A COMPARATIVE STUDY OF FOUR COMMERCIALLY AVAILABLE SWAB TRANSPORT SYSTEMS

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ABSTRACT

A comparative study of four commercially available swab transport systems were performed on twelve species of bacteria. Transport systems included: BBL Port-A-Cul (with modified Stuart's medium) Marion Scientific Culturette (with modified Stuart's medium), Scott Swab Pack (with Amies medium without charcoal), and Difco Swab Transport Pack (with Amies medium without charcoal). Organisms tested included: *Escherichia coli, Salmonella* C_2*, Streptococcus mitis, Streptococcus pneumoniae, Pseudomonas aeruginosa, Acinetobacter anitratus, Streptococcus faecalis, Campylobacter jejuni, Haemophilus influenzae, Neisseria cineria, Neisseria meningitidis* and *Neisseria gonorrhoeae.* Each swab was seeded with pure cultures of organisms in saline calibrated to 10^8 colony forming units/ml at time zero.

Following 4, 24 and 48 hours post inoculation the swabs were emersed in saline and serial dilutions were prepared from the suspensions. A calibrated loop was used to plate the swab suspensions on to plated media. An increase in organism viability was seen in both of the systems which utilized Amies media (Difco and Scott) over the systems which utilized Stuart's Media (BBL and Marion).

For all organisms tested, Difco yielded the best overall results. Difco had the highest colony counts recovered and lowest percent reductions from zero for all times tested.

INTRODUCTION

The transport of viable microorganisms from patient sources to the laboratory remains of utmost importance in the diagnosis and treatment of infectious diseases. Indeed, the reliability of culture reports depends upon this. Suitable transport conditions vary depending upon the type of infectious agents suspected and their growth requirements. Ideally, specimens should be inoculated onto appropriate culture media at the bedside. However, this is not practical in most instances. In practice, the culture of some specimens may be delayed several days in transit to reference laboratories performing the culture. Clinical specimens for aerobic and facultative anaerobic microorganisms are routinely collected and transported to the laboratory using a single collection device. Anaerobic and some fastidious pathogens may require the use of special transport systems.[1] Too often the decision on which system to use is not based upon laboratory evaluations but rather upon presentations by sales personnel.

An ideal culture transport system must preserve the viability of microorganisms without allowing them to replicate over a period of time. Several media available for this purpose are Stuart, Amies with or without charcoal, and Cary-Blair[2]. Appelbaum et.al.[2], recently reported a comparison of two commercially available transport systems for the recovery of microorganisms from clinical specimens. The present study evaluates four commerically available transport systems for the recovery of 12 species of bacteria over a 48 hour period.

MATERIALS AND METHODS

Test organisms (table 1), were cultured on trypticase soy agar supplemented with 5% sheep blood or on chocolate agar plates (BBL Microbiology Systems, Cockeysville, MD) at 35 C. in an atmosphere of 5% CO_2 in air. Fresh isolates were suspended in saline and calibrated to equal a 0.5 McFarland standard (10^8 cfu/ml). The standardized suspensions were calibrated using a A-just turbidity reader (Abbott Laboratories, Chicago, IL). Swabs from each of the four transport systems (table 2), were seeded with pure cultures of the individual organisms by dipping the swabs into the calibrated saline suspensions and returning them to their respective transport system.

A total of 192 swabs were used (four swabs for each of 12 organisms at 4 incubation times). After inoculation, swabs were removed from the transport system and were rinsed in one ml. of sterile saline. Each saline rinse was then diluted 1:5, 1:6 and 1:7 in sterile water and immediately streaked in duplicate onto culture plates.

This procedure was repeated for each transport system following 4, 24, and 48 hour storage at room temperature. Culture plates were incubated for 24 hours and colony counts were generated from the dilution yielding between 30-300 colonies per plate.

Colony counts were performed for each organism at 4, 24, and 48 hour incubation times and compared to the counts generated at zero time. All counts were then transformed to logarithmic ($\log_{10}$) bacterial counts/ml.

