2	3	4	5	6	7	8	9	10	
Animal ♂	$*P_1 P_2$ $P_{11}P_{12}$	$*P_3$	$*P_7$	$P_{25} *P_{10}$	P_{31}						9
Animal ♀	$P_{13}P_{14}$ P_{15}	$P_{16}*P_{17}$	$P_{19}P_{20}$ $P_{21}P_{22}*P_{23}$	$P_{26} P_{27} P_{28}$ $P_{29} P_{30} *P_{31}$	$P_{32} P$ $_{33}P_{34}$	S_{35}					20
Weight (g) ♂	237/ 367		167 / 280	323	380						
Weight (g) ♀	230/152 372	303	369/281 168/532	362/219/326 /201/409	222/250 358	226					
Farm B											
Animal ♂		$S_1 S_2 S_3$				$S_4S_5S_6$					6
Animal ♀						S_7					1
Weight (g) ♂		110/101 /96				120/240/ 202					
Weight (g) ♀						100					

* Trapped animals dying of injury, ♂5 ♀3 on farm A

Twenty females and 9 males were trapped on farm A, which is indicative of an increased risk of pig maintenance (20 CCPs). Much fewer animals were trapped on farm B (6♂ and 1♀, 9 CCPs) (Table 1). Gender ratio was different: males were in the majority 6:1 compared to females on farm B, which indicates a slower reproduction in the coming period and fewer offspring, which results from regular sanitation and technological measures, and regular rodent control.

The number of animals of both genders on farm A was considerably higher and the gender ratio indicates that a new population would develop very soon, even though a greater rodenticide amount was consumed (Figure 1). Preventive control and systematic rodent control treatments are required four times annually. Sanitation and technological obstacles should be resolved, which is expected to reduce risks of infection and death of pigs.

Total amount of bait laid was different on the two farms: 1880 g of the total 7700 g of bait offered on farm A remained uneaten (Figure 1), while the remains were much smaller on farm B (2944 g). The data show that farm A had a much denser rodent population and that higher bait consumption did not reduce the pupulation significantly. All available measures should be applied to reduce the number of critical control points and resulting risks for pig mainainance (Table 1, Figure 1).

CONCLUSION

Reduce or eliminate CCPs that rodents may use for nests or shelters. Animal feed should be stored as regulated. Prevent entry and walking around the farm.

Use baits for effective rodent control after first signs of their presence, and keep regular inspections. Use live traps to determine the size of rodent population.

After reducing rodent population with a control treatment, continue checks in order to keep the population at a minimum. Keep bait boxes in place to control the next rodent generation and prevent their increasing survival.

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