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A Research Note

Rapid Methods and Automation: A Survey of Professional Microbiologists

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ABSTRACT

Participants of an international workshop on rapid methods and automation were surveyed concerning the numbers of total plate counts and coliform counts performed per year, the numbers and kinds of pathogen detection tests routinely performed, and the type of instruments and diagnostic kits routinely used in their laboratories. The candid opinions on what is needed in the near future and the general perceptions of the field of rapid methods and automation in microbiology and their wish list were also solicited. Responses from 55 professional practicing microbiologists were analyzed. The data should be of interest to educators and the developers of instruments and diagnostic kits as well as applied microbiologists concerned with the current status and future development of the field of rapid methods and automation in microbiology

Since 1981 an eight to nine day "hands-on" or "wet" workshop on rapid methods and automation in microbiology has been held annually on the campus of Kansas State University (KSU). Participants interact with the newest kits, instruments and procedures under the direction of workshop faculty members as well as commercial company representatives. Participants of the workshop (1981-1987) were surveyed concerning the current status and future needs in the field of rapid methods and automation in microbiology.

MATERIALS AND METHODS

A questionnaire was designed to ascertain some key issues in applied microbiology. The individual questions are listed sequentially in the Results and Discussions section of this paper. The first six questions (A,B,C,D,E and F) obtained demographic information from the respondents. The next 11 questions (numbered 1 to 11) were designed to elicit specific information and obtain comments concerning issues involved with the practical use and application of rapid methods. Some of the answers to the questions could be grouped and tabulated while others could not.

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RESULTS AND DISCUSSION

We assume that the readers of this paper are familiar with diagnostic kits, automated instruments, and modern systems used in applied microbiology and immunology. We previously presented discussion on these topics *(1-8)*.

The following are synopses of the 55 responses. Items subjected to numerical tabulation are listed in Table 1 for questions 1, 2 and 3, and Table 2 for questions 6 and 7. The italicized words in the following sections were part of the questionnaire.

QUESTIONNAIRE

A. *Name (optional, will not be used in print)*
Eighty-seven percent (48/55) of the respondents gave their names; 23 were male (48%) and 25 female (52%).

B. *Educational level*
There were 31 B.S., 14 M. S., 5 Ph.D., 1 DVM and 4 "others."

C. *Job Title*
Thirty respondents called themselves microbiologists, 12 are quality assurance/quality control (QA/QC) managers or workers and 13 "others" which included market specialist, chemists, senior research scientists, inspector, and a professor.

D. *Actual work relating to Microbiology*
Nineteen respondents were involved in some form of administration and supervisional roles, 18 were bench workers and the other 18 had a variety of work ranging from research to compliance.

E. *Type of Organization*
Twenty-one respondents were involved in food and beverage industries, 11 were in medical, pharmaceuticals and veterinary areas, 7 were from government laboratories, 3 were with universities and 13 were in other related areas.

TABLE 1. *Workshop participants' responses to the type of routine tests, criteria for choosing systems and "wish" list of instruments and kits.*

Routine tests presently employed		Criteria for choosing system		"Wish" list of instrument and kits	
API	32[1]	Rapid	18	Vitek	26
Enterotube	10	Easy	16	EIA	7
Micro-ID	9	Accurate (data base		Spiral Plater	6
Isogrid	6	confidence in ID)	12	Bactomatic	5
Vitek	6	Cost	9	Micro-ID	5
Minitek	4	Previous experience	4	Geneprobe	4
Conventional	4	K-State workshop	3	AMBIS	4
Spiral plate	3	Space saver	3	Petrifilm	4
EIA (Bioenzabead)	3			API	3
Artek	2			Biocontrol 1-2	3
ATP	2			Minitek	2
Bactometer	2			Isogrid	1
Hewlett Packard	2			DEFT	1
GeneTrak	2			Hewlett Packard	1
Petrifilm	2			ATP	1

[1]Number of responses to the question.