A percent reduction in viability from zero was calculated for each organisms and each transport system using the following equation:

$$\frac{\text{Count at 0 hr. - count at test time}}{\text{Count at 0 hour}} \text{ X } 100 = \% \text{ reduction}$$

RESULTS

The Difco Transport Pack and the Scott Swab Pack yielded the best overall results. The highest colony counts and the lowest percent reduction from zero were calculated for organisms cultured from the Difco Swab Transport Pack. Two exceptions to this occurred, *Escherichia coli* and *Campylobacter jejuni*. For *E. coli*, BBL Port-A-Cul and the Marion Culturette had higher counts and lower reductions from zero than Difco. This may be due to organism propagation during transport in these two systems (see graphs). *Campylobacter jejuni* did not survive in any of the transport systems. Overall, the systems using Amies medium did better than the systems using Stuarts medium.

DISCUSSION

The Culturette brand transport device is the most widely used system by microbiology laboratories for the transport of aerobic and facultative anaerobic bacteria. Appelbaum et. al.[2] have shown that this system is inferior to the Difco transport system in preserving the viability of most clinically significant bacteria. In the present study, transports using Amies medium were superior to those using Stuarts medium. Reasons suggested for this superiority are a reduced environment, better thermal protection, lack of dilution effect, lower oxygen permeability and ease of use. In addition, Amies medium contains a phosphate balanced salt solution in a semisolid medium which in itself may better protect organisms and allow them to maintain equilibrium during transport. Most organisms survive in Stuart medium overtime, but reduce in numbers as compared to preservation using Amies medium. One exception to this occurred with *E. coli*. A possible reason for this might be that sodium glycerophosphate can be used as an energy source by some organisms including *E. coli*.[3] This would account for the growth in both BBL and Marion swab systems for *E. coli* at four hour storage. In addition to the preservation advantage offered by the Amies transport systems, both Difco and Scott are much easier to use than BBL and Marion. The Difco and Scott systems do not require an activation step, while BBL and Marion do. The effect, if any, that normal flora or a mixed flora has on the recovery of pathogens from transport systems needs to be evaluated through additional studies. However, we conclude the Difco system to be the best for the recovery of stock microorganisms over a 48 hour period at room temperature.

REFERENCES

1. Isenberg, H.D., J.A. Washington II, A. Balows, and A.C. Sonnenwirth, 1985. Collection, handling, and processing of Specimens, p 73-98. In E.H. Lannette, A. Balows, W.J. Hausler, Jr., and H.J. Shodomy (ed.), Manual of Clincial Microbiology, 4th ed. American Society for Microbiology, Washington, D.C.
2. Appelbaum, P.C., S.K. Spangler, R. Crist and A.E. Crist, Jr. 1988. Survival of Bacteria in Difco Culture Swab and Marion Culturette II Transport Systems. J. Clin. Microbiology, 26:136-138.
3. Human, R.P. and G.A. Jones, l986. Survival of bacteria in Swab Transport Packs. Med. Lab. Science, 43:14-18.

TABLE I

Bacterial strains used for viability study

TEST ORGANISM	SOURCE OF ISOLATE
Escherichia coli	ATCC 25922
Salmonella C2	PA T8 1985
Streptococcus mitis	clinical isolate
Streptococcus pneumoniae	ATCC 602527
Streptococcus faecalis	ATCC 29212
Pseudomonas aeruginosa	ATCC 27833
Acinetobacter anitratus	clinical isolate
Campylobacter jejuni	clinical isolate
Haemophilus influenzae	clinical isolate
Neisseria cineria	clinical isolate
Neisseria meningitidis	ATCC 13090
Neisseria gonorrhoeae	ATCC 19424

