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(54) Title: SALIVARY BIOMARKERS FOR THE DETECTION OF EPIDERMOID CANCER OF THE HEAD AND NECK

(57) Abstract: Present invention relates to the in vitro use of the level or concentration in a salivary or breath sample of bacteria belonging to the *Alloprevotella*, *Prevotella*, *Campylobacter*, *Rothia*, *Catonella*, *Porphyromona*, *Fretibacterium* genus, or any combination thereof, for the diagnosis of carcinomas or epidermoid cancers, especially epidermoid cancer of the head and neck, in a patient, or to obtain useful data that allow such a diagnosis.



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SALIVARY BIOMARKERS FOR THE DETECTION OF EPIDERMOID CANCER OF THE HEAD AND NECK

Technical field of the invention

5 The present invention relates to a biomarker or a combination of biomarkers in salivary samples that, on the one hand, help to the diagnosis of Epidermoid Cancer of the Head and Neck and, on the other hand, predict the response to treatment of a subject with this disease.

State of the art

10 Epidermoid Cancer of the Head and Neck is a malignant neoplastic entity originated in the epithelium that covers the mucosa of the aerodigestive tract. Its annual incidence of 700,000 patients places it in sixth position of the world ranking in terms of more frequent cancers. Of the 53,640 new cases of head and neck tumours (oral cavity, pharynx and larynx) that were detected in the United States in 2013, 95% of them corresponded to epidermoid cancer of the head and neck. According to the 2010 GLOBOCAN Report, Spain is one of the countries with
15 the highest incidence of epidermoid cancer of the head and neck in the entire European continent, proof of this are the 11,513 cases of patients with epidermoid cancer of the head and neck that were diagnosed in 2002.

In recent years, the use of saliva as a diagnostic tool or evolutionary follow-up of certain pathologies or diseases, has acquired great relevance in the field of biomedicine. The main
20 advantage of the use of saliva as a diagnostic or follow-up tool is that consists on a non-invasive method, easy to collect, inexpensive, difficult to alter and stable under non-refrigerated conditions.

The human oral microbiota of which the salivary microbiota is also part comprises the set of microorganisms and pathogens that are components of the oral cavity. Its function is to
25 protect the oral cavity and prevent the development of diseases. Recently, the use of massive sequencing techniques has allowed to study changes in the composition of the oral microbiota of healthy and sick patients. Some of the studies carried out so far, show that sites with oncological character have a lower diversity of species. Currently, the results of the salivary microbiota composition suggest that salivary species such as *Capnocytophaga gingivalis*,
30 *Prevotella melaninogenica*, and *Streptococcus Mitis* correlate with epidermoid cancer of the head and neck. Dysbiosis between epidermoid head and neck tumour sites and healthy tissues shows a decrease in Actinobacteria and *Firmicutes* phylo when compared with healthy tissues. However, analysis of the results at genus or species level does not show the same trend.

Epidermoid cancer of the head and neck is frequently diagnosed in advanced stages of the disease, conferring it a grim prognosis. At present, it seems paradoxical that, with the available means, there are no effective programs for the early detection of this type of tumours. In fact, between the genera proposed in the present invention as possible biomarkers with a predictive and diagnostic character (*Rothia*, *Prevotella*, *Alloprevotella*, *Campylobacter*, *Catonella*, *Porphyromona* and *Fretibacterium*), *Rothia* is the only one that has been used as an oral biomarker with clinical indications for carcinoma detection in the oral and oropharyngeal cavity until now [Lim Y, Fukuma N, Totsika M, Kenny L, Morrison M, Punyadeera C: The Performance of an Oral Microbiome Biomarker Panel in Predicting Oral Cavity and Oropharyngeal Cancers. Front Cell Infect My 2018, 8].

Thus, we understand that there is still a need to provide useful programs and tools for the early detection of epidermoid cancer of the head and neck.

Description of the invention

Throughout the present invention, we analyze the diagnostic and prognostic capacity of the salivary microbiota, to be used as a biomarker for pharyngolaryngeal epidermoid cancer. With this purpose, a clinical study with sample collection at the "Bioithas" clinical research center (Alicante) was carried out. The statistical analysis was performed using the software SPSS © 15.0 and consisted of one descriptive part and another inferential part ("Chi square" test for qualitative variables and "Student's T" for quantitative variables). Spearman's "S" correlation was used for nonparametric samples. Finally, to study the validity of salivary microbiota values as a diagnostic and prognostic proof, ROC curves were used to calculate the most appropriated cut-off points together with their corresponding sensitivity and specificity values.

A total of 40 salivary samples corresponding to 20 patients and 20 healthy controls were included in the study. Among the patients, the average age was 61.9 years (minimum of 38 and maximum of 86). Most of them were male (98.7%), with a male / female ratio of 19 to 1, all patients were at the time of diagnosis in advanced stages of the disease (60.0%). The laryngeal location was the most frequently affected (85%).

Profiles of the salivary microbiota, comparative between cases and controls, and areas under the ROC curve for the main germs involved are described in the figures of the present invention. Figures 6 to 13 and table 3 show the different areas under the curve for each of the

genera that showed statistically significant differences between groups in the present study. From this information, is possible to conclude that:

- 5 - In case of both absolute values and percentage of presence of *Alloprevotella* genus in salivary samples and, especially, of its *Alloprevotella rava* and *Alloprevotella tanneriae* species, there is a negative correlation between subjects with epidermoid cancer of the mouth and pharynx and healthy subjects;
- In case of both absolute values and percentage of presence of *Prevotella* genus in salivary samples, there is a negative correlation between subjects with epidermoid cancer of the mouth and pharynx and healthy subjects;
- 10 - In case of both absolute values and percentage of presence of *Campylobacter* genus in salivary samples, there is a negative correlation between subjects with epidermoid cancer of the mouth and pharynx and healthy subjects;
- In case of both absolute values and percentage of presence of *Rothia* genus in salivary samples, there is a positive correlation between subjects with epidermoid cancer of the mouth and pharynx and healthy subjects;
- 15 - In case of both absolute values and percentage of presence of *Catonella* genus in salivary samples, there is a negative correlation between subjects with epidermoid cancer of the mouth and pharynx and healthy subjects;
- In case of both absolute values and percentage of presence of *Porphyromona* genus in salivary samples; there is a negative correlation between subjects with epidermoid cancer of the mouth and pharynx and healthy subjects; and
- 20 - In case of both absolute values and percentage of presence of *Fretibacterium* genus in salivary samples, there is a negative correlation between subjects with epidermoid cancer of the mouth and pharynx and healthy subjects.
- 25 Therefore, it can be conclude that on the one hand salivary microbiota shows high potential as a prognostic and diagnostic marker for the development of screening programs helping to the early diagnosis of epidermoid cancer of the head and neck in high-risk patients, and on the other hand it has potential to diagnose and predict both evolution and follow-up of patients with epidermoid cancer of the head and neck, being able to complement the known classic
- 30 diagnostic / prognostic factors.

It is noted that, in the context of the present invention, *Alloprevotella* genus and, especially, its *Alloprevotella rava* and *Alloprevotella tanneriae* species, are at lower levels in salivary biological samples of patients with epidermoid cancer of the head and neck than in general population. Furthermore, it is noted that the following sequences SEQ ID NO 1 to SEQ ID NO 3, are representative sequences of this genus and, therefore, useful for identification of bacteria belonging to this genus in such samples through a PCR procedure or by means of any sequencing technique, being of special interest the molecular diagnostic techniques by microarray.

SEQ ID NO 1 >d643812b99d154c919c0ce6b382a6d32

AGGAATATTGGTCAATGGACGGAAGTCTGAACCAGCCAAGTAGCGTGCAGGATGACGGCCCTCTGGG
 TTGTAAACTGCTTTTAGTTGGGAATAAAAAAGAGGACGTGTCCTCTATTGTATGTACCTTCAGAAAAAG
 GACCGGCTAATTCCGTGCCAGCAGCCGCGGTAATACGGAAGGTCCAGGCGTTATCCGGATTTATTGGG
 TTTAAAGGGAGCGTAGGCGGATTATTAAGTCAGTGGTGAAAGACGGTGGCTCAACCATCGTTAGCCAT
 TGAAACTGGTAGTCTTGAGTGCAGACAGGGATGCTGGAACCTCGTGGTGTAGCGGTGAAATGCTTAGAT
 ATGACGAAGAACTCCGATTGCGAAGGCAGCTGACGGGAGCGCAACTGACGCTTAAGCTCGAAGGTGC
 GGGTATCAAAC

SEQ ID NO 2 >be884fc0a4b0abb13e06f9da1978b834

AGGAATATTGGTCAATGGACGGAAGTCTGAACCAGCCAAGTAGCGTGCAGGATGACGGCCCTCTGGG
 TTGTAAACTGCTTTTAGTTGGGAATAAAAAAGAGGACGTGTCCTCTATTGTATGTACCTTCAGAAAAAG
 GACCGGCTAATTCCGTGCCAGCAGCCGCGGTAATACGGAAGGTCCAGGCGTTATCCGGATTTATTGGG
 TTTAAAGGGAGCGTAGGCGGATTATTAAGTCAGTGGTGAAAGACGGTGGCTCAACCATCGTTAGCCAT
 TGAAACTGGTAGTCTTGAGTGCAGACAGGGATGCTGGAACCTCGTGGTGTAGCGGTGAAATGCTTAGAT
 ATCACGATGAACTCCAATCGCGAAGGCAGGTGTCCGGGCTGCAACTGACGCTGAGGCTCGAAAAGTGTG
 GGTATCAAAC

SEQ ID NO 3 >566e492fc8c692afeb1e84a3baeb42ad

AGGAATATTGGTCAATGGACGGAAGTCTGAACCAGCCAAGTAGCGTGCAGGATGACGGCCCTCTGGG
 TTGTAAACTGCTTTTAGTTGGGAATAAAAAAGAGGACGTGTCCTCTATTGTATGTACCTTCAGAAAAAG
 GACCGGCTAATTCCGTGCCAGCAGCCGCGGTAATACGGAAGGTCCAGGCGTTATCCGGATTTATTGGG
 TTTAAAGGGAGCGTAGGCGGATTATTAAGTCAGTGGTGAAAGACGGTGGCTCAACCATCGTTAGCCAT
 TGAAACTGGTAGTCTTGAGTGCAGACAGGGATGCTGGAACCTCGTGGTGTAGCGGTGAAATGCTTAGAT
 ATCACGATGAACTCCGATCGCGAAGGCAGGTGTCCGGGCTGCAACTGACGCTGAGGCTCGAAAAGTGT
 GGGTATCAAAC

Other representative sequences of this genus will be known by the person skilled in the art and they will serve to identify those bacteria belonging to this genus in a saliva or breath sample.

On the other hand, it is noted that, in the context of the present invention, *Prevotella* genus is at lower levels in salivary biological samples of patients with epidermoid cancer of the head and neck than in general population. Furthermore, it is noted that the following sequences
5 SEQ ID NO 4 to SEQ ID NO 6, are representative sequences of this genus and, therefore, useful for the identification of bacteria belonging to this genus in such samples through PCR or any other sequencing technique, including the molecular diagnostic techniques used by DNA microarray.

SEQ ID NO 4 >29971068736dbb4328b226203638d02e

GGGAATATTGCACAATGGGGGAAACCCTGATGCAGCAACGCCGCGTGAACGATGAAGGCCTTTGGGT
CGTAAAGTTCTGTTCTAGGTGATGAAAACCTGACAGTAACCTAGGAGAAAGCCCCGGCTAACTCCGTGC
CAGCAGCCGCGTAATACGGAGGGGGCAAGCGTTATCCGGATTTATTGGGTTTAAAGGGAGCGTAGG
CCGTAGATTAAGCGTGTTGTGAAATGTAGATGCTCAACATCTGACTTGCAGCGCGAACTGGTTTACTTG
AGTGTGCGCAACGTAGGCGGAATTCGTCGTGTAGCGGTGAAATGCTTAGATATGACGAAGAACTCCGA
TTGCGAAGGCAGCTTACGGGAGCACAACCTGACGCTGAAGCTCGAAGGTGCGGGTATCAAAC

SEQ ID NO 5 >c6ed086de07dcb19c3164e681606b792

GGGAATATTGCACAATGGAGGAAACTCTGATGCAGTGACACCGCGTATAGGAAGAAGGTCTTAGGATT
GTAAGCTATTGTCGTGTGAGAAGAAAATGACCATCACAGGAGGAAGCCCTGGCTAAATATGTGCCAGC
AGCCGCGTAATACGGAAGGTCCGGGCGTTATCCGGATTTATTGGGTTTAAAGGGAGCGTAGGCCGT
GGATTAAGCGTGTTGTGAAATGCAGGTGCTCAACGTCTGCACTGCAGCGCGAACTGGTTCACTTGAGT
GTGCACAACGCAGGCGGAATTCGTCGTGTAGCGGTGAAATGCTTAGATATGACGAAGAACTCCGATTG
CGAAGGCAGCTTGCGGGAGCACAACCTGACGCTGAAGCTCGAAAGTGCGGGTATCGAAC

SEQ ID NO 6 >6a4ca61245b7dfbbc3d341b72b017eca

GGGAATATTGGACAATGGGGGCAACCCTGATCCAGCAATTCTGTGTGCACGATGAAGGTCTTCGGATT
GTAAAGTGCTTTCAGCAGGGAAGAAAAAATGACGGTACCTGCAGAAGAAGCGACGGCTAAATACGT
GCCAGCAGCCGCGTAATACGGAAGGTCCAGGCGTTATCCGGATTTATTGGGTTTAAAGGGAGTGTAG
GCGGTTTGTAAAGCGTGTTGTGAAATTTAGATGCTCAACATTTAACTTGCAGCGCGAACTGTCAGACTT
GAGTACACGCAACGTATGCGGAATTCATGGTGTAGCGGTGAAATGCTTAGATATCATGAAGAACTCCG
ATTGCGAAGGCAGCATACGGGAGTGTAACTGACGCTTAAGCTCGAAGGTGCGGGTATCGAAC

Other representative sequences of this genus will be known by the person skilled in the art and they will serve to identify those bacteria belonging to this genus in a saliva or breath sample.

Furthermore, it is noted that, in the context of the present invention, the *Campylobacter* genus is at lower levels in salivary biological samples of patients with epidermoid cancer of the head and neck than in general population. Furthermore, it is noted that the following sequences
5 SEQ ID NO 7 to SEQ ID NO 9, are representative sequences of this genus and, therefore, useful for the identification of bacteria belonging to this genus in such samples through PCR or any other sequencing technique.

