Culturomics: A New Approach for the Diagnosis of the Oral Microbiota

The study of the oral microbiota (OM) has assumed considerable importance in recent years as numerous studies have reported its alteration in a large number of diseases, both oral and systemic.

The close relationship between oral dysbiosis, caries, periodontal disease is already strongly known evidence, but recent studies have also highlighted how this relationship is equally validated for oral oncological diseases.[1-3]

Dysbiosis of the oral cavity and the pathologies connected to it, however, also play fundamental roles in the genesis of systemic diseases and their maintenance.[4]

Research in the microbiological field has provided very useful tools for the OM analysis, allowing the expansion of the number of species that can be analysed, even with a limited amount of biological samples (one of the main problems often experienced in samples from oral cavity). Such tools are the recent methods of molecular and genomic analysis. Among them the best known is metagenomics.

Metagenomics, however, has several limits as it cannot discriminate between live and dead bacteria and a minimum concentration of 105 bacterial cells per gram is needed to effectively detect a population.[5]

An alternative method of microbiological analysis was presented in 2012 to overcome the intrinsic limitations of metagenomic analysis techniques: culturomics.

The culturomic technique involves using different culture conditions and identifying bacterial populations through matrix-assisted laser desorption ionization-time of flight mass spectrometry (MALDI–TOF MS).[6]

The abovementioned different culture conditions are reproduced in order to force virtually every type of bacteria to grow in a specific culture medium. It has been demonstrated that even the so-called "fastidious bacteria" (an organism that grows only when specific nutrients are included in its medium) living in the human gut succeeded in growing.[6,7] Different cultures conditions include several conditions of temperature, pressure, oxygen and specific cultural media availability. Culture media are to be improved with blood and rumen fluid in blood culture bottles in order to promote the growth of minority populations.[5] A previous experiment confirmed that around 200 different culture conditions revealed more than 30,000 bacterial colonies and, among them, 31 species belonging to very rare phyla were isolated.[5]

Once culturomic conditions have been reproduced and all colonies have been allowed to grow for an appropriate time the subsequent identification of bacterial species is carried out by MALDI–TOF mass spectrometry. A double-checking of colonies' identification with the 16S ribosomal RNA (rRNA) sequencing is strongly suggested. This additional method, being based on rRNA and not on DNA, allows adequate discrimination between live and dead cells.

The use of culturomics for the identification of new species colonizing the oral cavity is strongly suggested, mainly because such technique allows obtaining living bacteria on which additional analyses could be performed. The search for pathogenicity factors to correlate oral bacterial populations with systemic diseases or conducting antibiotic susceptibility tests are just some of the potential applications. Antibiotic susceptibility tests on OM bacterial populations, moreover, is a very urgent need as it has been recently demonstrated that the prescription of antibiotic molecules in the absence of correct indications or with inappropriate dosage can cause the onset of bacterial resistance.[8]

The main limit of culturomics is that it is based on the induction of bacterial growth; such intrinsic working method prevents every type of quantitative analysis on the samples. Anyway this limit could be easily overcome combining the culturomic analysis with the real-time PCR even if it causes an increase in costs.

The available evidence about the use of culturomics for the analysis of OM is quite poor therefore, with the aim of better evaluating its potential additional applications and further limits, additional studies investigating culturomics and comparing the different diagnostic techniques are encouraged.

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Conflicts of interest

There are no conflicts of interest.

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