TABLE 2. *Numbers of total plate count, coliform count and specific pathogen tests performed by respondents.*

A. Total Plate Count (TPC)

	# doing TPC/# responding	Average #/year	Maximum #
TPC	44/55	12,786	250,000
		# doing TPC	
	< 1000 per year	1000 - 10,000	> 10,000
TPC	10	27	7

B. Coliform count

	# doing coliform count/# responding	Average #/year	Maximum #
coliforms	43/55	25,023	840,000
		# doing coliform count	
	< 1000 per year	1000 - 10,000	> 10,000
coliforms	13	23	7

C. Pathogens detection

Pathogen	# doing/# responding	Average #/year	Maximum #
Salmonella	34/55	1,500	15,000
Listeria	12/55	520	15,000
Campylobacter	5/55	4	100
S. aureus	6/55	330	6,000
E. coli	6/55	2,000	50,000
		# doing specific pathogen	
	< 1000 per year	1000 - 10,000	> 10,000
Salmonella	14	19	1
Listeria	8	2	2
Campylobacter	5	0	0
S. aureus	2	4	0
E. coli	1	3	2

F. *Year participated at Kansas State University workshop* Thirty from 1987, 10 from 1986, 7 from 1985, 1 from 1984, 3 from 1982, and 1 from 1981.

In brief, the demographic profile indicated a good mixture of male and female respondents from many areas of applied microbiology. Most of the respondents were microbiologists and QA/QC workers with good educational backgrounds (BS degrees and above). Most held responsible positions in their organizations and many were bench top workers as well. Most of them worked directly with the food industry while some worked in medical, pharmaceutical, veterinary and other fields. Therefore, we assumed that their responses to the following questions would certainly be representative of the general opinions of applied microbiologists in these fields.

SURVEY

1. *What diagnostic kits, instruments, or systems are you routinely using?*
   Table 1 contains results of questions 1, 2 and 3. API systems were the most frequently used by the respondents. Thirty-two (58%) respondents were using API routinely. Ten were using Enterotube, 9 using Micro-ID, and 6 each were using Vitek and ISOGRID sys-

tems. The chronological development of these systems seem to have had some effect. API, Enterotube, and Micro-ID have been on the market for more than 10 years and thus caught the attention of users more than the newer systems. The situation may change as microbiologists become aware of other systems including DNA probes, immunological kits or instruments.

2. *What was the basis for your decision to use these?*
The four major reasons for deciding on a particular system were rapidity (18 responses), ease of operation (16), accuracy of systems (12), and cost (9). Other reasons including previous experience (4), KSU workshop (3) and "space saver" (3). It was obvious from the total in column one of Table 1 that some of the respondents were utilizing more than one of the systems or instruments. The three most frequently used systems by the respondents were API, Enterotube, and Micro-ID and their top criteria for choosing a system was "rapidity". This is interesting because they are inoculated with a pure culture obtained from solid plating media. In the routine analysis of food or environmental samples it requires several days of laboratory work to reach the point where a colony is available. On the other hand, Enzyme Immunology Assay (EIA) and DNA Probe (GeneTrak) are more rapid than these miniaturized systems, but only a few respondents indicated that they were utilizing these technologies. The perception of the practicing microbiologist is that the miniaturized identification systems are rapid, and when compared to the conventional procedure, they do speed up the overall process, but compared to the newer technologies, they are not so rapid.

3. *What kit, instrument or system do you wish you could use regardless of cost?*
A large number of respondents (26) would like to have a Vitek system. The number of respondents for other systems were much lower. For example: EIA (7), Spiral plater (6), Bactomatic (5) and Micro-ID (5). The reason for Vitek system popularity in this survey is the system's versatility and high degree of automation. This illustrates the importance of automation in the microbiology laboratory, regardless of cost.

4. *As you see it what are the most urgent needs in (food) microbiology today?*
These answers were not subject to tabulation. Most of the respondents thought that more rapid, accurate, and inexpensive methods were needed to detect traditional pathogens such as *Salmonella* and *Staphylococcus aureus* and emerging pathogens such as *Listeria, Campylobacter* and *Yersinia*. A need for automation was reiterated in this section.

5. *If you could wish or dream, what kind of media would you like to have to help you in your daily work?*
Responses included a need for improved selective agars for *Salmonella, Listeria,* anaerobes, *Mycobacterium,* and *Pediococcus*. In addition, improvements in the media for recovery of injured microorganisms were mentioned.

