Microbial Growth on Small Percussion Instruments

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Abstract:

The goal of this study was to determine the frequency musical instruments should be cleaned based on the bacterial growth curve. The instruments were from a non-profit that had a once a month cleaning policy. A typical bacteria growth curve is expected to have four phases: lag, log, stationary, and death phase. The experiment was broken into two parts: the initial testing and follow up testing. The initial testing collected samples over the course of 30 days from four different percussion instruments. In the follow up testing, a control was added and instrument usage in the classroom was monitored. Instruments were swabbed to collect the sample, then spread plate into petri dishes and incubated. Colonies were counted, converted into concentrations, and graphed. The data was compared between the instruments. The graphs for the instruments indicated large spikes in bacteria concentration before 10 days had passed, but concentration decreased after that. It did not follow the standard growth curve, likely due to lack of nutrients on the instruments. The decrease in bacteria indicates that once a month cleaning is adequate.

Introduction:

Musical instruments are often used, but not necessarily cleaned frequently. The policy for instrument cleaning at the non-profit the instruments in this study were obtained from was to clean them once a month. Often times the students may have not washed their hands before using the instruments. Bacteria growth can be monitored to assess the levels on the musical instruments. Typical bacteria growth has four phases: lag (little to no growth), log (exponential growth), stationary (death and growth is equal), and death. The growth can then be plotted onto a growth curve to determine when the bacteria levels start to plateau. This can determine when the instruments should be cleaned. The goal of the study was to determine if the once a month policy was good enough for cleaning the instruments and determine if there was an optimum time for cleaning them.

Methods:

In experiment 1, samples were taken three times a week over the course of 30 days. At the start of the 30 days the djembe, maraca, and wood block were cleaned with a Clorox wet wipe and the volume control cover was washed. Samples collected at night and were obtained by swabbing the surface of the instruments with a sterile swab dipped in sterile DI water. Each swab was then dipped into a test tube containing nutrient broth and swirled. The test tubes were then plated the next day. 0.2 mL of the nutrient broth was spread plate onto a petri dish. Type of media varied. Then the samples were incubated at 37°C. Incubation time varied initially. Counts of colonies were recorded after incubation and then converted into concentration of bacteria in the sample using the formula:$Concentration = \frac{CFU\ x\ Dilution\ Factor}{Volume\ plated}$.

In experiment 2, follow up data was collected to try and improve on the first experiment. A log was kept of the instrument usage. Samples were collected over 14 days. At the start of the 14 days the djembe, maraca, wood block, and drumstick control were cleaned with a Clorox wet wipe and the volume control cover was washed using an antiseptic. Samples were collected and plated the same as in experiment 1. They samples were incubated at 37°C for a minimum of 4 days to allow for slow growing bacteria to be seen. The colonies were counted and converted to concentration of bacteria using the formula from experiment 1.

Results:

Table 1. Experiment 1 Data.

DAY	Incubation Time (Days)	Djembe (CFU/mL)	Volume Control Cover (CFU/mL)	Maraca (CFU/mL)	Wood Block (CFU/mL)
0	2	0	TNTC	0	0
2	5	0	35	525	20
7	2	0	0	0	0
9	3	55	0	5	0
19	4	0	0	5	0
21	5	0	0	0	0
23	5	10	10	0	5
26	4	5	5	0	5
30	5	5	5	0	0

Table 2. Experiment 2 Data.

DAY	Incubation Time (Days)	Djembe (CFU/mL)	Volume Control Cover (CFU/mL)	Maraca (CFU/mL)	Wood Block (CFU/mL)	Drumstick Control (CFU/mL)
0	5	0	155	0	0	0
2	5	10	45	0	0	5
5	4	0	450	785	120	0
9	5	80	1605	15	15	0
12	4	0	0	0	0	0

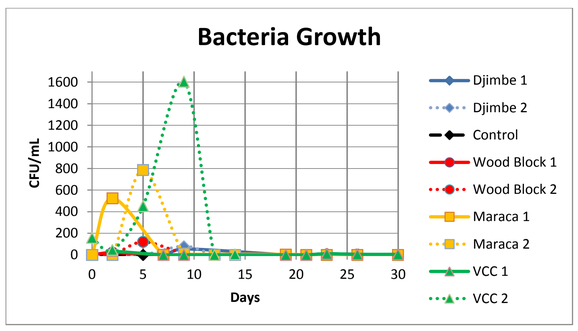

Figure 1. Overall comparison of bacteria growth from all samples in both experiments.

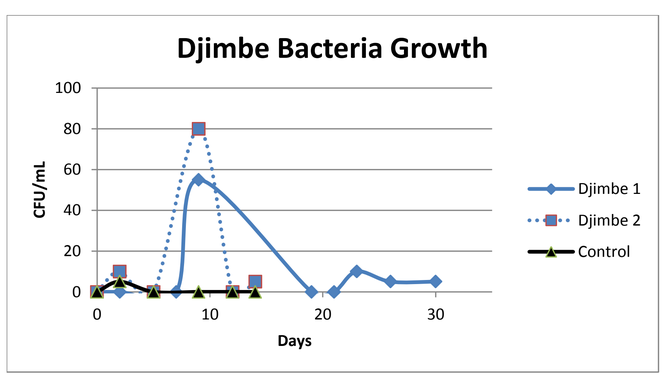

Figure 2. Growth curve for bacteria on the djembe against the control.

