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Application of active iodine-based preparation for pig production premises disinfection

Zastosowanie preparatu na bazie aktywnego jodu do dezynfekcji chlewni

Summary. The studies assessed a disinfectant with an active iodine component. The disinfectant fogging in the pigsty was performed at the end of the production cycle. The air in the pigsty showed a high bacteria and fungi concentration exceeding the sanitary norms and the disinfectant application markedly improved the air microbiological quality. The highest reduction factor RF-2,15 was determined for the total microbial count, which accounts for 99% total effectiveness.

Key words: disinfection, microbiological contamination, piggery

INTRODUCTION

Disinfecting preparations are characterized with a broad spectrum of activity, from the basic bactericidal to elimination of *Mycobacterium tuberculosis*, fungi and viruses. The key to disinfecting agent performance is dependent upon environmental factors, like pH, temperature that affect microbial survivability as well as preparation active substance. A vital aspect proves to be optimization of disinfection process parameters, matching the process duration and disinfectant concentration. Knowledge about disinfection and its function helps not only to maintain the appropriate sanitary status of animal units but, importantly, prevents the spread of microorganisms in the environment of animals and human and consequently, ensures consistent production performance [Chmielowiec-Korzeniowska *et al.* 2008, Kaniewski 2008, Krug *et al.* 2011, Ondrašovič *et al.* 2008, Pietruszka 2011, Skoracki 2010]. Most agricultural workers are exposed to high occupational health risks associated with the biological agents (10^5–10^6 thousand cfu/m^3) in the workplace and the presence of organic dust and gaseous contaminants in air that can notably impair the respiratory system. Therefore, cleaning and efficient disinfection is imperative to maintain the hygiene standards at animal raising and breeding, improved sanitary state of livestock production premises and finally, to reduce the risk of animal and human occupational exposure to biological agents in the environment [Fèvre *et al.* 2006, Krug *et al.* 2011, Krug *et al.* 2012, Nowakowicz-Dębek *et al.*, 2011a, b, Szadkowska--Stańczyk *et al.* 2010, Skórska 2008, Soroka 2008, Tymczyna and Bartecki 2007].

The research objective was to assess the effectiveness of active iodine-based disinfectant fogged in the pig unit after the production cycle completion.

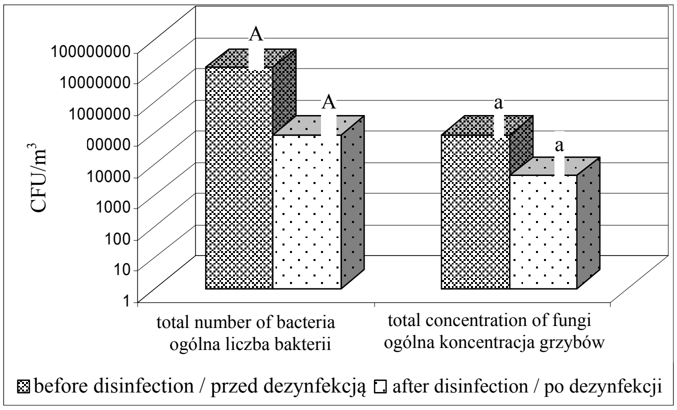
MATERIAL AND METHODS

The studies were conducted in a pig fattener farm. Disinfection was performed in the pig facility housing 80 animals, after the production cycle end. There was used a liquid disinfectant containing, among others, active iodine and surface-active compounds. Prior to disinfection, excessive organic matter and portable equipment were removed. A recommended solution at 1 : 400 concentration (manufacturer recommendation) was prepared and applied in the afternoon with fogger powered by compressed air. The air samples for microbiological analysis were collected twice testing in duplicate, i.e. pre and 4hr post disinfection at four sampling points in the pig house using MicroBio impactor and the Koch sedimentation method. The air samples meant for the bioaerosol evaluation were taken directly onto the medium of TSA (Trypticase Soy Agar), MEA (Malt Extract Agar) with chloramphenicol and MacConkey`s. The grown colonies were calculated after incubation according to PN-89/Z-04111/02, PN-89/Z-04111/03. The calculations were based on the Omeliański's formula modified by Gogoberidze. Bioaerosol concentration using the impactor was calculated after the incubation and expressed as the number of cells forming units (CFU) in the air volume converted into 1 m^3. The lowest air volume in the impactor (25 l) turned out to be too big and therefore, excluded from the research. At the same time, the measurements of temperature, relative moisture and air motion conducted. Volume these parameters were optimized for fattening and they do not work. The results of the preparation cidal activity under the farm conditions were assessed based on a bacteria reduction degree. There was established the logarithmic reduction factor RF = log CFU (N_0) – log CFU (N_t) where N_0 – cell count pre disinfection, N_t – cell count post disinfection. Efficiency of microbial removal reached 99% that corresponded to one log-stage. The results were analyzed statistically and presented in Tables and Figure.

RESULTS AND DISCUSSION

Disinfection of livestock production premises proves to be integral part of a biosecurity program. Growing animal density resulting from the increasing herd size induces negative microclimate changes and rising concentration of pathogenic agents in air. Currently, disinfection of flooring and walls without their thorough cleansing but pouring or spreading means over them is absolutely insufficient. Appropriate biosecurity measures often impose changes in the production technology and implementation of the herd management "all-in-all-out system". Well tailored and performed disinfection procedures improve effectiveness of the treatment and thus, production performance [Fèvre *et al*. 2006, Krug *et al.* 2012, Ondrašovič *et al.* 2008, Pietruszka 2011, Skoracki 2010, Tymczyna and Bartecki 2007].