SEQ ID NO 7 >9eae616717ec194797c56f02fab79102

GGGAATATTGCTCAATGGGGGAAACCCTGAAGCAGCAACGCCGCGTGGAGGATGACACTTTTCGGAG
CGTAAACTCCTTTTCTTGGGGAAGAAATTTGACGGTACCCAAGGAATAAGCACCCGGCTAACTCCGTGCC
AGCAGCCGCGGTAATACGGAGGGTGCAAGCGTACTCGGAATCACTGGGCGTAAAGGACGCGTAGGC
GGATTATCAAGTCTCTTGTGAAATCCAATGGCTTAACCATTGAACTGCTTGGGAACTGATAATCTAGA
GTGAGGGAGAGGCAGATGGAATTGGTGGTGTAGGGGTAAAATCCGTAGAGATCACCAGGAATACCCA
TTGCGAAGGCGATCTGCTGGAACCTCAACTGACGCTAATGCGTGAAAGCGTGGGGAGCAAAC

SEQ ID NO 8 >69552d32bb95376b080521fcc96eca94

GGGAATATTGCTCAATGGGGGAAACCCTGAAGCAGCAACGCCGCGTGGAGGATGACACTTTTCGGAG
CGTAAACTCCTTTTCTTGGGGAAGAAATTTGACGGTACCCAAGGAATAAGCACCCGGCTAACTCCGTGCC
AGCAGCCGCGGTAATACGGAGGGTGCAAGCGTACTCGGAATCACTGGGCGTAAAGGACGCGTAGGC
GGATTATCAAGTCTCTTGTGAAATCCAATGGCTTAACCATTGAACTGCTTGGGAACTGATAATCTAGA
GTGAGGGAGAGGCAGATGGAATTGGTGGTGTAGGGGTAAAATCCGTAGAGATCACCAGGAATACCCA
TTGCGAAGGCGATCTGCTGGAACCTCAACTGACGCTAATGCGCGAAAGCGTGGGGAGCAAAC

SEQ ID NO 9 >3aad30e1911d0042c5a63850975b0af4

GGGAATATTGCTCAATGGGGGAAACCCTGAAGCAGCAACGCCGCGTGGAGGATGACACTTTTCGGAG
CGTAAACTCCTTTTCTTAGGAAAGAATTATGACGGTACCTAAGGAATAAGCACCCGGCTAACTCCGTGCC
AGCAGCCGCGGTAATACGGGGGGTGCAAGCGTACTCGGAATCACTGGGCGTAAAGGACGCGTAGGC
GGATTATCAAGTCTCTTGTGAAATTTAACGGCTTAACCGTTAACTGCTTGGGAACTGATAATCTAGA
GTAAGGGAGAGGCAGATGGAATTCTTGGTGTAGGGGTAAAATCCGTAGAGATCAAGAAGAATACTTA
TTGCGAAGGCGATCTGCTAGAACTTAACTGACGCTAATGCGTGAAAGCGTGGGGAGCAAAC

Other representative sequences of this genus will be known by the person skilled in the art and
10 they will serve to identify those bacteria belonging to this genus in a saliva or breath sample.

Additionally, it is noted that, in the context of the present invention, the *Rothia* genus is at increased levels in salivary biological samples of patients with epidermoid cancer of the head and neck compared with general population. Furthermore, it is noted that the following sequences SEQ ID NO 10 to SEQ ID NO 12, are representative sequences of this genus and, therefore, useful for identification of bacteria belonging to this genus in such samples through PCR or any other sequencing technique, including the molecular diagnostic techniques used by DNA microarray.

SEQ ID NO 10 >efea3bb92600988408d794a5d199c1f3

GGGAATCTTCGGCAATGGACGGAAGTCTGACCGAGCAACGCCGCGTGAGTGAAGAAGGTTTTCGGAT
CGTAAAGCTCTGTTAGCAGGGAAGAAGAGAGATTGACGGTACCTGCAGAGAAAGCGCCGGCTAACTA
CGTGCCAGCAGCCGCGTAATACGTAGGGCGCGAGCGTTGTCCGGAATTATTGGGCGTAAAGAGCTT
GTAGGCGGTTTGTGCGCTCTGCTGTGAAAGGCCGGAGCTTAACTCCGTGTATTGCAGTGGGTACGGGC
AGACTAGAGTGCAGTAGGGGAGACTGGAATCCTGGTGTAGCGGTGGAATGCGCAGATATCAGGAAG
AACACCGATGGCGAAGGCAGGTCTCTGGGCTGTAAGTACGCTGAGAAGCGAAAGCATGGGGAGCGA
AC

SEQ ID NO 11 >8f1f146c86e844fcd81a5c504efea83

AGGAATATTGGTCAATGGGCGGAGCCTGAACCAGCCAAGTAGCGTGCAGGATGACGGCCCTATGGG
TTGTAAACCTCTGTTAGCAGGGAAGAAGAGAGATTGACGGTACCTGCAGAGAAAGCGCCGGCTAACTA
CGTGCCAGCAGCCGCGTAATACGTAGGGCGCGAGCGTTGTCCGGAATTATTGGGCGTAAAGAGCTT
GTAGGCGGTTTGTGCGCTCTGCTGTGAAAGGCCGGAGCTTAACTCCGTGTATTGCAGTGGGTACGGGC
AGACTAGAGTGCAGTAGGGGAGACTGGAATCCTGGTGTAGCGGTGGAATGCGCAGATATCAGGAGG
AACACCGATGGCGAAGGCAGGTCTCTGGGCTGTAAGTACGCTGAGAAGCGAAAGCATGGGGAGCGA
AC

SEQ ID NO 12 >40a5d7d7947a9b9f428d2a4de54030d2

GGGAATATTGCACAATGGGCGCAAGCCTGATGCAGCGACGCCGCGTGAGGGATGACGGCCTTCGGGT
TGTAACCTCTGTTAGCAGGGAAGAAGAGAGATTGACGGTACCTGCAGAGAAAGCGCCGGCTAACTA
CGTGCCAGCAGCCGCGTAATACGTAGGGCGCGAGCGTTGTCCGGAATTATTGGGCGTAAAGAGCTT
GTAGGCGGTTTGTGCGCTCTGCTGTGAAAGGCCGGAGCTTAACTCCGTGTATTGCAGTGGGTACGGGC
AGACTAGAGTGCAGTAGGGGAGACTGGAATCCTGGTGTAGCGGTGAAATGCGTAGATATTAGGAAG
AACACCGATGGCGAAGGCAGCTTTCTGGACGAAAAGTACGCTGAGGCGCGAAAGCCAGGGGAGCG
AAC

Other representative sequences of this genus will be known by the person skilled in the art and they will serve to identify those bacteria belonging to this genus in a saliva or breath sample.

Furthermore, it is noted that, in the context of the present invention, *Catonella* genus is present at lower levels in salivary biological samples of patients with epidermoid cancer of the head and neck compared with general population. Moreover, it is noted that the following sequences SEQ ID NO 13 to SEQ ID NO 15, are representative sequences of this genus and, therefore, useful for identification of bacteria belonging to this genus in such samples through PCR or any other sequencing technique, including the molecular diagnostic techniques used by DNA microarray.

SEQ ID NO 13 >b91a78471249bb403f13253808314b44

GGGGATATTGCACAATGGAGGAACTCTGATGCAGCGACGCCGCGTGAGTGAAGAAGTGCTCCGGCA
TGTAAGCTCTTTCAGCAGGGAAGATGATGACGGTACCTGAATAAGAAGCCCCGGCTAACTACGTGCC
AGCAGCCGCGGTAATACGTAGGGGGCAAGCGTTATCCGGATTTACTGGGTGTAAAGGGAGCGCAGGC
GGTCTGGCAAGTTGAGAGTGGAAGCAGGGGGCTCAACCCCTGACTGCTCCAAAAGTGTGGACTGG
AGTATGGGAGAGGCAGGCGGAATTCCTAGTGTAGCGGTGAAATGCTCAGATATTAGGAAGAACACCG
GTGGCGAAGGCGGCCTGCTGGACCAAACTGACGCTGAGGCTCGAGAGCGTGGGGAGCGAAC

SEQ ID NO 14 >60000a298e962dd45ea8f64f83d13296

GGGGATATTGCACAATGGAGGAACTCTGATGCAGCGACGCCGCGTGAGTGAAGAAGTATTTTCGGTA
TGTAAGCTCTATCAGCAGGGAAGATGATGACGGTACCTGACTAAGAAGCCCCGGCTAACTACGTGCC
AGCAGCCGCGGTAATACGTAGGGGGCAAGCGTTATCCGGATTTACTGGGTGTAAAGGGAGCGCAGGC
GGTTTTGCAAGTTGAGAGTGGAAGCAGGGGGCTCAACCCCTGACTGCTCCAAAAGTGTAAAAGTTG
AGTGTAGATGAGGTAGGCGGAATGCGTGGTGTAGCGGTGGAATGCATAGATATCACGCAGAACTCCG
ATTGCGAAGGCAGCTTACTAAGGTACAAGTACGCTGAAGCAGAAAGCGTGGGTATCAAAC

SEQ ID NO 15 >8a4f390e5a28fa4b319a417165699560

GGGGATATTGCACAATGGAGGAACTCTGATGCAGCGACGCCGCGTGAGTGAAGAAGTATTTTCGGTA
TGTAAGCTCTATCAGCAGGGAAGATGATGACGGTACCTGACTAAGAAGCCCCGGCTAACTACGTGCC
AGCAGCCGCGGTAATACGTAGGGGGCAAGCGTTATCCGGATTTACTGGGTGTAAAGGGAGCGCAGGC
GGTTTTGCAAGTTGAGAGTGGAAGCAGGGGGCTCAACCCCTGACTGCTCCAAAAGTGTAAAAGTTG
AGTATGGGAGAGGCAGGCGGAATTCCTAGTGTAGCGGTGAAATGCTTAGATATTAGGAAGAACACCG
GTGGCGAAGGCGGCCTGCTGGACCAAACTGACGCTGAGGCTCGAAAGCGTGGGTAGCAAAC

Moreover, it is noted that, in the context of the present invention, the *Porphyromona* genus is present at lower levels in salivary biological samples of patients with epidermoid cancer of the head and neck compared with general population. Furthermore, it is noted that the following sequences SEQ ID NO 16 to SEQ ID NO 18, are representative sequences of this genus and, therefore, useful for identification of bacteria belonging to this genus in such samples through PCR or any other sequencing technique, including the molecular diagnostic techniques used by DNA microarray.

SEQ ID NO 16 >70a4cb1a6aa33f9abfdf84f2c9707e1b

AGGAATATTGGTCAATGGGCGAGAGCCTGAACCAGCCAAGTCGCGTGAAGGATGACTGTCTTATGGAT
TGTA AACTTCTTTTATACGGGAATAACAAGAGCCACGTGTGGCTCCCTGCATGTACCGTATGAATAAGC
ATCGGCTAACTCCGTGCCAGCAGCCGCGTAATACGGAGGATGCGAGCGTTATCCGGATTTATTGGGT
TTAAAGGGTGCGTAGGCGGCCTGTTAAGTAAGTGGTTAAATTGTTGGGCTCAACCCAATCCAGCCACTT
AAACTGGCAGGCTAGAGTATTGGAGAGGCAAGTGAATTCCATGTGTAGCGGTA AAAATGCGTAGATA
TATGGAGGAATACCGATGGCGAAGGCAGCCTCCTGGGATAACTGACGTT CATGCTCGAAAGCGTGG
GTAGCAAAC

SEQ ID NO 17 >a37c30c91c4a20d9074d2eb6757a8ef8

AGGAATCTCCACAATGGGCGAAAGCCTGATGGAGCAACGCCGCGTGAAGGATGAAGGCCTTCGGGT
TGTA AACTTCTTTTGTAGGGGAATAAAGAATGGTACGTGTACCATAGTGAATGTACCCTACGAATAAGC
ATCGGCTAACTCCGTGCCAGCAGCCGCGTAATACGGAGGATGCGAGCGTTATCCGGATTTATTGGGT
TTAAAGGGTGCGTAGGCGGCCTGTTAAGTCAGCGGTGAAATCTAGGGGCTTAACTCCTAAATTGCCATT
GATACTGGTGGGCTTGAGTGTAGATGAGGTAGGCGGAATGCGTGGTGTAGCGGTGGAATGCATAGAT
ATCACGCAGAACTCCAATTGCGAAGGCAGCTTACTAAGGTACA ACTGACGCTGAAGCACGAAAGCGTG
GGTATCAAAC

SEQ ID NO 18 >b79c9d865f361911a29c5ccda8af5804

GGGAATATTGCACAATGGGGGAAACCCTGATGCAGCGACGCCGCGTGAGTGAAGAAGTATTTTCGGTA
TGTA AAGCTCTATCAGCAGGGAAGATAATGACAGTACCTGACTAAGAAGCCCCGGCTAACTACGTGCC
AGCAGCCGCGGTAATACGGAGGATGCGAGCGTTATCCGGATTTATTGGGTTTAAAGGGTGCGTAGGC
GGCCTGTTAAGTCAGCGGTGAAATCTAGGAGCTTAACTCCTAAATTGCCATTGATACTGGC GGGCTTGA
GTGTAGATGAGGTAGGCGGAATGCGTGGTGTAGCGGTGGAATGCATAGATATCACGCAGAACTCCGA
TTGCGAAGGCAGCTTACTAAGGTACA ACTGACGCTGAAGCACGAAAGCGTGGGTATCAAAC

Moreover, it is noted that, in the context of the present invention, the *Fretibacterium* genus is

at lower levels in salivary biological samples of patients with epidermoid cancer of the head and neck than in general population. Furthermore, it is noted that the following sequences SEQ ID NO 19 to SEQ ID NO 21, are representative sequences of this genus and, therefore, useful for identification of bacteria belonging to this genus in such samples through PCR or any other sequencing technique, including the molecular diagnostic techniques used by DNA microarray.