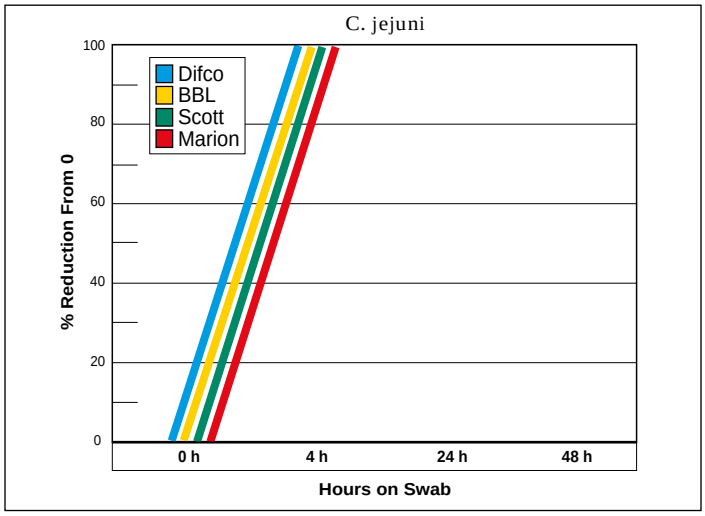
TABLE 2

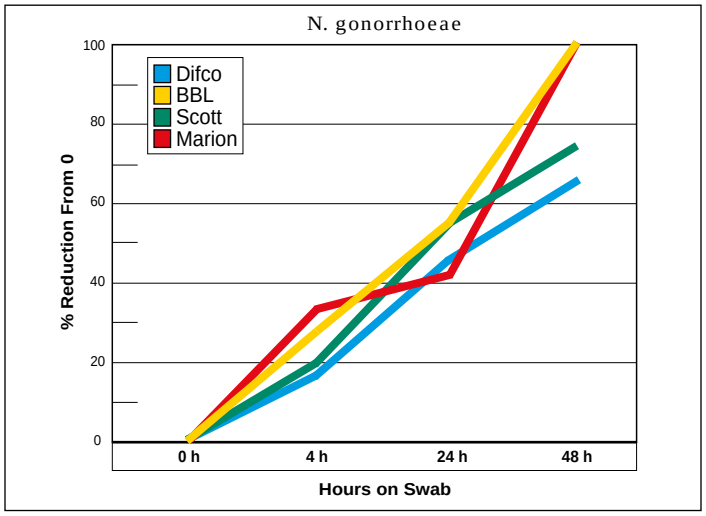
Transport Systems Studied

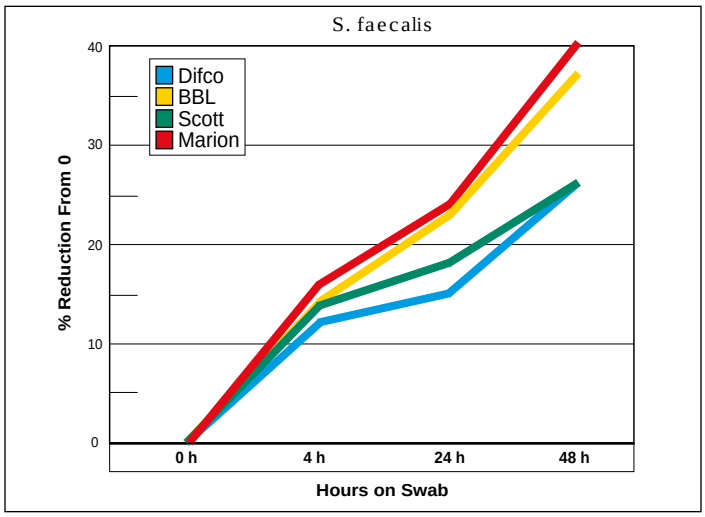
SWABS EVAULATED	MANUFACTURER	MEDIA
1. BBL Port-A-Cul aerobic transport medium	BBL Microbiology Systems, Becton Dickenson & Co., Cockeysville, MD	Stuart2
2. Culture Swab	Difco Laboratories, Detroit, MI	Amies without charcoal[1]
3. Culturette II	Marion Scientific, Div. of Marion Laboratories, Inc., Kansas City, MO	Stuart
4. Swab Pack	Scott Laboratories Inc., West Warwick, RI	Amies without charcoal

