

Opinion Article

Conventional Culture Media: an Outdated Microbiological Tool but Still Useful

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Abstract

Conventional culture media are the backbone for many microbiological activities in clinical, research, industrial and other fields. They are cheap, easy to handle and convenient. For many decades, they served mankind in the advances made in the microbiological field. However, in the recent years, the limitations of these old tools became evident in many areas, especially when compared with the newly emerged technologies in the microbial detection, identification and enumeration. These drawbacks of the classical culture media may limit their use in the near future and lead to its replacement with rapid microbiological methods (RMMs). A progress that is fast growing in the developed nations and increases the gap in the microbiological field advancement between the advanced and the developing countries.

Keywords: Culture Media; Developing Countries; RMM; Archaea; TSA; TVC; VBNC

The traditional culture media are a crucial tool in the microbiology field that covers a various area of applications which have been developed over many decades. These fields include - but are not limited to - research, industrial, quality control, clinical and many others. They are globally available and manufactured in many countries distributed around the world [1]. Although conventional or culture-dependent techniques are relatively cheap and reproducible, they are known to be inaccurate in the estimation of the total viable count of bacteria by up to several orders of magnitude, whatever incubation temperature and/or time variations have been applied. It has long been documented that artificial microbiological media lead to only a very small estimation (0.01–1%) from the true total viable count of bacteria present in any given sample [2]. Viable-but-not-culturable (VBNC) cells have also been shown to be tolerant to antimicrobial, as well as exhibiting tolerance to heavy metals, environmental harsh conditions, and ethanol [3]. Therefore, despite considerable financial/legal costs associated with culture-based results, application of selective agents in any culture-based method, including those for pathogens is likely to lead to considerable underestimation of the actual number of potentially infective bacteria present. The differentiation within persisters and VBNC microbial interties appears artificial, and while there has been much published in recent years on

persisters, the article on the VBNC is voluminous, and to date there are no true evidences that prove that they are not the same, or at least variants, of the same phenomenon [4].

Despite the appealing advantages of classical culture media especially for developing countries, the limitations encountered from it are critical as mentioned in addition to the problems associated with recovery of injured cells. Moreover, Microbiological culture-based techniques are not efficient for the recovery of the relatively newly emerged domain Archaea [5, 6]. Thus, the actual total viable count (TVC) recovered from general media such as Tryptone Soya Agar (TSA) is questionable. The problem is intensified if the low probability nature of detection for microbial contamination into consumable products was taken into consideration [7]. The understanding of these limitations is important among professionals in the healthcare industries, where the health and possibly the life of the served populations may be seriously impacted by the microbiological quality of the delivered product or service.

The current challenges of this topic in the microbiology has been addressed by researchers in the clinical practice field. Advantages and disadvantages of both conventional and RMM techniques can be summarized in Table 1. [8, 9]. Despite cons, pros possessed by the classical microbiological media make them an indispensable tool in the microbiology laboratories which are essentially financial as could be found from Table 1.

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Table1. A Brief comparison between major points of advantages and disadvantages between conventional culture and RMMs techniques [8, 9].

Class	Comparison Point	RMMs	Classical Culture Technique
Financial	1. Capital (upfront) cost and ongoing expenses	Very expensive	cheap
	2. Return on Investment (ROI) period	Long that may reach years	Short within just few months
Financial and Technical	3. Test time	From zero to hours	Ranges from days to weeks
Technical	4. Sensitivity	High	Low
	5. Ability to recover/detect stressed/injured and VBNC microbial cells	High	Very low and may be missed
	6. Labour skill requirements	Low	High

VBNC= Viable-But-Not-Culturable

The new technologies in the microbiology collectively called Rapid Microbiological Methods (RMMs) have advantages over microbiological culture media in many aspects including time, scope and sensitivity for detection, identification and enumeration of the viable particles. However, the main burden for application in developing countries is financial [10]. The main challenge is to make these technologies available globally with suitable capital and maintenance costs in addition to the awareness of their importance over classical culture methods. This will improve dissemination of these technologies to the industries that are linked to microbiology. The transition phase may actually require a significant lag time before becoming dominant. Accordingly, several guidelines such as pharmacopeias provided requirements for validation of RMMs as alternatives for the conventional culture-based techniques before being applied and should prove to be equivalent or better than the reference traditional microbiological method [11]. The adoption of the new technologies by pharmaceutical standards such as ISO, Ph. Eur, USP, JP among others is often a slow process and limited in implementation in Good Manufacturing Practice (GMP) governed environment [9]. Both FDA and USP in addition to other standards provided detailed guidance for validation package of RMMs which is composed of several items that should be fulfilled by regulatory authorities depending on the nature of RMMs [9]. Basically, RMMs are based on four basic platforms: *Growth-based*, *Artifact-based*, *Nucleic-acid-based*, *Viability-based* methods [11]. The future of microbiological safety is dependent on the extent to which the development of new technologies could be seen practically in the various microbiological fields.

Conclusion

Conventional culture media and techniques have helped the human being in achieving breakthroughs in various fields of microbiology. However, with advances that have been made in this field - especially in the few last decades - have demonstrated the limitations of this old tool which

may impact its reliability on detection, enumeration and identification of the microbial entity, if compared with the new emerging technologies. RMMs have demonstrated their superiority over the conventional culture methods during last year's. It is crucial to set a global trend to establish RMMs use in the various industries as a basic mean for microbiological activities, even though the conventional microbiological technique still retain its attractiveness in terms of cheapness, availability, simplicity and ease of use especially for developing countries. The barriers to application of RMMs should be removed to be available even to poor countries in order to overcome microbiological challenges in healthcare industries which impact human health in the world of ever-increasing ill populations versus the number of objectionable microbes.

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Conflict of Interest

None to declare.

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