SEQ ID NO 19 >d97b5732e62c39dd8bebf5a5ad9652f0

GGGAATATTGGGCAATGGGAGGAATCCTGACCCAGCGACGCCGCGTGAACGAAGACGGCCTTCGGGT
TGTAAGTTCTTTTATGTGGGAAGAATGAAGTGACGGTACCACATGAATAAGCCCCGGCTAACTACGT
GCCAGCAGCCGCGTAATACGTAGGGGGCGAGCGTTGTCCGGAATTACTGGGCGTAAAGGGCACGCA
GGCTGTGCTTCAAGTCAGCTGTAAAAGGATGCGGCTTAACCGTGTATGCGGCTGAGACTGAGGTGCT
GGAGTACCGGAGAGGCAAGTGAATTCCCAGTGTAGCGGTGAAATGCGTAGATATTGGGAAGAACAT
CGGTGGCGAAGGCGACTTGCTGGACGGTAACTGACGCTGAGGTGCGAAAGCCAGGGTAGCGAAC

SEQ ID NO 20 >efbe0d96382930addc15fd966fce61e4

GGGAATATTGGGCAATGGGAGGAATCCTGACCCAGCGACGCCGCGTGAACGAAGACGGCCTTCGGGT
TGTAAGTTCTTTTATGTGGGAAGAAGGAAGTGACGGTACCACATGAATAAGCCCCGGCTAACTACGT
GCCAGCAGCCGCGTAATACGTAGGGGGCGAGCGTTGTCCGGAATTACTGGGCGTAAAGGGCACGCA
GGCTGTGCTTCAAGTCAGCTGTAAAAGGATGCGGCTTAACCGTGTATGCGGCTGAGACTGAGGTGCT
GGAGTACCGGAGAGGCAAGTGAATTCCCAGTGTAGCGGTGAAATGCGTAGATATTGGGAAGAACAT
CGGTGGCGAAGGCGACTTGCTGGACGGTAACTGACGCTGAGGTGCGAAAGCCAGGGTAGCGAAC

SEQ ID NO 21 >f69168cdcc49ef7e9886e21a801d14bd

GGGAATATTGGGCAATGGGAGGAATCCTGACCCAGCGACGCCGCGTGAACGAAGACGGCCTTCGGGT
TGTAAGTTCTTTTATGTGGGAAGAATAAAGTGACGGTACCACATGAATAAGCCCCGGCTAACTACGTG
CCAGCAGCCGCGTAATACGTAGGGGGCGAGCGTTGTCCGGAATTACTGGGCGTAAAGGGCACGCAG
GCTGTGCTTCAAGTCAGCTGTAAAAGGATGCGGCTTAACCGTGTATGCAGTTGAGACTGAGGTGCTG
GAGTACCGGAGAGGCAAGTGAATTCCCAGTGTAGCGGTGAAATGCGTAGATATTGGGAAGAACATC
GGTGGCGAAGGCGACTTGCTGGACGGTAACTGACGCTGAGGTGCGAAAGCCAGGGTAGCGAAC

Thus , a first aspect of the present invention relates to the in vitro use of the level or concentration of bacteria in a salivary or breath sample, belonging to the genus of *Alloprevotella*, *Prevotella*, *Campylobacter*, *Rothia*, *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof, for the diagnosis of head and neck cancer, esophageal cancer, lung

cancer, stomach cancer or carcinomas or epidermoid cancers selected from the list consisting of epidermoid cancer of the esophagus, epidermoid cancer of the lung, epidermoid carcinoma of the stomach, or epidermoid cancer of the head and neck, in a patient, or to obtain useful data that enable such diagnosis. Preferably, bacteria belonging to the *Alloprevotella* genus are

5 *Alloprevotella rava* and / or *Alloprevotella tanneriae* species. An alternative embodiment of the first aspect of the invention refers to a method for in vitro diagnosis or collection of useful data to support in such diagnosis, of a subject suspected of resembling head and neck cancer, esophageal cancer, lung cancer, stomach cancer or epidermoid cancers selected from the list consisting of epidermoid cancer of the esophagus, epidermoid cancer of the lung, epidermoid

10 carcinoma of the stomach, or epidermoid cancer of the head and neck, which comprises the use as an indicator in a salivary or breath sample obtained from such subject, of the bacteria level or concentration in such sample belonging to the genus of *Alloprevotella*, *Prevotella*, *Campylobacter*, *Rothia*, *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof, where if the level or concentration in such salivary sample of bacteria belonging to the genus

15 of *Alloprevotella*, *Prevotella*, *Campylobacter*, *Rothia*, *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof, differs or varies compared with a salivary or breath sample obtained from a healthy subject or a reference value, this is indicative of a subject with head and neck cancer, esophageal cancer, lung cancer, stomach cancer or carcinomas or epidermoid cancers selected from the list consisting of epidermoid cancer of the esophagus,

20 epidermoid cancer of the lung, epidermoid cancer of the stomach, or epidermoid cancer of the head and neck.

In another preferred embodiment of the first aspect of the invention, the method comprises the use as an indicator in a salivary or breath sample obtained from such subject, of at least the level or concentration in such sample of bacteria belonging to the genus of *Alloprevotella*,

25 where if the level or concentration in the salivary sample of bacteria belonging to such genus is decreased or significantly lower than in a salivary sample obtained from a healthy subject or compared with a reference value, this is indicative of that such subject shows head and neck cancer, esophageal cancer, lung cancer, stomach cancer or carcinomas or epidermoid cancers selected from the list that consists of epidermoid cancer of the esophagus, epidermoid cancer

30 of the lung, epidermoid cancer of the stomach, or epidermoid cancer of the head and neck.

In another preferred embodiment of the first aspect of the invention, the method comprises the use as an indicator in a salivary or breath sample obtained from such subject, of at least the level or concentration in such sample of bacteria belonging to the genus of *Prevotella*, where if the level or concentration in such salivary sample of bacteria belonging to such genus,

is decreased or significantly lower than in a salivary or breath sample obtained from a healthy subject or compared with a reference value, this is indicative of that such subject shows head and neck cancer, esophageal cancer, lung cancer, stomach cancer or carcinomas or epidermoid cancers selected from the list that consists of epidermoid cancer of the esophagus, epidermoid cancer of the lung, epidermoid cancer of the stomach, or epidermoid cancer of the head and neck.

In another preferred embodiment of the first aspect of the invention, the method comprises the use as an indicator in a salivary or breath sample obtained from such subject, of at least the level or concentration in such sample of bacteria belonging to the genus of *Campylobacter*, where if the level or concentration in such salivary or breath sample of bacteria belonging to such genus, is decreased or significantly lower than in a salivary or breath sample obtained from a healthy subject or compared with a reference value, this is indicative of that such subject shows head and neck cancer, esophageal cancer, lung cancer, stomach cancer or carcinomas or epidermoid cancers selected from the list consisting of epidermoid cancer of the esophagus, epidermoid cancer of the lung, epidermoid cancer of the stomach, or epidermoid cancer of the head and neck .

In another preferred embodiment of the first aspect of the invention, the method comprises the use as an indicator in a salivary or breath sample obtained from such subject, of at least the level or concentration in such sample of bacteria belonging to the genus of *Catonella*, where if the level or concentration in such salivary or breath sample of bacteria belonging to such genus, is decreased or significantly lower than in a salivary or breath sample obtained from a healthy subject or compared with a reference value, this is indicative of that such subject shows head and neck cancer, esophageal cancer, lung cancer, stomach cancer or carcinomas or epidermoid cancers selected from the list consisting of epidermoid cancer of the esophagus, epidermoid cancer of the lung, epidermoid cancer of the stomach, or epidermoid cancer of the head and neck.

In another preferred embodiment of the first aspect of the invention, the method comprises the use as an indicator in a salivary or breath sample obtained from such subject, of at least the level or concentration in such sample of bacteria belonging to the genus of *Porphyromona*, where if the level or concentration in such salivary or breath sample of bacteria belonging to such genus, is decreased or significantly lower than in a salivary or breath sample obtained from a healthy subject or compared with a reference value, this is indicative of that such subject shows head and neck cancer, esophageal cancer, lung cancer, stomach cancer or

carcinomas or epidermoid cancers selected from the list consisting of epidermoid cancer of the esophagus, epidermoid cancer of the lung, epidermoid cancer of the stomach, or epidermoid cancer of the head and neck.

In another preferred embodiment of the first aspect of the invention, the method comprises the use as an indicator in a salivary or breath sample obtained from such subject, of at least the level or concentration in such sample of bacteria belonging to the genus of *Fretibacterium*, where if the level or concentration in such salivary or breath sample of bacteria belonging to such genus, is decreased or significantly lower than in a salivary or breath sample obtained from a healthy subject or compared with a reference value, this is indicative of that such subject shows head and neck cancer, esophageal cancer, lung cancer, stomach cancer or carcinomas or epidermoid cancers selected from the list consisting of epidermoid cancer of the esophagus, epidermoid cancer of the lung, epidermoid cancer of the stomach, or epidermoid cancer of the head and neck.

In another preferred embodiment of the first aspect of the invention, the method comprises the use as an indicator in a salivary or breath sample obtained from such subject, of at least the level or concentration in such sample of bacteria belonging to the genus of *Rothia*, where if the level or concentration in such salivary or breath sample of bacteria belonging to such genus, is decreased or significantly lower than in a salivary or breath sample obtained from a healthy subject or compared with a reference value, this is indicative of that such subject shows head and neck cancer, esophageal cancer, lung cancer, or stomach cancer or carcinomas or epidermoid cancers selected from the list consisting of epidermoid cancer of the esophagus, epidermoid cancer of the lung, epidermoid cancer of the stomach, or epidermoid cancer of the head and neck.

In the context of the present invention, the epidermoid cancer of the head and neck is considered as the set of malignant tumours produced in the mucosa epithelium of the aerodigestive tracts. This type of cancer represents the 90% of the head and neck cancers and according to their characteristics are classified into three groups:

- Oral cavity, pharynx and larynx group: including epidermoid carcinomas mainly related to tobacco and alcohol and with a greater or lesser degree of differentiation.
- Nostrils-nasosinusal cavities group: including epidermoid cancers produced in the lining epithelium of the nasal and paranasal sinuses.

- Nasopharynx group: including epidermoid cancers mainly related to the Epstein-Barr virus (EBV).

In the context of the present invention, the terms of carcinoma or epidermoid cancer are not only related to epidermoid cancer of the head and neck, but also to epidermoid cancer of the esophagus, epidermoid cancer of the lung and / or epidermoid cancer of the stomach. Epidermoid esophageal carcinoma develops in the inner tissue of the esophagus. It usually occurs in the upper and middle part of the esophagus. It is the most common esophageal cancer in the world. Epidermoid cancer of the lung occurs in the lung tissues, usually in the cells covering the respiratory tract (bronchi) that connect the trachea to the lung. This type of cancer represents between 25 and 30 % of lung cancers. Epidermoid cancer of the stomach is a gastric epidermoid cancer that originates in the stomach. It is a very rare tumour, but it should be considered as a possibility of a gastric neoplasm. It is usually diagnosed in advanced stages, which gives it a poor prognosis.

It is noted that, the present invention sufficiently describes the representative nucleotide sequences (i.e SEQ ID No. 1 to SEQ No. 21) that allow identifying the presence as well as the concentration of each of the genera mentioned herein in salivary or breath samples.

A second aspect of the present invention relates to an in vitro method for monitoring the evolution of a subject with head and neck cancer, esophageal cancer, lung cancer, gastric cancer or epidermoid cancers selected from the list consisting of epidermoid cancer of the esophagus, epidermoid cancer of the lung, epidermoid cancer of the stomach , or epidermoid cancer of the head and neck , which comprises the following steps:

- Determination of the levels or concentration of bacteria belonging to, at least, one of the following bacterial genera: *Alloprevotella*, *Prevotella*, *Campylobacter*, *Rothia*, *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof, in a saliva or breath sample isolated from such subject; and
- Comparison of the levels or concentration of such bacteria in such salivary or breath sample with the value obtained in a sample of a healthy subject or with a reference value, where if the level or concentration in such salivary or breath sample of bacteria belonging to the genus of *Alloprevotella*, *Prevotella*, *Campylobacter*, *Rothia*, *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof, differs or varies from a salivary or breath sample obtained from a healthy subject or with respect to a reference value, this is indicative of the favorable or unfavorable evolution of the subject.

A third aspect of the present invention relates to an in vitro method for monitoring the evolution of a subject with head and neck cancer, esophageal cancer, lung cancer, stomach cancer or epidermoid cancers selected from the list consisting of epidermoid cancer of the esophagus, epidermoid cancer of the lung, epidermoid cancer of the stomach, or epidermoid cancer of the head and neck, which comprises the following steps:

- 5 - Determination of the levels or concentration of bacteria belonging to at least one of the following bacterial genera: *Alloprevotella*, *Prevotella*, *Campylobacter*, *Rothia*, *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof, in a saliva or breath sample isolated from such subject; and
- 10 - Comparison of the levels or concentration of such bacteria in such salivary or breath sample with the value obtained in a sample of such subject previously obtained, where if the level or concentration in such salivary or breath sample of bacteria belonging to the genus of *Alloprevotella*, *Prevotella*, *Campylobacter*, *Rothia*, *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof, differs or varies from
15 such previously obtained sample, this is indicative of the favorable or unfavorable evolution of the subject.

A fourth aspect of the invention refers to an in vitro method for predicting the therapeutic response of a patient diagnosed with head and neck cancer, esophageal cancer, lung cancer, stomach cancer or epidermoid cancers selected from the list consisting of epidermoid cancer of the esophagus, epidermoid cancer of the lung, epidermoid cancer of the stomach, or epidermoid cancer of the head and neck, where such method comprises the following steps:

- 20 - Determination of the levels or concentration of bacteria belonging to at least one of the following bacterial genera: *Alloprevotella*, *Prevotella*, *Campylobacter*, *Rothia*, *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof, in a saliva or
25 breath sample isolated from such subject; and
- Comparison of the levels or concentration of such bacteria in such salivary or breath sample with the value previously obtained in a sample of such subject, where if the level or concentration in such salivary or breath sample of bacteria belonging to the
30 genus of *Alloprevotella*, *Prevotella*, *Campylobacter*, *Rothia*, *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof, differs or varies from the value previously obtained in such sample, this is indicative of the favorable or unfavorable evolution of the subject.

A fifth aspect of the invention refers to an in vitro method for predicting the therapeutic response of a patient diagnosed with head and neck cancer, esophageal cancer, lung cancer, stomach cancer or epidermoid cancers selected from the list consisting of epidermoid cancer of the esophagus, epidermoid cancer of the lung, epidermoid cancer of the stomach, or
5 epidermoid cancer of the head and neck, where such method comprises the following steps:

- Determination of the levels or concentration of bacteria belonging to at least one of the following bacterial genera: *Alloprevotella*, *Prevotella*, *Campylobacter*, *Rothia*, *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof, in a saliva or breath sample isolated from such subject; and
- 10 - Comparison of the levels or concentration of such bacteria in such salivary or breath sample with the value obtained in a sample of a healthy subject or with a reference value, where if the level or concentration in such salivary or breath sample of bacteria belonging to the genus of *Alloprevotella*, *Prevotella*, *Campylobacter*, *Rothia*, *Catonella*,
15 *Porphyromona*, *Fretibacterium*, or any combination thereof, differs or varies from a salivary or breath sample obtained from a healthy subject or with respect to a reference value, this is indicative of favorable or unfavourable response to the treatment.

