



THE ROLE OF STERILIZATION IN MINIMIZING PATHOGEN TRANSMISSION IN AGRICULTURE

Biology

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ABSTRACT

This paper explores the critical role of sterilization in reducing pathogen transmission in agricultural systems, focusing on the disinfection of high-risk farm equipment and surfaces as a key component of biosecurity protocols. A controlled laboratory experiment was conducted to quantify the regrowth of microorganisms on disinfected surfaces, using microscope slides to simulate frequently handled farm tools. The findings revealed a significant resurgence of microbial populations within 24 hours post-disinfection, underscoring the necessity for daily sterilization practices in preventing the rapid proliferation of pathogens. These results highlight the importance of targeted, routine disinfection in minimizing contamination risks, particularly in areas of frequent contact, reinforcing its role as a preventative measure in maintaining biosecure agricultural environments.

KEYWORDS

INTRODUCTION

Biosecurity in agriculture is a term used to describe a range of measures put in place to limit pathogen spread between livestock on individual holdings as well as across the country. It is often recognized for the key role it plays in reducing the transmission of disease between commercial animals. Biosecurity measures are commonly divided into three main areas: selection of stock for introduction, disinfection and cleansing (sanitation), and external sources.

Despite the central position that biosecurity plays in animal health and welfare, recommendations are rarely formalized as legal requirements. The exception is during outbreaks of a notifiable disease¹⁾, such as those involving foot and mouth disease or an incidence of bovine tuberculosis. As a result, many farmers will develop their own routines which vary greatly in both frequency and scale.

In the case of the sanitation, opinions regarding the necessity of regular disinfection of farm equipment differ enormously with many farmers choosing to avoid the economic implications of daily cleansing and instead disinfecting farm equipment on a much less frequent basis.

There is no widely accepted timescale recommended for the disinfection of potentially high risk areas for pathogen spread within an individual group of animals such as water troughs and hay racks that are in almost constant contact with the livestock. Although regular cleansing is encouraged, it is not known for certain if the benefits of daily disinfection are sufficiently greater than a weekly routine when dealing with equipment that is used solely within one holding.²⁾

Literature Review

The APHA (Animal and Plant Health Agency, UK) has issued legal requirements for the use of a disinfectant approved by the Department for Environment, Food and Rural Affairs (DEFRA) for the cleansing of all livestock vehicles visiting markets or moving between holdings in order to reduce the spread of pathogens between farms³⁾.

However, within an individual holding, disinfection guidelines are much less clear. The official advice offered by the APHA is that a farmer should 'clean and disinfect all buildings and equipment after use by livestock'⁴⁾. No recommendation is made for the ideal frequency of disinfection appropriate for items in constant daily use.

Investigation

The aim of the investigation was to examine microorganism growth following disinfection in a laboratory situation. It was hoped that the experiment would be suitable to act as a model of different frequencies of sanitation routines that may be in place within an individual farm holding. This would enable conclusions to be drawn relating to the most appropriate frequency of disinfection for application in an agricultural setting.

Method

On the first day, the microscope slide labeled 'three days' was disinfected by wiping all surfaces with 5 ml of dettol antibacterial

surface cleanser applied to a paper towel. The slide was then placed on a sterile tray which was positioned on the laboratory window sill. A control slide was also placed on the tray. This slide had not been disinfected and would be used for comparison when drawing conclusions from the investigation's results. The next day, the process was repeated with the 'two days' slide and on day three with the slide labelled 'one day'. The labelling corresponded to the time elapsed since disinfection when the swab was taken 24 hours later. Before collecting the swabs from each slide, four plates of agar growth medium were prepared and labelled with the corresponding slide names as well as being divided into thirds. Using a fresh sterile cotton bud each time, a swab was taken from the center of each slide and wiped across one third of the appropriately labelled agar plate. This process was repeated with a second and third swab from each slide which was wiped across the remaining thirds on each plate. Repetition of swab collection from each microscope slide would later enable the average number of microorganism colonies grown from each slide to be calculated and allow any anomalous results to be identified.

When transferring each swab to the agar plate, it was important that care was taken to open the petri dish lid as little as possible in order to prevent microorganisms in the air from contaminating the sample.

Each plate was sealed at four separate points using sticky tape. The four plates were then placed in an incubator at 25°C for seven days. Although this is approximately 10°C below the optimum temperature for microorganism growth and therefore required a longer incubation period, a temperature of 25°C was chosen to reduce the likelihood of the growth of potentially harmful pathogens since it is significantly below human body temperature.