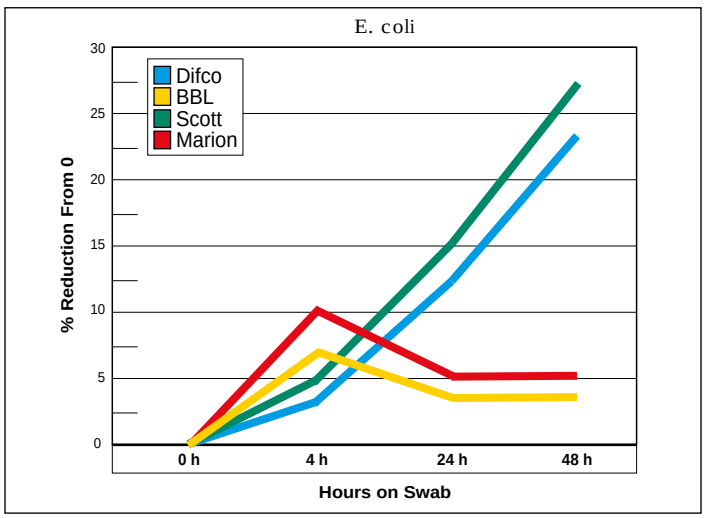
1. Amies w/o charcoal			
Sodium Chloride	3g	Disodium Phosphate	1.15g
Potassium Chloride	0.2g	Sodium Thioglycolate	1g
Calcium Chloride	0.1g	Bacto Agar	75g
Magnesium Chloride	0.1g	Distilled water	
Monopotassium phosphate	0.2g	Final ph 7.3+0.2@25 C	
2. Stuart			
Sodium glycerophosphate	10g	Sodium Thioglycolate	lg
Calcium Chloride	0.1g	Distilled Water	lL
Final ph 7.4 ± 0.1@25 C			

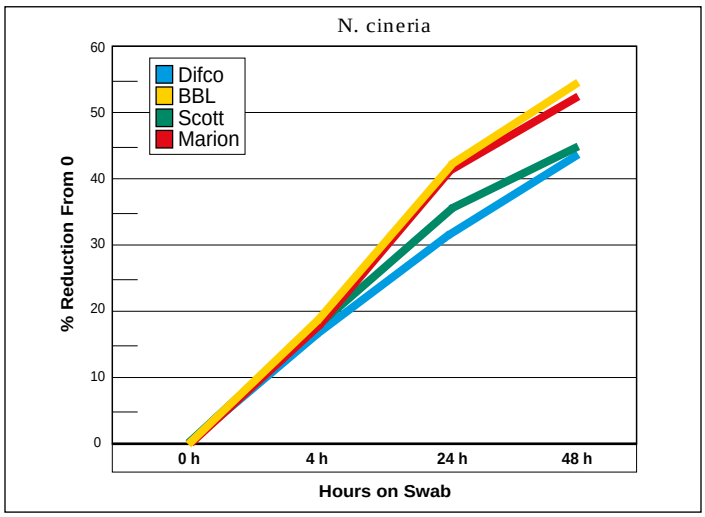
CHARTED RESULTS

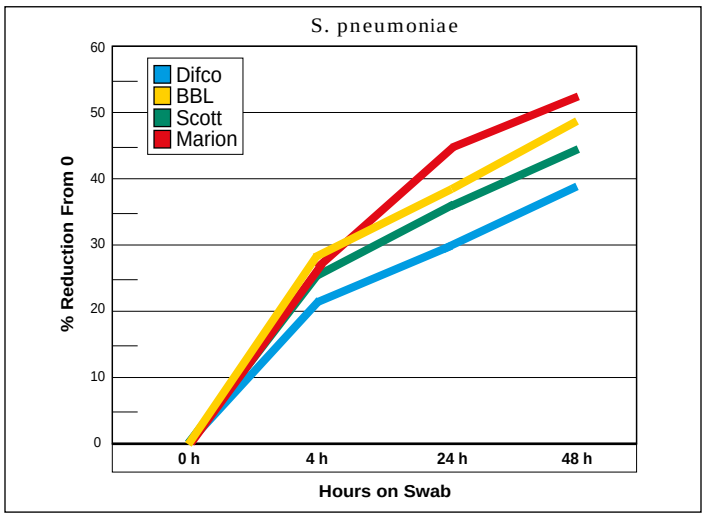












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