The pig facility air was found to show high concentration of bacteria and fungi exceeding the sanitary norms for pig units (8.0×10^4 CFU/m^3) and occupational exposure limits for workers (2.0×10^6 CFU/m^3), [Dutkiewicz and Górny 2002, Krzysztofik 1992]. Mean concentration of total bacterial count pre disinfection was 1.2×10^7 CFU/m^3, whereas for fungi – 8.5×10^4 CFU/m^3 (Fig. 1, Tab. 1–3). The sanitary air assessment in the studied pig facility indicated higher concentration of total bacterial numbers than that reported by Dutkiewicz and Górny [2002]. The authors determined mean bacterial concentration in the pig production premises air at 1×10^5–2×10^6, while for fungi 1×10^3 – 1×10^5. Mean mesophilic bacteria concentration in the pig unit air pre disinfection was 1.5×10^6 CFU/m^3 (i.e. log 6.18 CFU/m^3), whereas psychrophilic bacteria 7.8×10^5 CFU/m^3 (i.e. log 5.89 CFU/m^3) (Tab. 1). Mesophilic bacteria count was slightly higher compared to that obtained by Chmielowiec-Korzeniowska *et al*. [2008] in the growing pig house. Use of the disinfectant has markedly improved microbiological air quality in the fattener facility (Fig. 1, Tab. 1–3). The highest reduction factor RF – 2.15 was determined for the concentration of total microbial count, that accounted for 99% effectiveness (tab. 2). Whereas for mesophilic, psychrophilic bacteria and fungi, some lower reduction was shown, namely RF – 1.73; RF – 1.32 and RF – 1.14, respectively, that is 90% removal performance (Tab. 1–2). The obtained results agree with the findings of other authors evaluating effectiveness of the preparation with chlorine dioxide [Chmielowiec-Korzeniowska *et al.* 2008].



Explanation: AA – values marked with the same letters significantly different at $p \le 0.01$; aa – values marked with the same letters significantly different at $p \le 0.05$

Fig. 1. Mean concentration of microorganisms in the piggery before and after disinfection (CFU/m^3)
Rys. 1. Średnia koncentracja mikroorganizmów w chlewni przed i po dezynfekcji (jtk/m^3)

Table 1. The concentration of bacteria before and after disinfection (log CFU/m^3)
Tabela 1. Koncentracja bakterii przed i po dezynfekcji (log jtk/m^3)

Collection site Punkt pobrań	Mesophilic bacteria Bakterie mezofilne			Psychrophilic bacteria Bakterie psychrofilne		
	N_0	N_t	RF	N_0	N_t	RF
I	6.28	4.20	2.07	5.68	4.57	1.11
II	6.04	4.89	1.15	5.83	4.53	1.29
III	6.11	4.00	2.11	5.75	4.41	1.33
IV	6.20	4.89	1.31	6.15	4.72	1.43
Mean / Średnia	6.18	4.45	1.73	5.89	4.57	1.32

Table 2. The concentration of the total number of bacteria on TSA medium (log CFU/m^3)
Tabela 2. Koncentracja ogólnej liczny bakterii na podłożu TSA w chlewni (log jtk/m^3)

Collection site Punkt pobrań	Total number of bacteria Ogólna liczba bakterii		
	Before disinfection N_0 Przed dezynfekcją N_0	After disinfection N_t Po dezynfekcji N_t	RF
I	5.67	4.96	0.71
II	7.53	4.88	2.65
III	6.57	4.79	1.78
IV	7.74	5.04	2.70
Mean / Średnia	7.08	4.93	2.15

Table 3. Concentration of fungi on the MEA medium (log CFU/m^3)
Tabela 3. Koncentracja grzybów na podłożu MEA w chlewni (log jtk/m^3)

Collection site Punkt pobrań	Concentration of fungi Koncentracja grzybów		RF
	Before disinfection N_0 Przed dezynfekcją N_0	After disinfection N_t Po dezynfekcji N_t	
I	4.80	3.93	0.86
II	4.72	3.04	1.67
III	4.72	3.26	1.46
IV	4.77	3.72	1.05
Mean / Średnia	4.76	3.62	1.14

The researches have indicated that disinfection practices have become essential in livestock production premises to prevent the spread of pathogens. The tested preparation has shown high reduction efficiency. Optimization of animal management conditions through disinfection should be considered as an important element of the breeding process. Notably, unfavorable living conditions disturb immune reactivity of animals exposed to a heavy load of microorganisms that associated with released chemicals and organic dust can produce chronic inflammatory diseases. As a result, final production performance declines [Heederik *et al*. 1991, Kaniewski 2008, Nowakowicz-Dębek 2011b, Skoracki 2010, Tymczyna and Bartecki 2007].

Summing up, it should be highlighted that cleaning and disinfection, being good husbandry practices, are worth the investment as they ensure healthy disease free conditions for animals, which translates into higher production profitability, higher quality of products of animal origin and safety of farm workers.

CONCLUSIONS

1. The analysis of the air samples from the pig unit has confirmed high bactericidal effectiveness of the tested disinfecting preparation.
2. Irrespective of laboratory evaluation, it is recommended to check the preparation effectiveness under production conditions so that prevention operations could be fully realized.

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Streszczenie. Ocenie poddano preparat dezynfekcyjny zawierający aktywny jod. Dezynfekcję wykonano metodą zmgławiania w chlewni na zakończenie cyklu produkcyjnego. W powietrzu badanej chlewni wykazano wysokie, przekraczające sanitarne normy, stężenia bakterii i grzybów. Zastosowanie preparatu dezynfekcyjnego wyraźnie poprawiło jakość mikrobiologiczną powietrza. Najwyższy stopień redukcji RF – 2,15 wykazano dla ogólnej liczby mikroorganizmów, co stanowiło 99% skuteczność.

Słowa kluczowe: dezynfekcja, mikrobiologiczne zanieczyszczenia, chlewnia