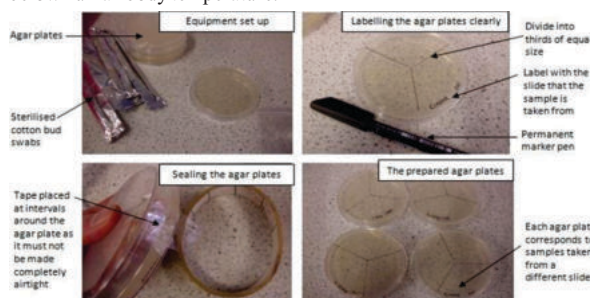


Figure 1: Preparation of the Agar Plates

RESULTS

Table 1: Number of Microorganism Colonies Grown on Each Section of the Agar Plates After 4 Days of Incubation at 25°C

Number of days after disinfection	Number of Microorganism Colonies Grown			
	1	2	3	Mean average
1	1	1	1	1
2	1	3	2	2
3	4	0	2	3
Control	6	4	5	5

Investigation results (see Table 1) were collected by counting the number of visible microorganism colonies present on each third of the agar plate. Although it did not form part of the data collected for the investigation, it was also interesting to note that the 'control' and 'three days' swabs had produced the greatest range of microorganism species which were identified by differences in colony shape and colour.

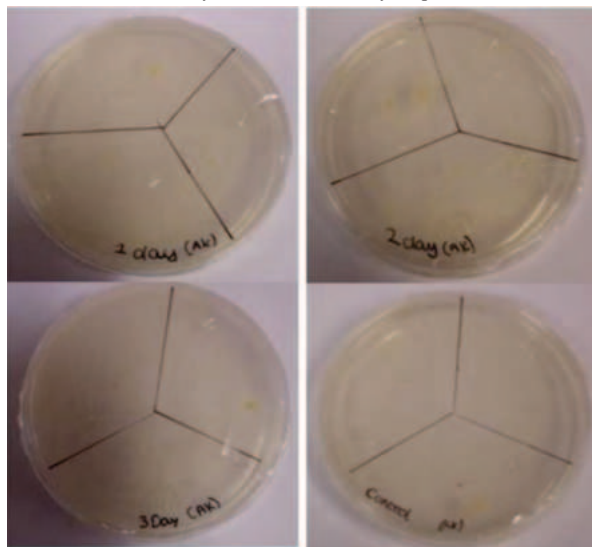


Figure 2: Agar Plates Showing Microorganism Growth After 4 Days of Incubation

In order to enable the easy identification of any pattern that may be present, the mean average number of colonies grown from each slide was then calculated. However, before calculating the average for the 'three days' slide, the decision was made to exclude the second result from the mean since it was felt that the value was significantly below the other two and did not fit the pattern. Therefore this anomalous result was discarded from overall consideration.

CONCLUSIONS AND DISCUSSION

In many ways the results of the investigation gave the expected outcome since it illustrates that frequent disinfection reduces the presence of microorganisms, and most importantly pathogens on a particular surface. This strong positive correlation between the number of days since disinfection and the number of microorganism colonies grown can be clearly identified from Figure 3.

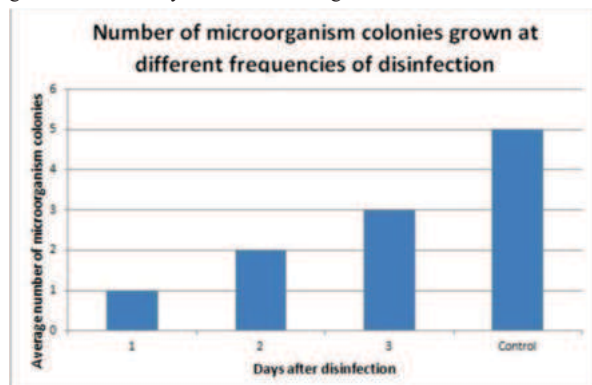


Figure 3: Graph to Show the Relationship Between the Time Elapsed Since Disinfection and the Number of Microorganism Colonies Grown

However, the most interesting finding of the investigation was the directly proportional relationship between the two positively correlating variables. If this pattern continues, it could be expected that after only five days, the number of microorganism colonies that can be grown from the disinfected slide would be equal to the number grown from the control slide. This suggests that if the frequency of disinfection is less than five days, the benefits in relation to reducing pathogen spread would be minimal.

disinfection only last a very short time. Immediately after disinfection, the numbers of microorganisms present on the disinfected surface begin to rise steadily and after less than a week will reach a level similar to that of a surface where regular cleaning and disinfection does not take place.

The implications for disinfection and cleansing practices in relation to livestock are largely that in order for disinfection to be effective, it must be carried out at regular intervals, not only after use of the equipment has ended. If the findings of this experiment could be repeated in an agricultural context, they would suggest that daily disinfection- or, at the very least, every other day- is essential in order to keep pathogen levels low and minimise disease transmission within the herd. It would also reflect that disinfection that takes place at intervals of five days or greater may have very little benefit in reducing microorganism levels compared to equipment or surfaces that had not been disinfected.

Investigation Limitations and Ideas for Further Research

Due to health and safety restrictions within the school environment, it was necessary for the investigation carried out to be purely laboratory based since testing on farm equipment could potentially encourage the development of zoonoses. Therefore, the investigation served only to act as a model of disinfection in the agricultural setting.

In order to make the findings more relevant to livestock disinfection and cleansing schemes, it would be important to repeat the investigation using agricultural equipment in regular contact with cattle and a DEFRA-approved disinfectant⁵.

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In conclusion, the results of the investigation suggest that the effects of