It is noted that the specific treatment for each type of cancer will depend on the stage in which the disease is found. However, the most common general treatment for this type of
20 pathologies usually is:

- Partial or radical surgery;
- Radiation therapy;
- Neoadjuvant or induction chemotherapy;
- Concomitant chemoradiotherapy;
- 25 - Molecular therapies (monoclonal antibodies). Ex: Molecular therapies with cetuximab, a monoclonal antibody that binds to the EGFR antigen (Epidermal Growth Factor Receptor) in epidermoid cancer of the head and neck; and
- Immunotherapy

Additionally, in the context of the present invention, it is understood that there is a poor or
30 unfavorable evolution of the subject if the level or concentration in such salivary or breath sample of bacteria belonging to the genus of *Alloprevotella*, *Prevotella*, *Campylobacter*,

Catonella, *Porphyromona*, *Fretibacterium*, or any combination thereof, is diminished or significantly lower than in a salivary or breath sample obtained from a healthy subject or with respect to a reference value or with respect to the value previously obtained in a salivary or breath sample of the same subject.

5 Particularly, in the context of the present invention, it is understood that there is an unfavourable response to the treatment if the level or concentration in such salivary or breath sample of bacteria belonging to the *genus* of *Alloprevotella*, *Prevotella*, *Campylobacter*, *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof, is diminished or significantly lower than in a salivary or breath sample obtained from a healthy subject or with
10 respect to a reference value or with respect to the value previously obtained in a salivary or breath sample of the same subject.

Alternatively or additionally, in the context of the present invention, it is understood that there is a poor evolution or unfavorable evolution of the subject if the level or concentration in such salivary or breath sample of bacteria belonging to the *Rothia* genus is increased or significantly
15 higher than in a salivary or breath sample obtained from a healthy subject or with respect to a reference value or with respect to the value previously obtained in a salivary or breath sample of the same subject.

Alternatively or additionally, in the context of the present invention, it is understood that there is an unfavorable response to the treatment of the subject if the level or concentration in such
20 salivary or breath sample of bacteria belonging to the *Rothia* genus is increased or significantly higher than in a salivary or breath sample obtained from a healthy subject or with respect to a reference value or with respect to the value previously obtained in a salivary or breath sample of the same subject.

Additionally, in the context of the present invention, the reference value is preferably
25 understood as the result of the data of a mathematical algorithm that uses the concentration and / or the total amount of each bacterium belonging to one or more of the genera proposed in the present invention for general population or a healthy subject. The best value for sensitivity and specificity will be proposed automatically using the algorithm. This algorithm will provide values together with the proposed one, as well as changing sensitivity and
30 specificity values providing more information to physicians and allowing them to decide the best test and cut-off value for each patient or specific situation.

In the context of the present invention, is possible to determine a bacterium belonging to any proposed genera of the salivary or breath sample from such subject, but not limiting to it,

through massive sequencing of the saliva or breath genoma obtaining by this way the total number of bacterial sequences in the saliva together with the total number of other bacteria in that saliva sample. Preferably, such determination is performed by PCR or real-time PCR method.

5 In another preferred embodiment of the first to fifth aspect of the invention or in any of the preferred embodiments of the invention, such bacteria levels or concentration refer to the total amount of bacteria belonging to genus category out of the total bacteria in such sample.

In another preferred embodiment of the first to fifth aspect of the invention or in any of the preferred embodiments of the invention, the levels or concentration of bacteria belonging to
10 the genus of *Alloprevotella*, *Prevotella*, *Campylobacter*, *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof, are determined via an amplification reaction of a nucleic acid preparation derived from such sample using a pair of primers able to amplify one or more representative regions of such genera of bacteria.

Furthermore, in another preferred embodiment of the first to fifth aspect of the invention or
15 in any of the preferred embodiments of the invention, the amplification reaction is carried out by a real-time polymerase chain reaction. Preferably, the detection of the amplification product is accomplished through a fluorescent intercalating agent. More preferably, detection of the amplification product /s is performed by means of a labelled probe, wherein preferably the probe comprises at its 5' end a reporter pigment and at its 3' end a "quencher" pigment or
20 silencer or buffer.

In a sixth aspect of the invention, the method for the first to fifth aspect of the invention or any of its embodiments, further comprises the storage of the method results on a data carrier, preferably wherein such data carrier is readable by computer.

In a seventh aspect of the invention, the method of the first to fifth aspect of the invention or
25 any of its embodiments, include at least the implementation of the comparative step and optionally the provision of a result as a consequence of such comparison by a computer program.

An eighth aspect of the invention refers to a kit including one or more primer pairs able to amplify the bacteria belonging to the genus of *Alloprevotella*, *Prevotella*, *Campylobacter*,
30 *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof. Preferably, such kit is used to implement a method for the detection of bacteria from a sample of saliva or breath isolated from a human subject, that comprises the following steps:

i) Contacting the sample to be analyzed with a reaction mixture, containing specific primers able to amplify bacteria belonging to the genus of *Alloprevotella*, *Prevotella*, *Campylobacter*, *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof, preferably for the production of Multiplex PCR.

5 ii) Amplification by means of polymerase chain reaction.

iii) Identification of the products formed in the prior step, being such information indicative of the levels or concentration of bacteria belonging to one or more of the genera of *Alloprevotella*, *Prevotella*, *Campylobacter*, *Catonella*, *Porphyromona*, *Fretibacterium*, or any combination thereof.

10 It is noted that the present invention protects the methodology per se abovementioned, as well as its use for the implementation of any of the methodologies described in the first to seventh aspects of the invention. Also, the present invention protects the use of the kit of the eighth aspect of the invention for implementation of the methodology according to any of the first to fifth aspects of the present invention.

15 In connection with this eighth aspect of the invention, preferably it provides a method for detecting bacteria belonging to *Alloprevotella rava* and / or *Alloprevotella tanneriae*. In a particular embodiment of this eighth aspect of the invention, fragments of DNA included or comprised in sequences 1 to 21 are amplified. In another embodiment of this eighth aspect of the invention, amplification products, which allow to identify the different species and
20 bacterial groups are detected using probes. In a more preferred embodiment, these probes have between 15 to 25 nucleotides in length. The primers can be designed by multiple alignment with programs such as CLUSTAL X, which allow the identification of highly conserved regions that serve as a template.

Given the great abundance of PCR inhibitors, such as humic and fulvic acids, heavy metals,
25 heparin, etc. that result in false negatives, and although there are methods that reduce the concentration of these types of molecules, it is recommendable (see J. Hoorfar et al., "Making Internal Amplification Control Mandatory for Diagnostic PCR" J. of Clinical Microbiology, Dec 2003, pp.5835) PCR tests containing an Internal Amplification Control (IAC). This IAC consist of no more than a fragment of DNA, which is amplified simultaneously together with the target
30 sample, so its absence at the end of the tests is indicative of the presence of factors, that have caused an undesired development of the PCR.

Throughout the description, the term "specific" implies that the primers comprise a nucleotide sequence totally complementary to the genes or gene fragments employed by the present invention.

In summary, the knowledge gained on the composition of the salivary microbiota in patients undergoing treatment along with the development of the diagnostic or prognostic KIT based on this salivary microbiota is of crucial importance, since it would allow the oncology specialist who treats these patients to have data on the probability of a patient showing or not epidermoid cancer of the head and neck in his first visits, in addition to the probability of response to treatment, as well as patient evolution.

The following examples are merely illustrative of the present invention, but they should not be construed as limiting it.

Brief description of the figures

Figure 1. Rarefaction curves in cases and controls.

Figure 2. Analysis of major components in cases and controls.

Figure 3. Clusterization between different microorganisms at the genus level.

Figure 4. Beta diversity: genera.

Figure 5. Alpha diversity: genus.

Figure 6. Differences between groups of genera described in table 2.

Figure 7. ROC curve (the area under the curve is shown in table 2) for the *Alloprevotella* genus.

Figure 8. ROC curve (the area under the curve is shown in table 2) for the *Prevotella* genus.

Figure 9. ROC curve (the area under the curve is shown in table 2) for the *Campylobacter* genus.

Figure 10. ROC curve (the area under the curve is shown in table 2) for the *Rothia* genus.

Figure 11. ROC curve (the area under the curve is shown in table 2) for the *Catonella* genus.

Figure 12. ROC curve (the area under the curve is shown in table 2) for the *Porphyromonas* genus.

Figure 13. ROC curve (the area under the curve is shown in table 2) for the *Fretibacterium* genus.

Example

MATERIALS AND METHODS

Study population

All patients older than 18 years with an anatomopathological diagnosis of epidermoid carcinoma of pharyngolaryngeal localization were studied.

Samples

Salivary and tissue samples were collected by the Otorhinolaryngology and Molecular Biology
5 service, before signature of the informed consent by all patients who underwent treatment, of benign and malignant head and neck tumours during the period between January 2008 and December 2012, both inclusive. Thereby obtaining an initial total sample of 179 patients.

Subsequently, between these samples a total of 20 patients were chosen and, together with
10 salivary samples from 20 healthy volunteers, an analysis of the hypervariable region of the rS16 gene was performed in saliva samples. The results of the sequencing were analyzed in the biomedical research center of Bioithas, located in the scientific park of Alicante. Patients in both groups were selected in order to maintain the homogeneity in their sociodemographic characteristics.

Population included in the final analysis of the data was defined according to the following
15 criteria:

Inclusion criteria:

- 18-90 age group.
- Location of the original primary tumour in pharynx, larynx or cervical ganglion.
- Anatomopathological diagnosis of epidermoid carcinoma.
- 20 - Curative or palliative surgical treatment.
- Collection of biological samples in surgery room: blood, saliva, tumour tissue and healthy tissue.

Exclusion criteria:

- 25 - Age less than 18 years or over 90 years.
- Primary tumour of localization other than larynx, pharynx and / or lymph nodes.
- Anatomopathological diagnosis of benign and malignant tumours of non-epidermoid variants: adenocarcinoma, papillary carcinoma, mucoepidermoid carcinoma, anaplastic carcinoma, melanoma, lymphoepithelioma and paraganglioma.
- 30 - Treatment with non-surgical organ preservation.
- Extranodal metastatic disease concomitant with the primary tumour.
- Insufficient tumour samples, with inability for anatomopathological study.

- Low number of salivary samples.

Preparation and collection of biological samples

5

Biological samples were collected in the Otorhinolaryngology operating room at the time prior to the surgical intervention and in a fasting state of patients.

10

Saliva samples were collected using lentins placed in the sublingual region for a period of 10 minutes and prepared by the researcher. No method was used for the stimulation of salivary production.

15

All samples were identified and sent to the Research Unit of the Clinical Analysis Service (Laboratory of Molecular Therapy and Cancer Biomarkers), where they were processed. Saliva was centrifuged at 2500 rpm, 5 minutes, the supernatant was aliquotted and frozen at -80°C until next use.

20

Statistic analysis

25

Contingency tables and "Chi square (χ^2)" statistical test were used. Comparison of means with a dichotomous variable was evaluated using "Student's t" statistical test, as long as one variable was quantitative and the other categorical. In cases which the qualitative variable had more than 2 categories, the one-way variance analysis (ANOVA) was used.

30

Different analysis curves were elaborated: ROC curves (acronym of Receiver Operating Characteristic), for the graphic representation of Sensitivity versus 1- Specificity. Optimal cut-off point was determined for each salivary microbiome pattern by searching for the Youden index (IY) or maximum sensitivity and specificity point. Area under the curve (AUC) was calculated by the numerical integration of the ROC curves. Concentration with the highest AUC was identified as the strongest predictor for detection of epidermoid cancer of the head and neck. Data were analyzed using SPSS © (version 15.0) software.

35

RESULTS

During the study period, a total of 20 patients with tumour pathology and 20 healthy patients corresponding to the control group were analyzed. Clinical-pathological characteristics of these patients are summarized in Table 1 below.

Table 1. Clinico-pathological characteristics of the patients under study

Feature	No. of cases (%)
Age	
<55 yo	8 (10,5)
50-59 yo	26 (34,2)
60-69 yo	25 (32,9)
70-79 yo	12 (15,8)
>80 yo	5 (6,6)
Sex	
Male	75 (98,7)
Female	1 (1,3)
Tobacco	
Yes	69 (92,0)
No	6 (8,0)
Alcohol	
Yes	55 (72,4)
No	21 (27,6)
Comorbidities	
Diabetes	12 (15,8)
EPOC	27 (35,5)
Heart disease	19 (25,0)
Liver disease	6 (7,9)
Location	
Larynx	69 (90,8)
Supreglottis	26 (37,1)
Glottis	42 (60,0)
Subglottis	2 (2,9)
Pharynx	7 (9,2)
Clasification pT	
T1	13 (17,8)
T2	20 (27,4)
T3	28 (38,4)
T4	12 (16,4)
Clasification pN	
N0	53 (69,7)
N1	7 (9,2)
N2	10 (13,2)
N3	6 (7,9)
Stages	
Stage I	13 (17,1)
Stage II	20 (26,3)
Stage III	22 (28,9)
Stage IV	21 (27,6)
Stage type	
Initial	33 (43,4)
Advanced	43 (56,6)

Patients range from 38 to 86 years old with an average of 61.9 years old and a predominance of males (98.7%). 92% of the patients had a smoking habit and 72.4% had an enolic one. The majority had tumour of laryngeal location (90.8%), being the most frequent group the one
5 corresponding to glottic tumours (60.0%).

From the obtained salivary samples, those genera with significant differences between groups were analyzed. These results are shown below in table 2.

10

Table 2.