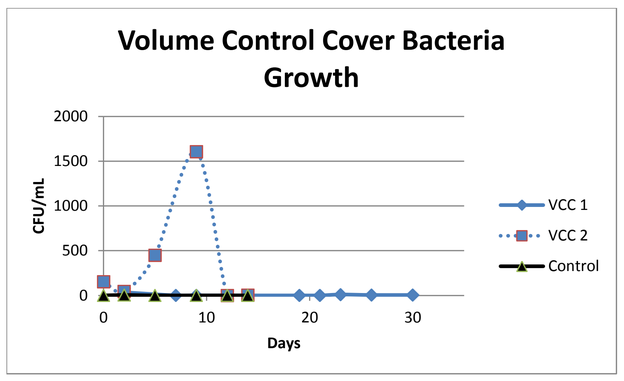

Figure 3. Growth curve for bacteria on the volume control cover against the control.

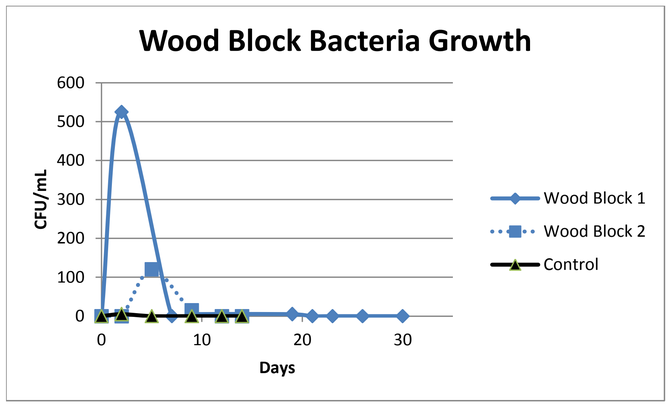

Figure 5. Growth curve for bacteria on the wood block against the control.

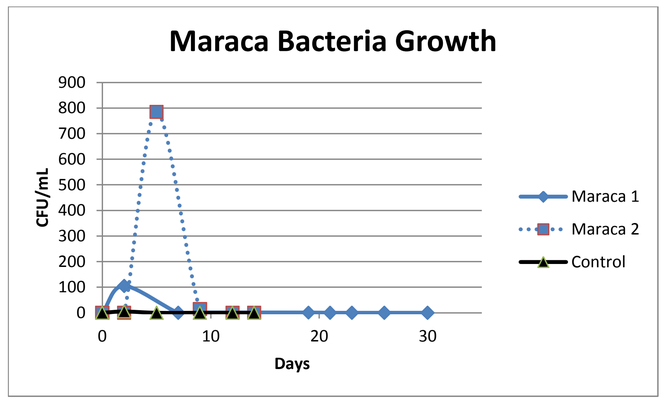

Figure 4. Growth curve for bacteria on the maraca against the control

Discussion:

There were relatively large spikes in all the growth curves early before 10 days had passed. However, in all of the samples overtime the bacteria counts decreased dramatically. Comparing each individual instrument in experiment 1 and 2, there appears to be a greater initial growth of bacteria present in experiment 2 than in experiment 1, except in the wood block (Figures 2-5). Note that the graphs do not include the first data point for the volume control cover in experiment 1 because it was too numerous to count (Table 1). Overall, this study showed that while there was a growth curve for the bacteria, it peaked very early and did not plateau as initially assumed. This makes sense because that kind of curve applies better to bacteria with relatively unlimited nutrients. There are not much nutrients for the bacteria to grow with on the instruments which is why the population ends up dropping back down. The initial increase could be explained by the bacteria population overshooting the equilibrium rate before crashing back down to equilibrium. Another possible explanation is that the bacteria growth curve was occurring at a faster rate where the bacteria population reached death phase before it was collected. The mixed results in experiment 1 prompted follow up tests to account for missing data points and correct some of the initial errors. The instrument usage during experiment 2 went from volume control cover as the highest, to maraca, to djembe, to wood block as the least used. While differences in the total amount of bacteria might have differed, the only large differences were on days 5 and 9, but as a whole the samples had low bacteria counts on other days (Table 2). Additionally, the experimental design could have been improved by having a longer follow up to allow for another 30 days rather than 14 days to confirm the results. However, due to time constraints this study was unable to have a full follow up. Additionally, due to limited resources the type of generic nutrient in the petri dishes varied throughout the study (nutrient agar, TGY, and TSY were used). This may have had impacts on the bacteria growth. This experiment only examined bacteria growth, although some fungi were seen in some samples. The instruments likely do not need to be cleaned more than once a month and the current policy is sufficient. However, this study did not examine the specific types of bacteria present. There were some small red colonies present on the nutrient agar plates which may have been *E. coli,* but further tests would have been needed to identify them. The instruments should still be cleaned after use as a precaution if the instructor is aware of sick students using them.