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3. The Chick–Martin test for disinfectants

Chick H, Martin C. J Hyg 1908; **8**: 654–697

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Background

Towards the end of the 19th century there was a need for standardized tests to determine the efficiency of disinfectants against the newly discovered bacterial pathogens. Methods had been developed in which disinfectants were tested on organisms soaked into thread or coated onto garnets. However, more appropriate were tests based on contact between dilutions of disinfectant and suspensions of organisms, which could be subcultured to detect residual infectivity.

The first such widely used test was that devised by Rideal and Walker in 1903 [1]. Briefly, cultures of *Salmonella typhi* (then called *Bacillus typhosus*), were added to dilutions of the test disinfectant and phenol in distilled water and subcultured every 2·5 min. The concentration of disinfectant which killed in 7·5 but not 2·5 and 5 min, was compared to the concentration of phenol which produced the same result. The ratio of concentrations obtained was referred to as the 'carbolic acid' (later phenol or Rideal–Walker) coefficient.

Though widely used, the Rideal–Walker test was also widely criticized; the reaction time was arbitrary and short; only one bacterial species was used. Perhaps most importantly, the use of distilled water as the suspending medium for the reaction did not reflect the 'dirty' conditions in which disinfectants were often used. This allowed unrealistically high Rideal–Walker coefficients to be quoted by disinfectant manufacturers. With this in mind Ashley Miles was to describe the Rideal–Walker test as 'at best a grossly over-simplified answer to a very difficult problem, and at worst little short of bacteriological prostitution' [2]!

The Chick–Martin test

In 1908, three papers on disinfection were published in the journal. The first, too long to be reproduced here, was by Harriette Chick of the Lister Institute [3]. She explored the kinetics of disinfection, showing by calculations using data collected by others that disinfection followed first-order kinetics. She investigated different disinfectants and test organisms, and emphasized that time, temperature and concentration should be standardized. In particular, she showed a logarithmic relationship between disinfectant concentration and the reaction velocity, and that the effect of dilution on the sterilization time differed for different disinfectants. This last point was taken up by Watson [4], who investigated the kinetics further, and expressed the disproportionate effect of dilution on the effects of different disinfectants as the concentration (dilution) coefficient.

The third paper, reproduced here [5], described a modification of the Rideal–Walker test by Chick and Charles Martin. The paper is long, with much experimental data which a modern editor might shorten or omit. Rapid appreciation of the main points is not easy because there is no overall summary; separate summaries are provided for the different sections of the paper.

The paper continues Chick's thorough investigation of the factors affecting disinfection and, based on the results obtained, describes a test method which was a significant improvement on the Rideal–Walker test. The paper includes information on the effects on sterilization time of different bacterial numbers added to the reaction mixture [Table I]; experiments on different disinfectants including metallic salts, Cresol and some unnamed phenolics [Tables III, IV, VIII].

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Here they appreciated that comparison with phenol was not always appropriate, and that carryover of disinfectant into the detection tubes might be a problem. They also used different organisms including *S. aureus*, *Bacillus* (*Yersinia*) *pestis and Bacillus anthracis* [Tables V, VI]. Although they proposed the use of *S. typhi* they appreciated that the result might not be directly relevant to other organisms, also that the causative agent of some infections, including measles, typhus and scarlet fever was then still unknown. Not considered were the sampling problems associated with detecting residual infectivity by sampling one standard loopfull.

Of particular importance was the investigation of dirt and organic matter in the test system. After testing the addition of various concentrations of serum, dust and charcoal [Tables IX–XII], they settled somewhat reluctantly on sterile powdered faeces [Tables XIII–XVIII]; 'The bulk of the disinfectants manufactured are destined for the disinfection of excreta, drains, etc., where they have to operate in the presence of more or less faecal matter.' To permit assessment of otherwise satisfactory disinfectants with low reaction velocities and to simplify the test, they sampled only after 30 min. Thus, the Chick–Martin coefficient was the ratio of the concentrations of disinfectant to phenol which sterilized the culture in 3% faeces in 30 min. The final test method was described at the end of their paper.

Later developments

Despite its use of *S. typhi* and phenol as the basis for comparison, the Chick–Martin test was a great improvement on the Rideal–Walker test. Although Chick and Martin stressed the ease with which faecal suspensions could be made, Garrod, in papers also published in the journal [6, 7], found that the faecal suspension clumped, trapping viable organisms. This could lead to an overestimate of disinfectant activity and he suggested the use of 5% sterile yeast instead. This modification was incorporated into the British Standard Specification in 1938 [8]. The test continued to be used for the testing of phenolic disinfectants in human and veterinary medicine for many years. For example, in 1965 the Public Health Laboratory Service still accepted the method for the evaluation of broad-spectrum phenolic disinfectants for general hospital use [9], and the method was used for the assessment of phenolic disinfectants for agricultural use under the Diseases of Animals Act (1950), until 1970.

The method gradually fell into disuse as other tests were introduced. These determined the optimum concentration of particular disinfectants for particular purposes, and without the comparison with phenol [10]. Account also had to be taken of the disinfection of increasingly complicated and delicate instruments [11], as well as of the possible presence of agents, newly recognized or whose clinical significance had not been appreciated, and which might be resistant to some disinfectants (e.g. [12, 13]).

Although the Chick–Martin test is now outdated, the practical implications of the factors affecting disinfection on which it was based still apply, and vestiges of the method itself are still seen in some current tests for disinfectants and also antibiotics.

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