Test Statistics^a

	g__Rothia	g__Porphyromonas	g__Alloprevotella	g__Prevotella 7	g__Campylobacter	g__Catonella	g__Fretibacterium
Mann-Whitney U	72,000	70,000	13,500	66,000	31,000	74,500	53,000
Wilcoxon W	282,000	280,000	223,500	266,000	241,000	284,500	263,000
Z	-3,462	-4,228	-5,085	-4,214	-4,573	-3,422	-4,255
Asym Sig. (2-tailed)	0,001	0,000	0,000	0,000	0,000	0,001	0,000

^a Grouping Variable: caso 1

5 Additionally, and on the basis of table 2 and figures 6 to 13, table 3 shows the different areas under the curve for each of the genera showing statistically significant differences between groups in the present study:

5 **Table 3. Characteristics of salivary microbiota results obtained from ROC curves.**

ROC Area Under the Curve						
Contrast variables	Area	Typical error	Asymptotic significance	Cut-off values	Sensibility	Specificity
Prevotella	0,86			8	0,65	0,95
Alloprevotella genus	0,966			19	0,95	0,85
Alloprevotella rava	0,966			19	-0,95	-0,85
Alloprevotella Tannarae	0,966			19	-0,95	-0,85
Campylobacter genus	0,923			61,5	1	0,80
Rothia genus	0,820			9563	0,75	0,85
Catonella genus	0,814			54	0,85	0,75
Porphyromona genus	0,825			1,5	65	1
Fretibacterium genus	0,868			7,5	0,80	0,85

As shown in table 3, figure 6 and figure 7, both in absolute values and in the presence percentage of *Alloprevotella* genus in salivary samples and, especially, of *Alloprevotella rava* and *Alloprevotella tannera species*, there is a negative correlation between subjects with epidermoid cancer of mouth and pharynx and healthy subjects.

As shown in table 3, figure 6 and figure 8, both in absolute values and in the presence percentage of *Prevotella* genus in salivary samples, there is a negative correlation between subjects with epidermoid cancer of the mouth and pharynx and healthy subjects.

As shown in table 3, figure 6 and figure 9, both in absolute values and in the presence percentage of *Campylobacter* genus in salivary samples, there is a negative correlation between subjects with epidermoid cancer of mouth and pharynx and healthy subjects.

As shown in table 3, figure 6 and figure 10, both in absolute values and in the presence percentage of *Rothia* genus in salivary samples, there is a positive correlation between subjects with epidermoid cancer of mouth and pharynx and healthy subjects.

As shown in table 3, figure 6 and figure 11, both in absolute values and in the presence percentage of *Catonella* genus in salivary samples, there is a negative correlation between subjects with epidermoid cancer of the mouth and pharynx and healthy subjects.

- 5 As shown in table 3, figure 6 and figure 12, both in absolute values and in the presence percentage of *Porphyromona* genus in salivary samples, there is a negative correlation between subjects with epidermoid cancer of the mouth and pharynx and healthy subjects.

- 10 As shown in table 3, figure 6 and figure 13, both in absolute values and in the presence percentage of *Fretibacterium* genus in salivary samples, there is a negative correlation between subjects with epidermoid cancer of the mouth and pharynx and healthy subjects.

- 15 Design of a RNA quantification test (qPCR) by any of the known methods including metagenomics, massive sequencing, qPCR, DNA microarray, and the correlation of these values with the values found by sequencing the hypervariable region Rs16 could be useful for the diagnosis, preferably for the early diagnosis of disease and relapse of epidermoid cancer of the mouth and pharynx.

- 20 Additionally, the use of probiotics that modulate the salivary microbiota of these patients could be a preventive or intervention treatment for patients with epidermoid cancer of the larynx and pharynx mouth.

CLAIMS

1. Method for the *in vitro* diagnosis of a subject suspected of having epidermoid cancer
5 of the oral cavity, pharynx and larynx, that comprises the use, as an indicator, in a
salivary or breath sample obtained from said subject, of the concentration in such
sample of bacteria belonging to the *Alloprevotella* genus, where if the concentration in
such salivary or breath sample of bacteria belonging to *Alloprevotella* is significantly
10 lower than in a salivary sample obtained from a healthy subject or with respect to a
reference value, this is indicative that such subject has epidermoid cancer of the oral
cavity, pharynx and larynx.
2. The method according to claim 1, wherein the bacteria belonging to the *Alloprevotella*
15 *genus* is selected from the group consisting of *Alloprevotella rava* and/or
Alloprevotella tanneriae species.
3. The method according to any of claims 1 or 2, wherein a further indicator is used and
said indicator is the concentration in said sample of bacteria belonging to the
Prevotella genus, where if the concentration in such salivary or breath sample of
20 bacteria belonging to the *Prevotella* genus is significantly lower than in a salivary or
breath sample obtained from a healthy subject or with respect to a reference value,
this is indicative that such subject has epidermoid cancer of the oral cavity, pharynx
and larynx.
- 25 4. The method according to any of claims 1 to 3, wherein a further indicator is used and
said indicator is the level or concentration in said sample of bacteria belonging to the
Campylobacter genus, where if the level or concentration in such salivary or breath
sample of bacteria belonging to *Campylobacter* is significantly lower than in a salivary
or breath sample obtained from a healthy subject or with respect to a reference value,
30 this is indicative that such subject has epidermoid cancer of the oral cavity, pharynx
and larynx.
5. The method according to any of claims 1 to 4, wherein a further indicator is used and
said indicator is the level or concentration in said sample of bacteria belonging to the
35 *Catonella* genus, where if the level or concentration in such salivary or breath sample

of bacteria belonging to *Catonella* is significantly lower than in a salivary or breath sample obtained from a healthy subject or with respect to a reference value, this is indicative that such subject has epidermoid cancer of the oral cavity, pharynx and larynx.

5

6. The method according to any of claims 1 to 5, wherein a further indicator is used and said indicator is the concentration in said sample of bacteria belonging to the *Porphyromona* genus, where if the level or concentration in such salivary or breath sample of bacteria belonging to *Porphyromona* is significantly lower than in a salivary or breath sample obtained from a healthy subject or with respect to a reference value, this is indicative that such subject shows epidermoid cancer of the oral cavity, pharynx and larynx.

10

7. The method according to any of claims 1 to 6, wherein a further indicator is used and said indicator is the concentration in such sample of bacteria belonging to the *Fretibacterium* genus, where if the level or concentration in such salivary or breath sample of bacteria belonging to *Fretibacterium* is significantly lower than in a salivary sample obtained from a healthy subject or with respect to a reference value, this is indicative that such subject has epidermoid cancer of the oral cavity, pharynx and larynx.

15

20

8. In vitro use of a kit comprising one or more pairs of primers able to amplify bacteria belonging to the *Alloprevotella* genus, and optionally *Prevotella*, *Campylobacter*, *Catonella*, *Porphyromona*, or *Fretibacterium*, for the implementation of the diagnostic method of any of claims 1 to 7.

25

9. Kit as defined in claim 8, to implement the methodology according to any of claims 1 to 7.

30

FIGURES

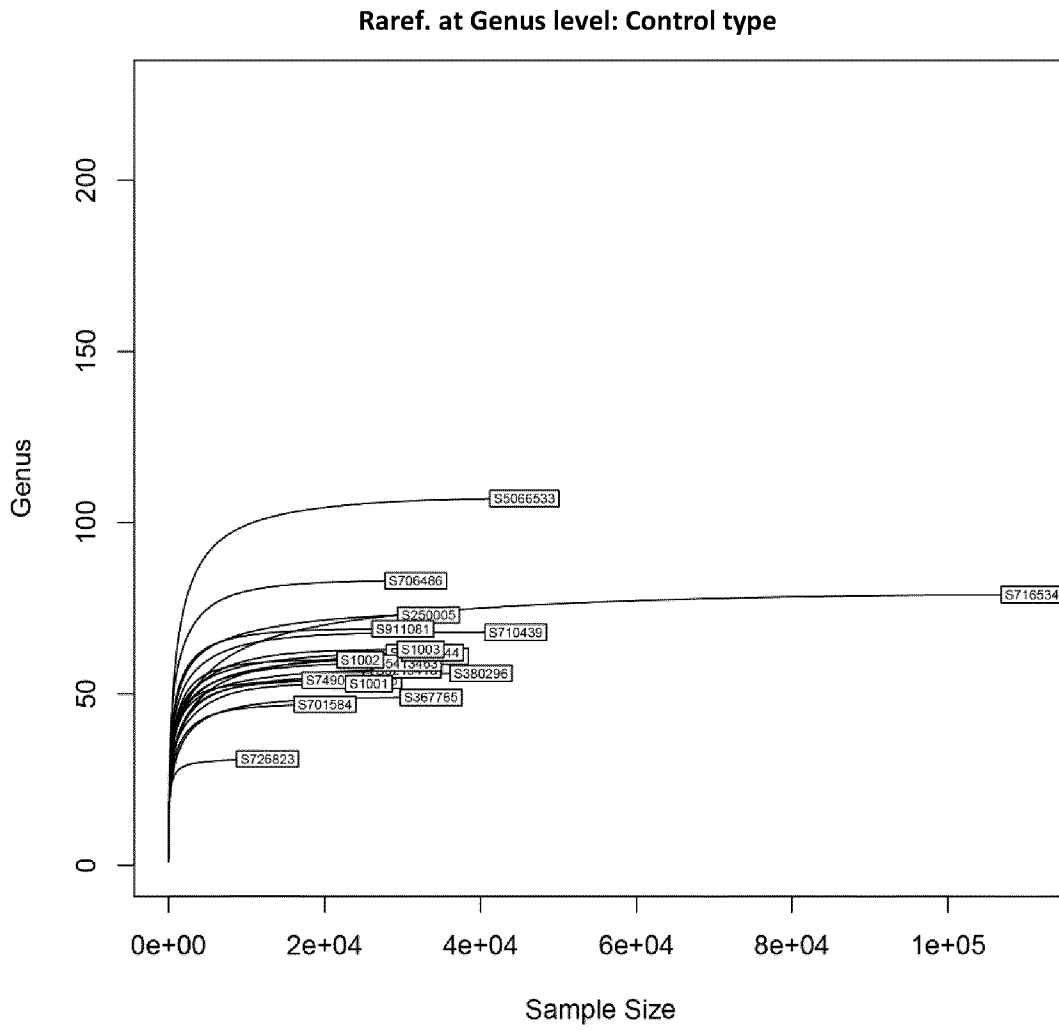


Fig. 1

Raref. at Genus level: Control type

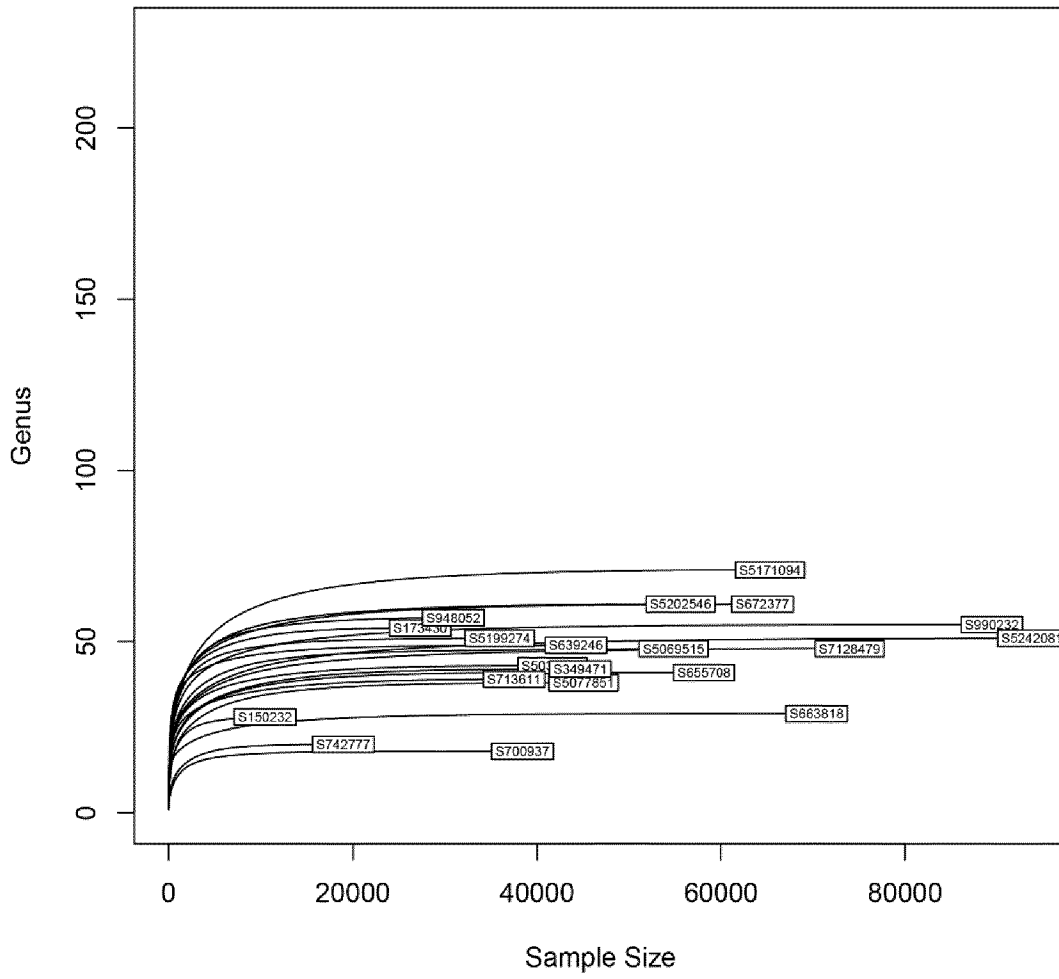


Fig. 1 (Cont.)