6. *How many bioburden (total plate count and coliform count) do you routinely run (per month, per year)?*
Table 2 contains data from questions 6 and 7. These data indicated that laboratory to laboratory variations were very extreme. Some laboratories did not perform any total plate counts (TPC) and coliform counts while one laboratory reported 250,000 TPC per year and another reported 840,000 coliform counts per year. Over two-thirds of those surveyed indicated they were routinely doing TPC and most of them were conducting between 100 and 10,000 TPC's per year with an average of 12,786 and a maximum of 250,000.

   The data for coliform analysis were similar to total counts, i.e. extreme diversity existed between laboratories. Coliform analysis was equally as popular a test as the TPC, probably because both tests were simple and easy to run and required minimum laboratory expense. About half of those testing for coliforms conducted between 1,000 and 10,000 tests per year, 20% over 10,000 per year, and about 30% less than 1,000 per year. The average number of tests per year was 25,023; however, this average was drastically skewed because of one soy product's operation that performed 840,000 coliform analyses per year.

7. *How many tests of* Salmonella, Listeria, Campylobacter *and other pathogens do you run per year?*
Over 60% of the respondents indicated that they routinely analyze for *Salmonella* with slightly greater than half of these performing 1,000 - 10,000 tests per annum. The others ran less than 1,000, except for one which ran 15,000 samples per year. The average number of tests among those doing them was 1,500 per year.

   Twenty-two percent of those questioned were testing for *Listeria*. Over 65% were running less than 1000 tests per year with an average of 520. Unfamiliarity with the laboratory procedure and uncertainty concerning the regulatory agency's view of this organism were probably the reasons that so few *Listeria* tests were being run at the time of this survey. The number of tests may increase or cease, depending on regulatory decisions and the type of food or material involved.

   Ten percent of those surveyed were testing for *Escherichia coli* and *S. aureus*, with an average of 2,000 and 330 tests per year for *E. coli* and *S. aureus* respectively.

Only nine percent of the respondents were testing for *Campylobacter* and the numbers of analyses per laboratory were low. It is surprising that testing for this organism is not of more importance, especially considering the clinical importance and the direct epidemiological connection to food (poultry in particular). The laboratory procedure for *Campylobacter* is slightly more involved than that for *Salmonella*. Probably the biggest single explanation lies in the fact that the regulatory agencies routinely analyze for *Salmonella* and rarely ever for *Campylobacter*. Should regulatory agencies intensify their efforts concerning *Campylobacter* testing, the number of tests done in many of these laboratories will no doubt increase at a logarithmic rate.

8. *How much are you willing to pay for an excellent system for any pathogens of concern* (Salmonella, Campylobacter, Yersinia, Listeria, etc? *How much would you be willing to pay for a system that would do all of the above pathogens AT ONCE?*
Of the 46% that responded to this question, the amounts given varied from $2 to $100. Forty percent said they would pay over $15, 36% said less than $10 and 24% said between $10 and $15. Some of the more interesting individual responses were:
   a. Four times (4x) the cost of our present conventional system.
   b. Ten times (10x) the price of the usual identification.
   c. If it fits our specific need, price wouldn't be a big issue unless it was ridiculously high.
   d. In our situation, we would like a negative test to be cheap and it would be okay if a positive test were more expensive.

9. *How much would you pay for any 8-10 hour test for any of these organisms?*
Over 50% responded to this question with a very wide range, the minimum being $3 and the maximum (for an automated instrument) of $100,000.

Cost of test		
<$10	$10-$100	>$100
9	10	11

While 19 of 30 responses were less than $100, the other 11 ranged from $10,000 to $100,000 with an average of $40,000. Some interesting responses:
   a. Not much.
   b. One hundred times (100x) price of usual identification.
   c. An automated instrument, with no enrichment step would be worth $100,000.

10. *Do you have any needs for sterility testing per se? What procedure are you using now?*
Nineteen respondents performed some form of sterility testing for their products. Most used conventional methods.

11. *What research developments in the field do you wish to see in the near future?*
Answers were similar to those for question 4. Respondents mainly wish to have inexpensive and accurate systems which could provide rapid and automated detection of pathogens.

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Mention of specific brand names does not imply endorsement by the authors or institutions at which they are employed to the exclusion of other brands or instruments which are not mentioned.

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