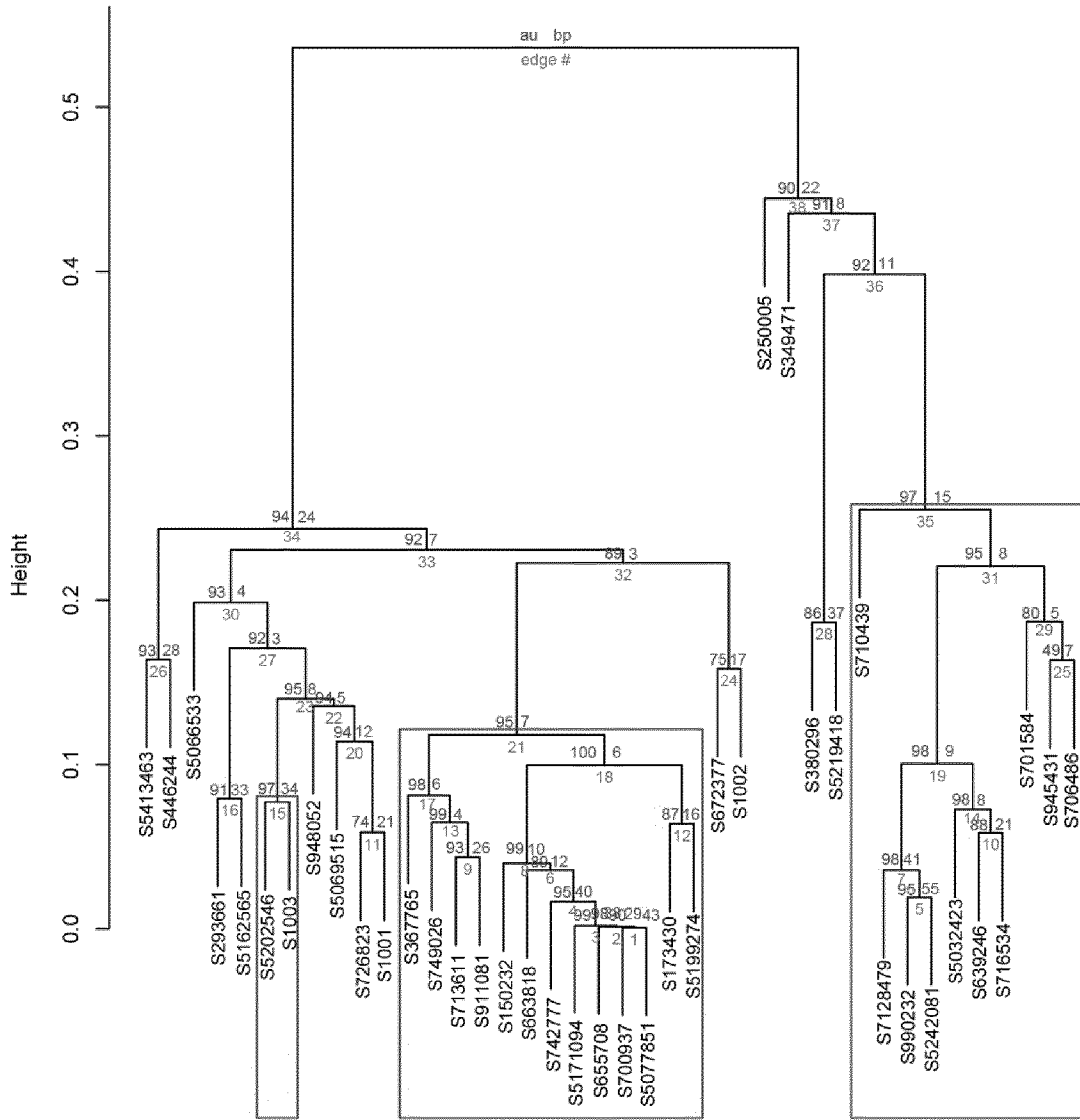


Fig. 3

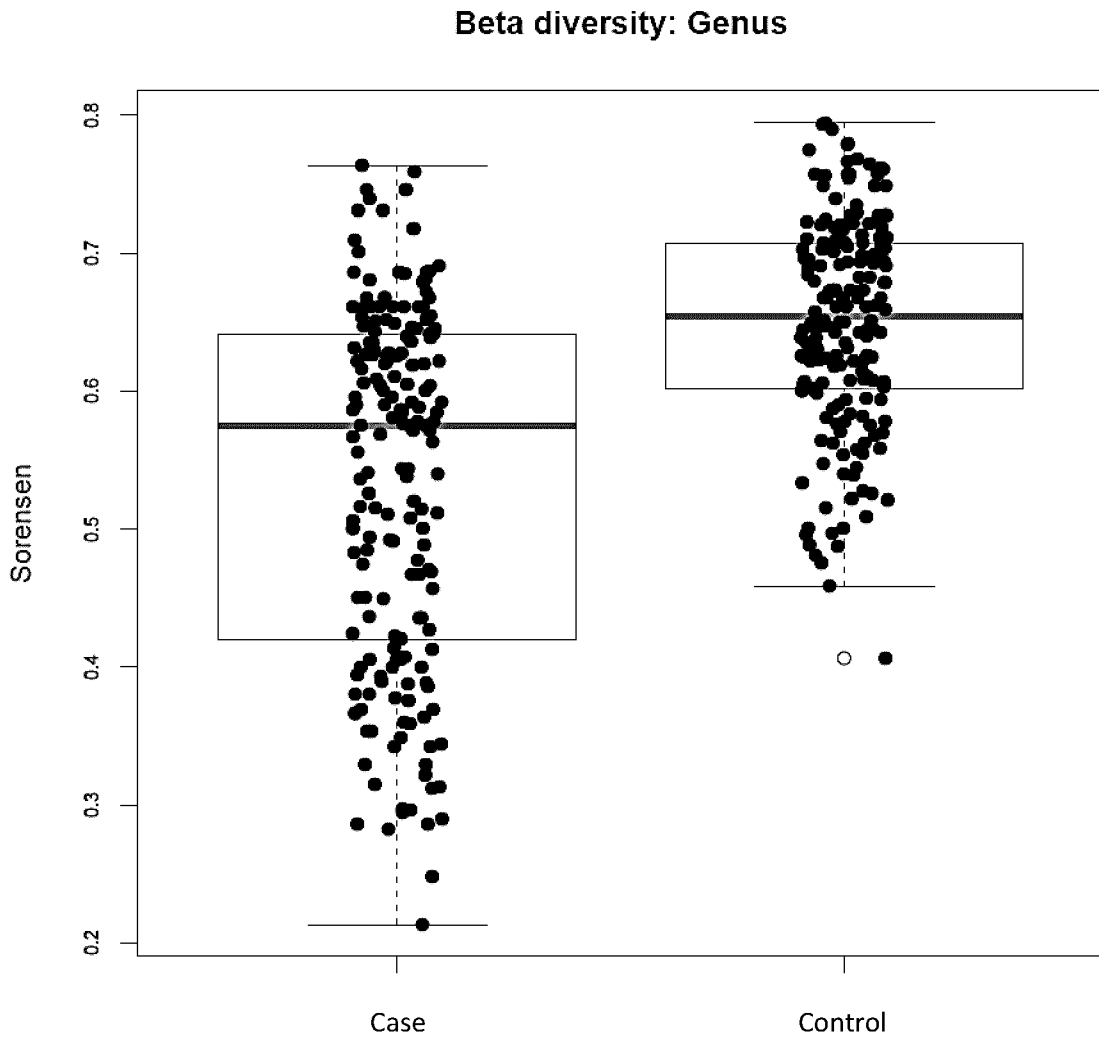


Fig. 4

ACE: Genus

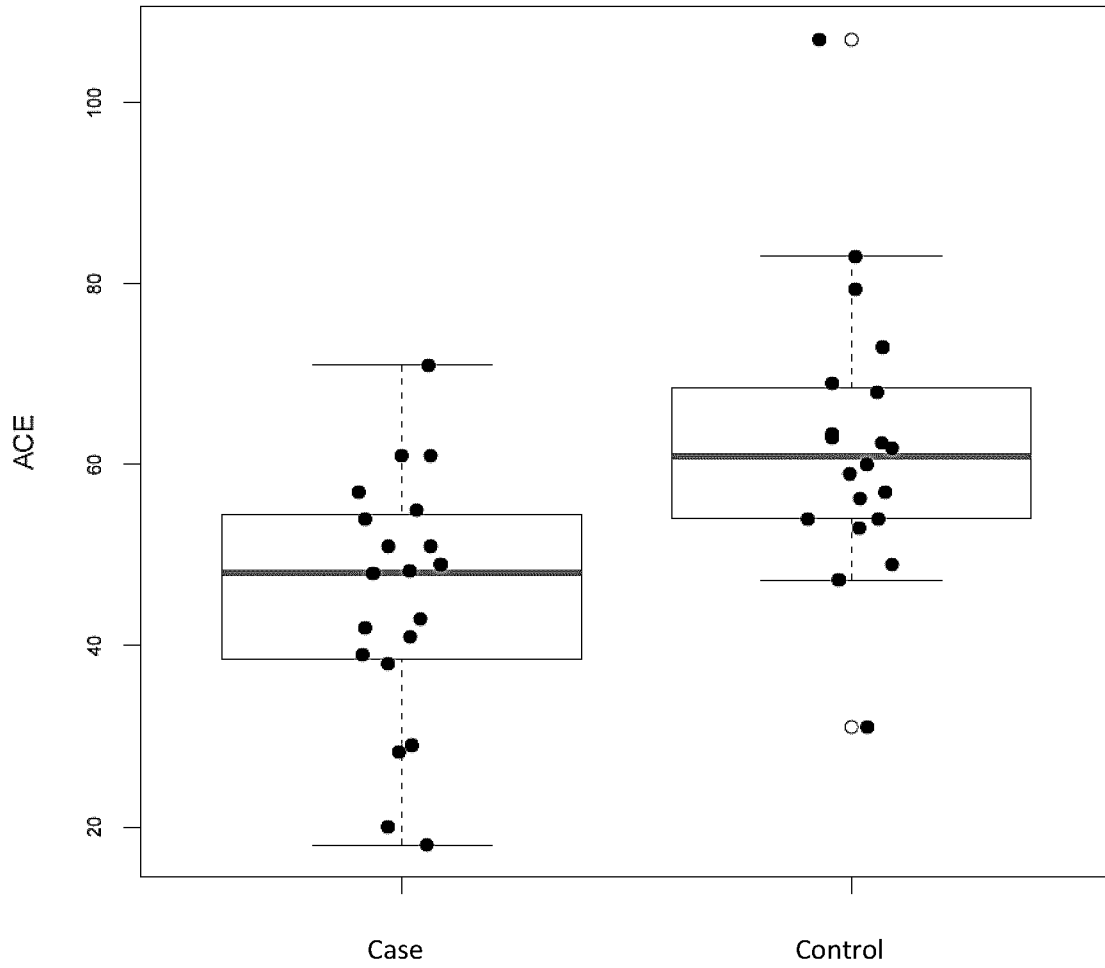


Fig. 5

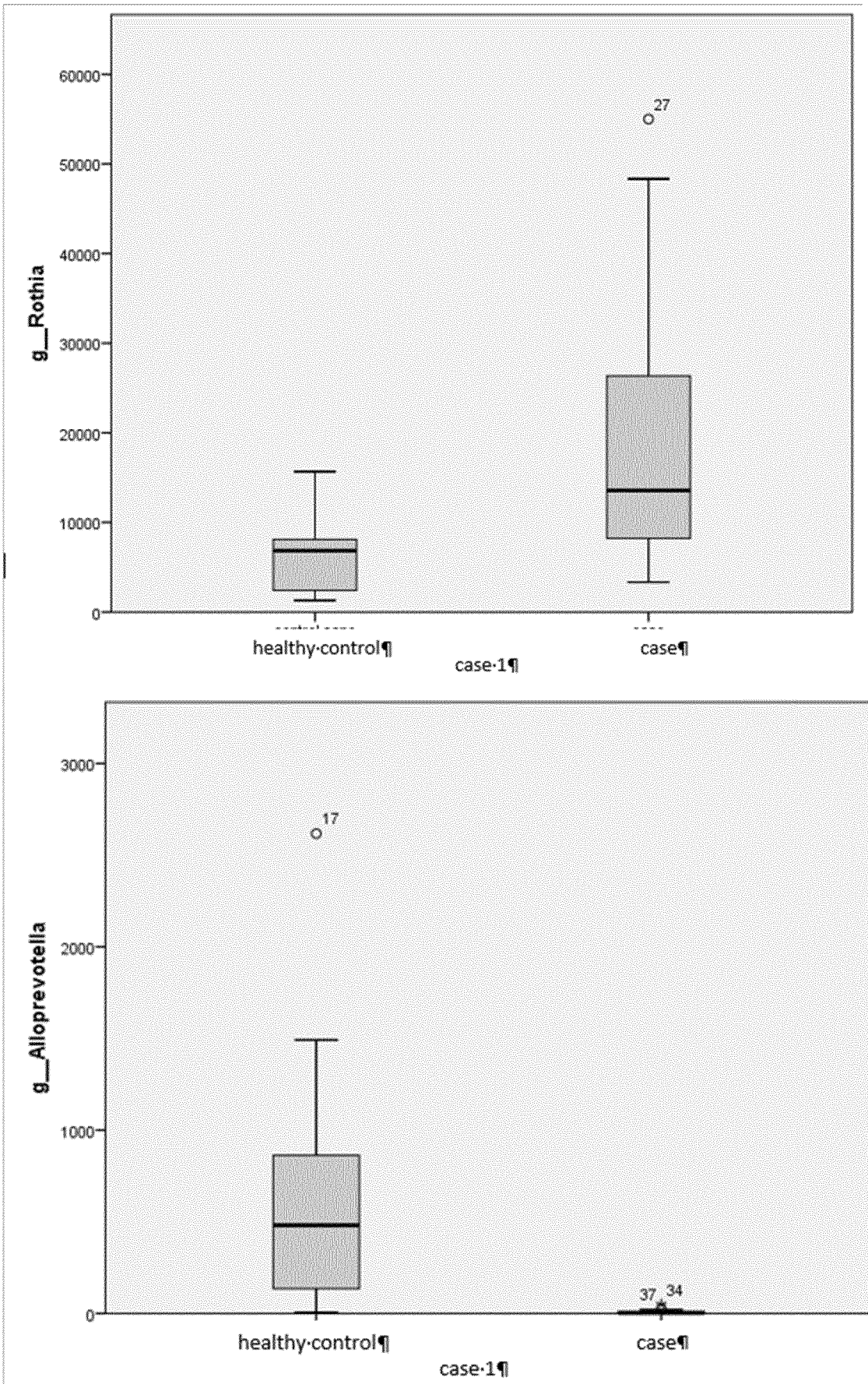


Fig. 6

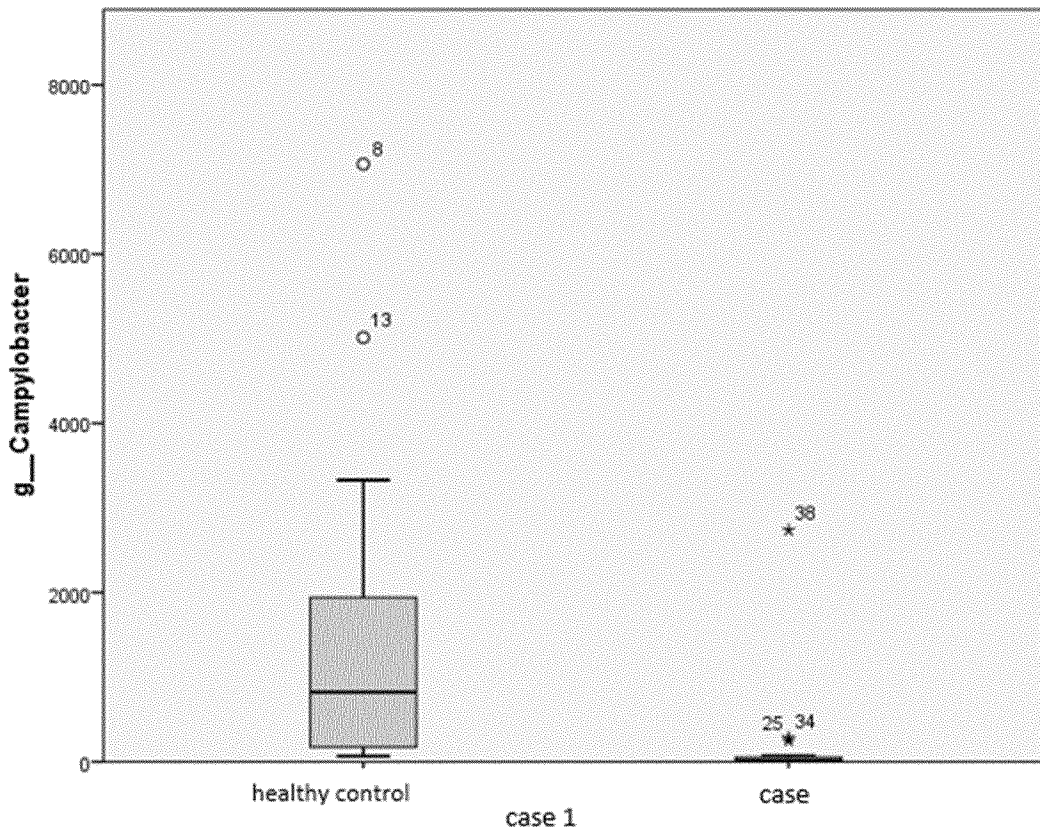
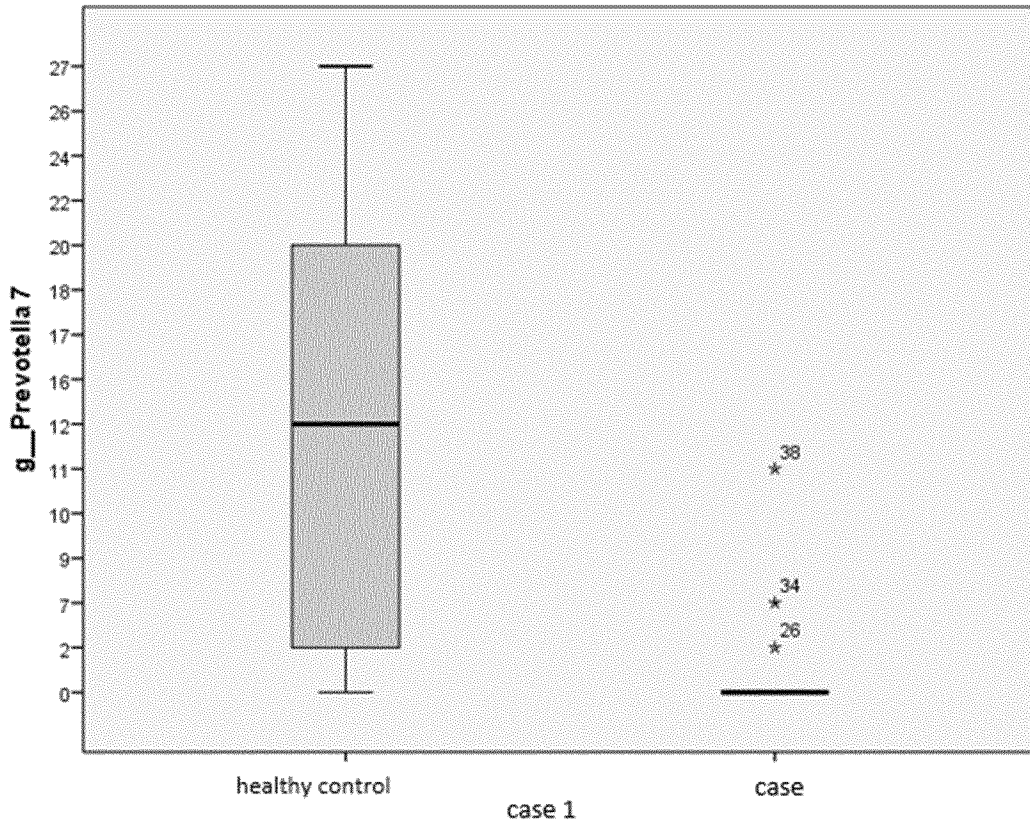


Fig. 6 (Cont.)

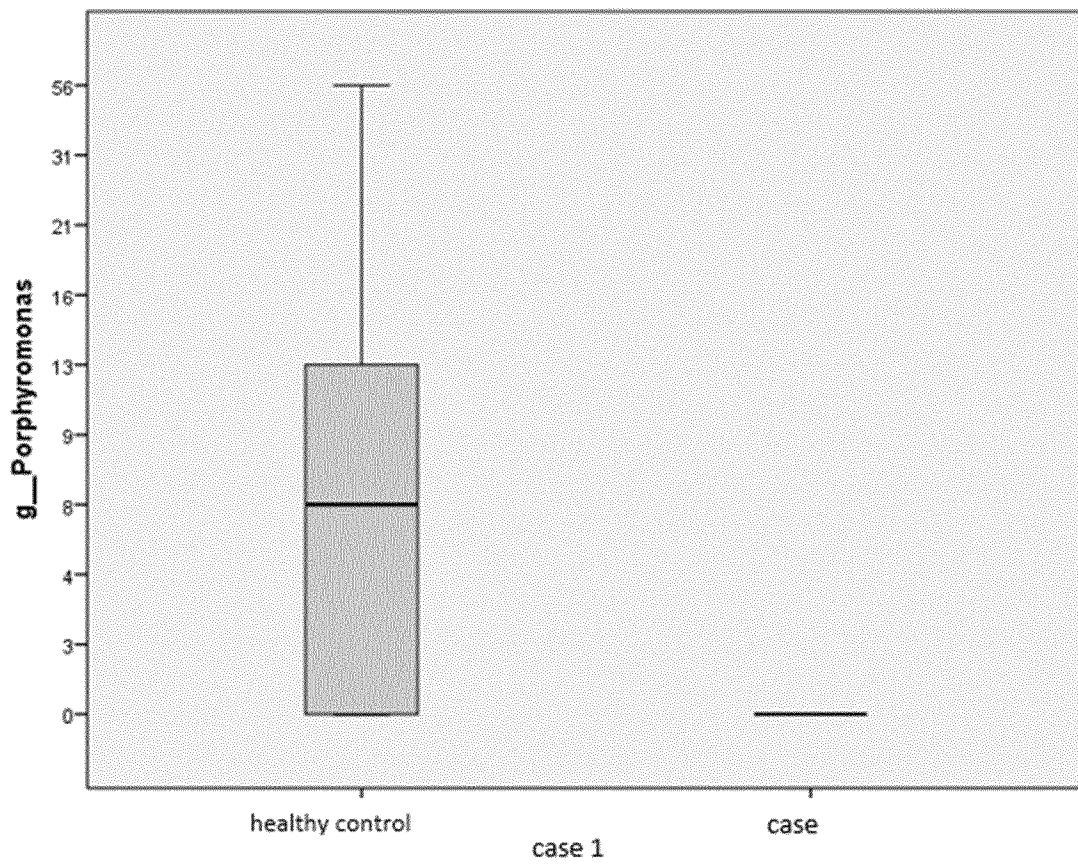
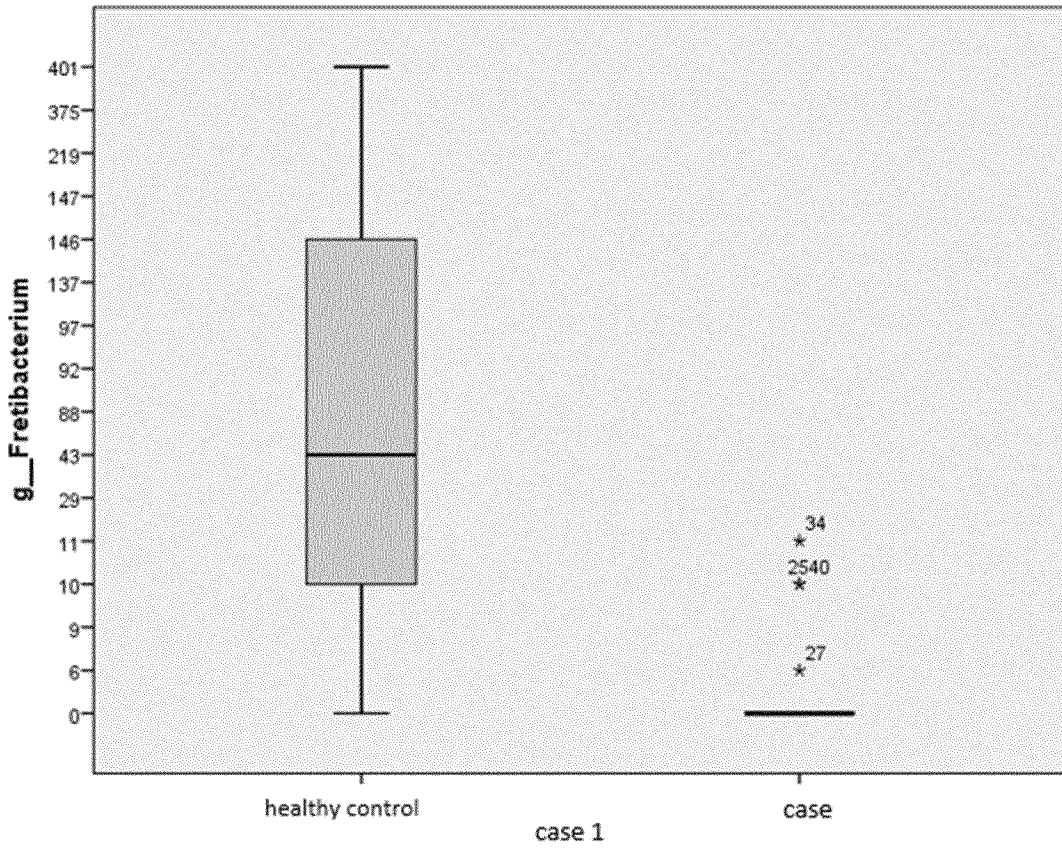


Fig. 6 (Cont.)

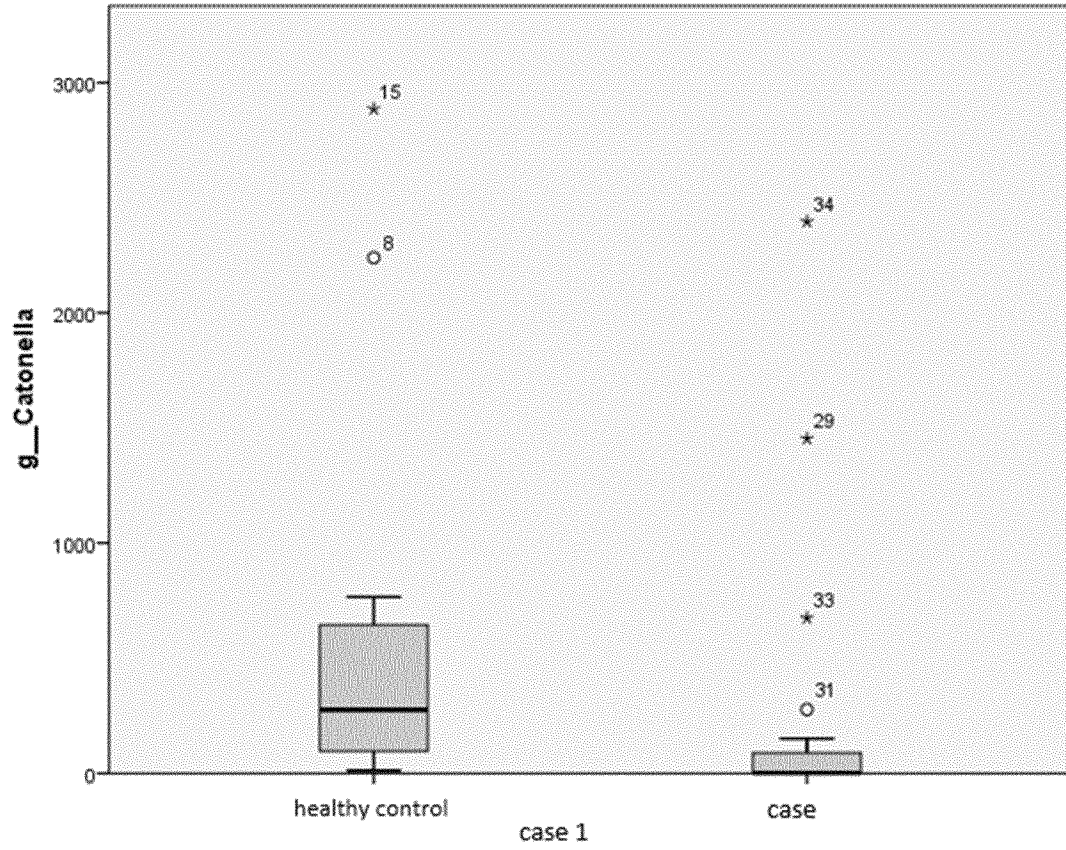
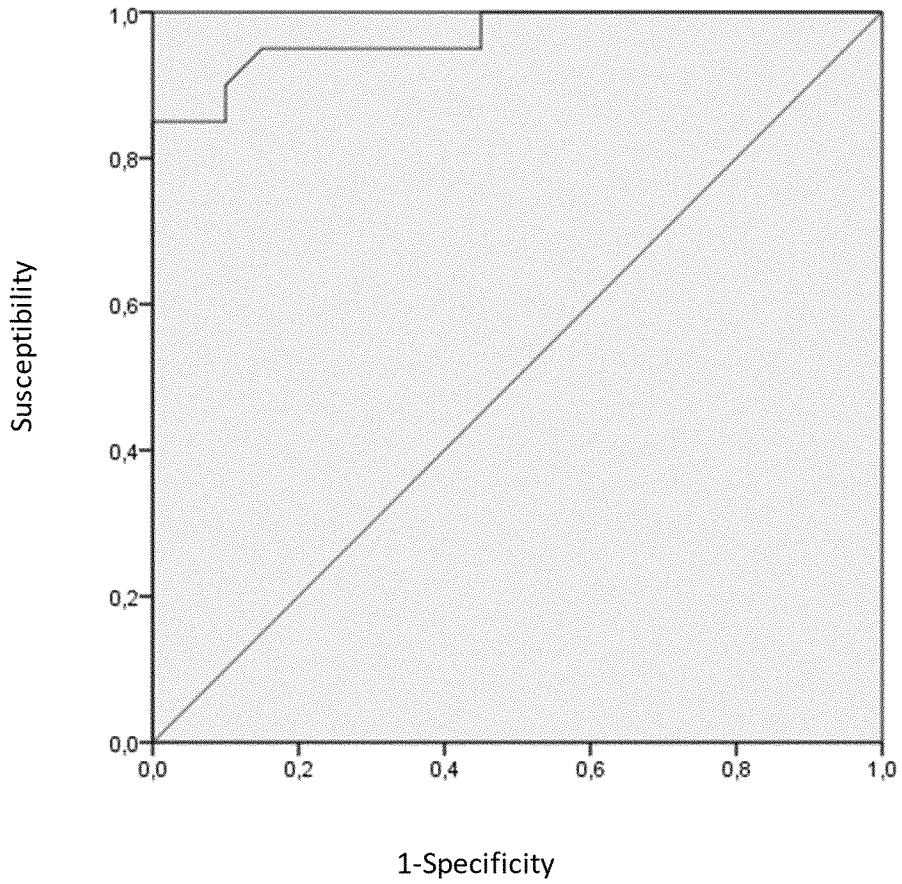


Fig. 6 (Cont.)

Alloprevotella Genera

ROC CURVE

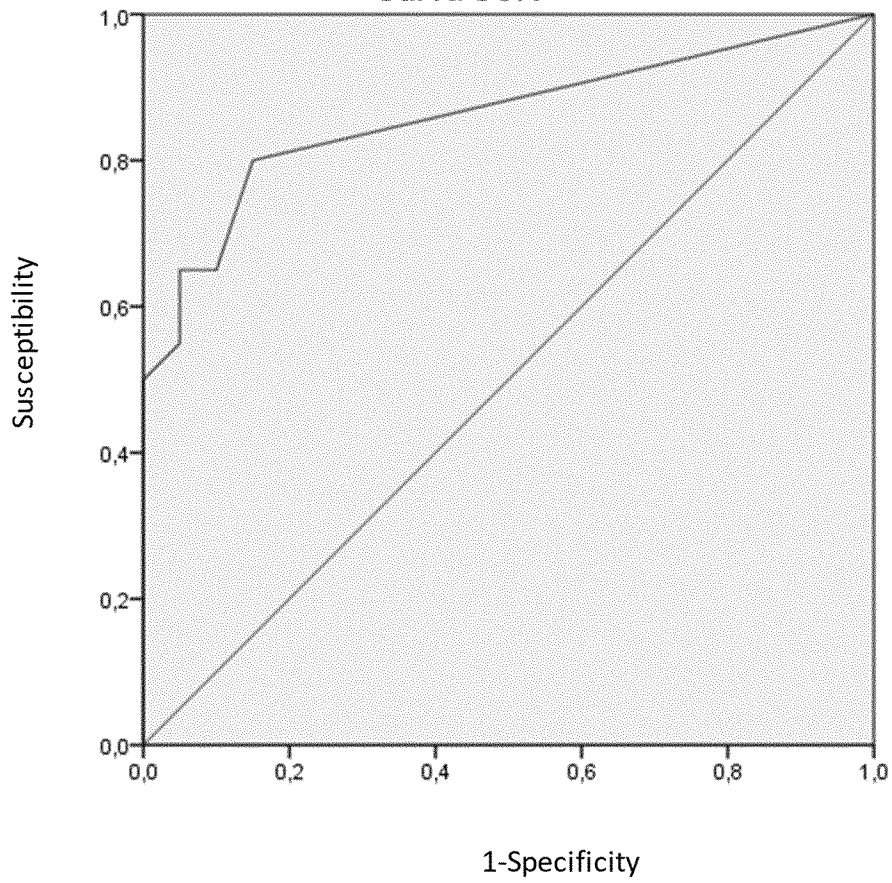


The diagonal segments are produced by the draws

Fig. 7

Prevotella 7 Genera

ROC CURVE

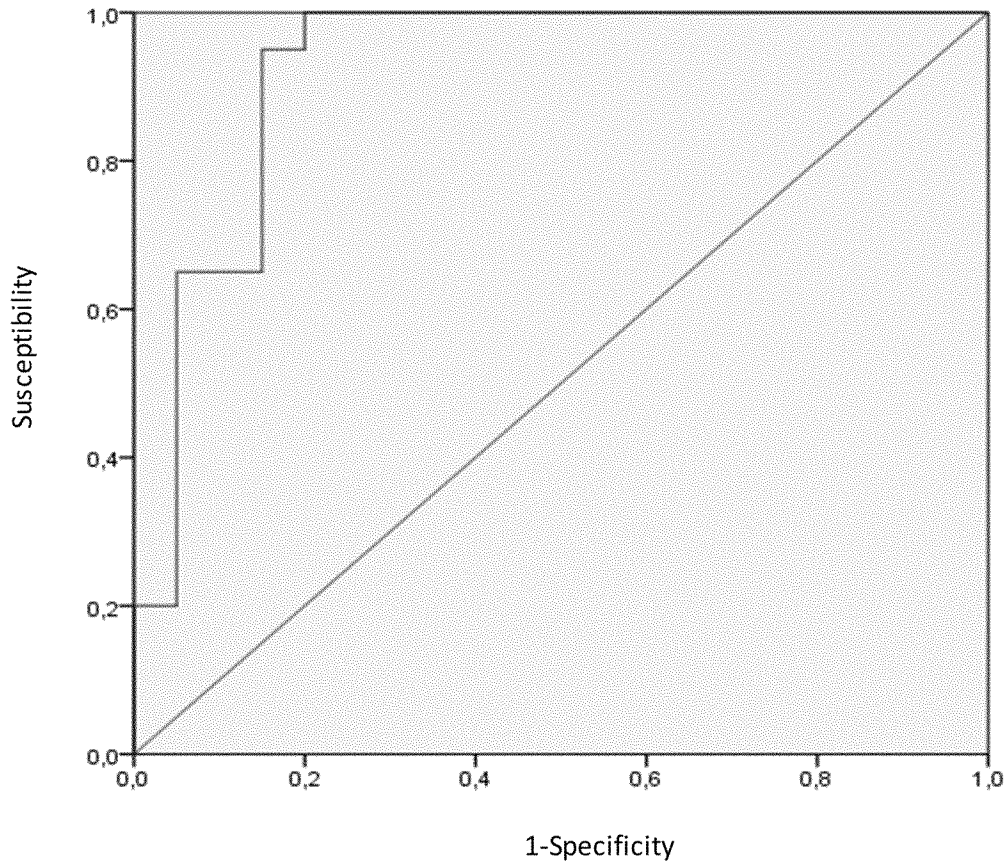


The diagonal segments are produced by the draws

Fig. 8

Campylobacter Genera

ROC CURVE

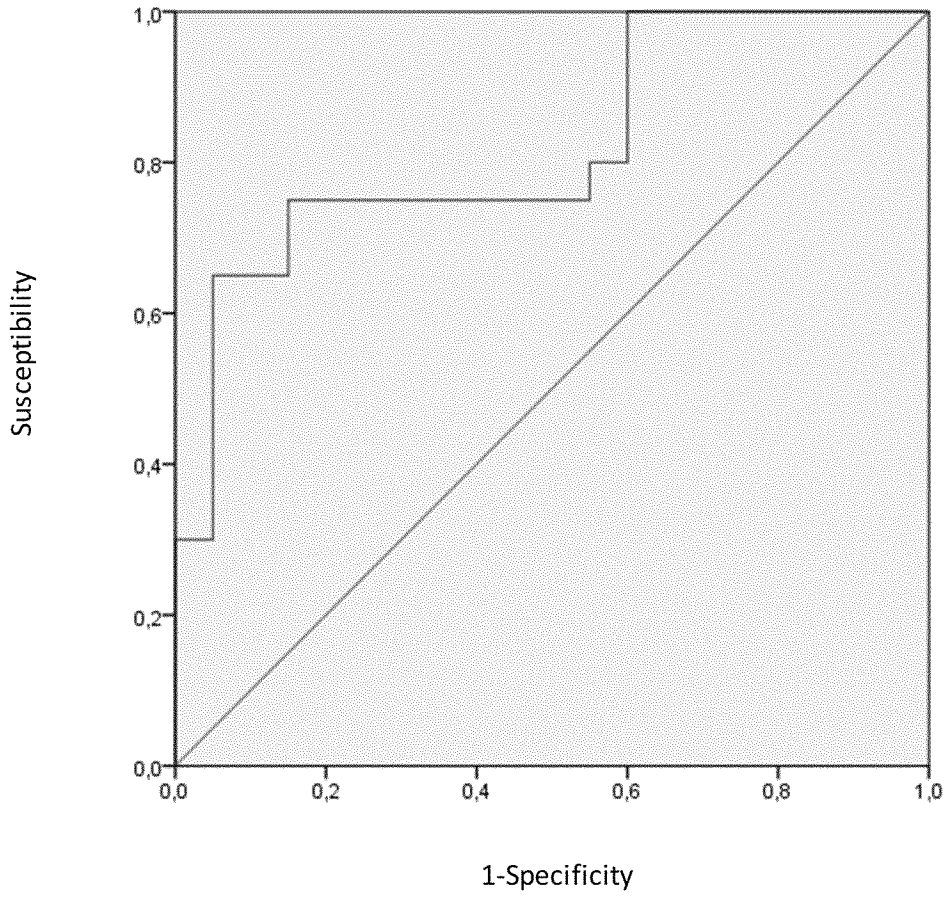


The diagonal segments are produced by the draws

Fig. 9

Rothia Genera

ROC CURVE

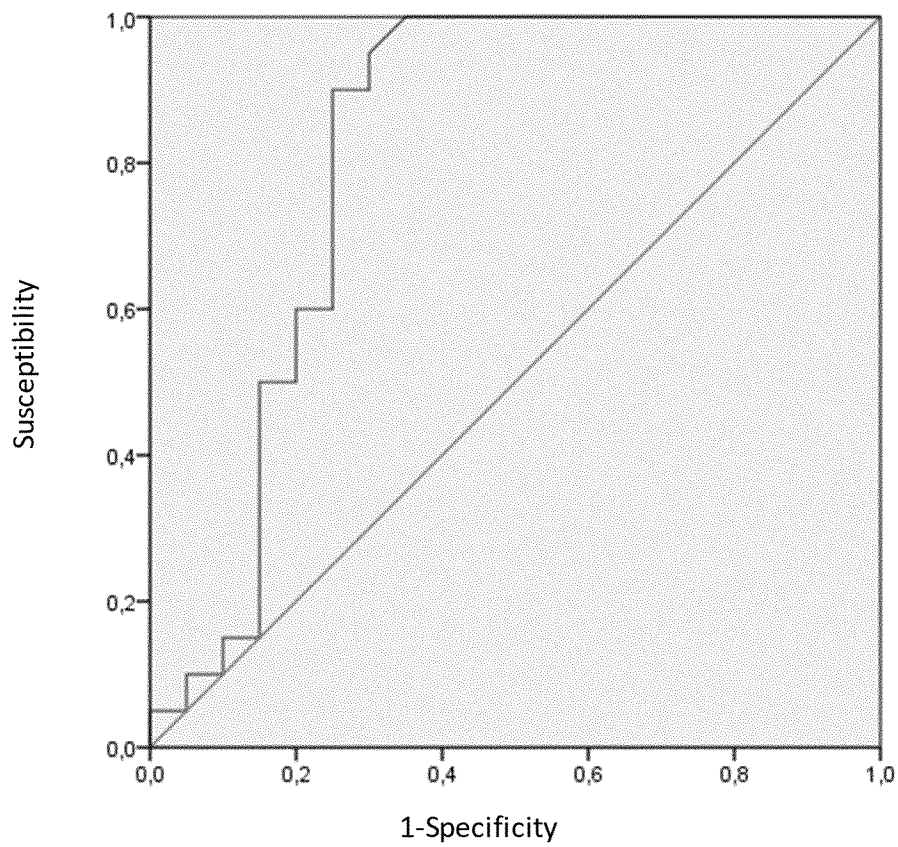


The diagonal segments are produced by the draws

Fig. 10

Catonella Genera

ROC CURVE

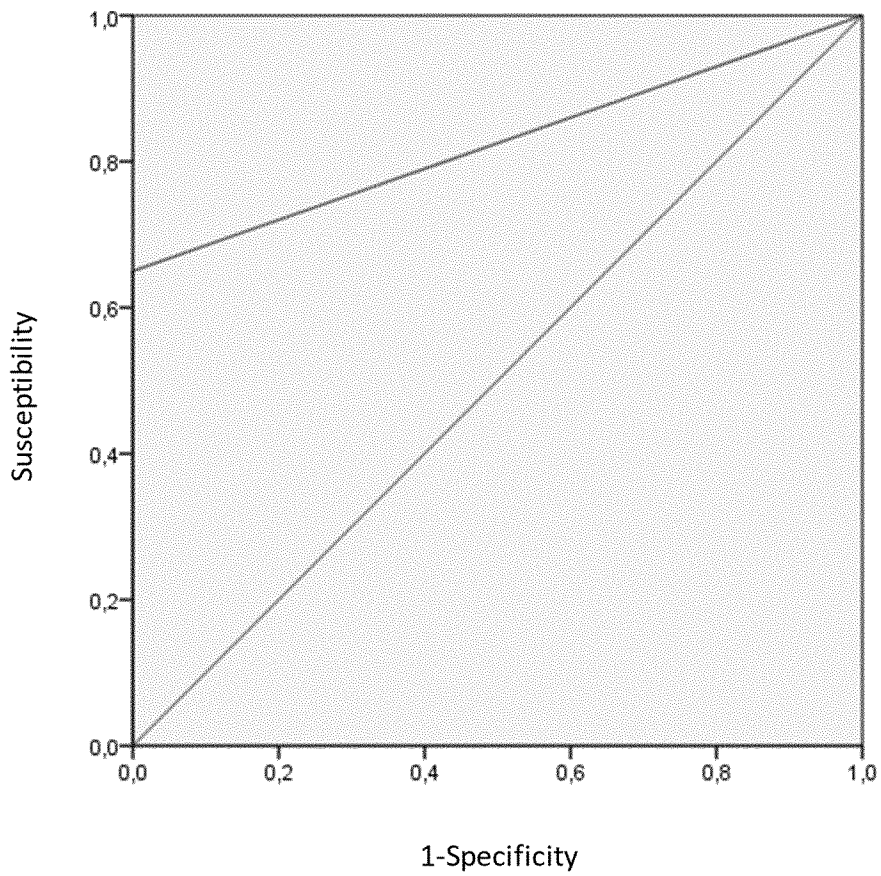


The diagonal segments are produced by the draws

Fig. 11

Porphyromonas Genera

ROC CURVE

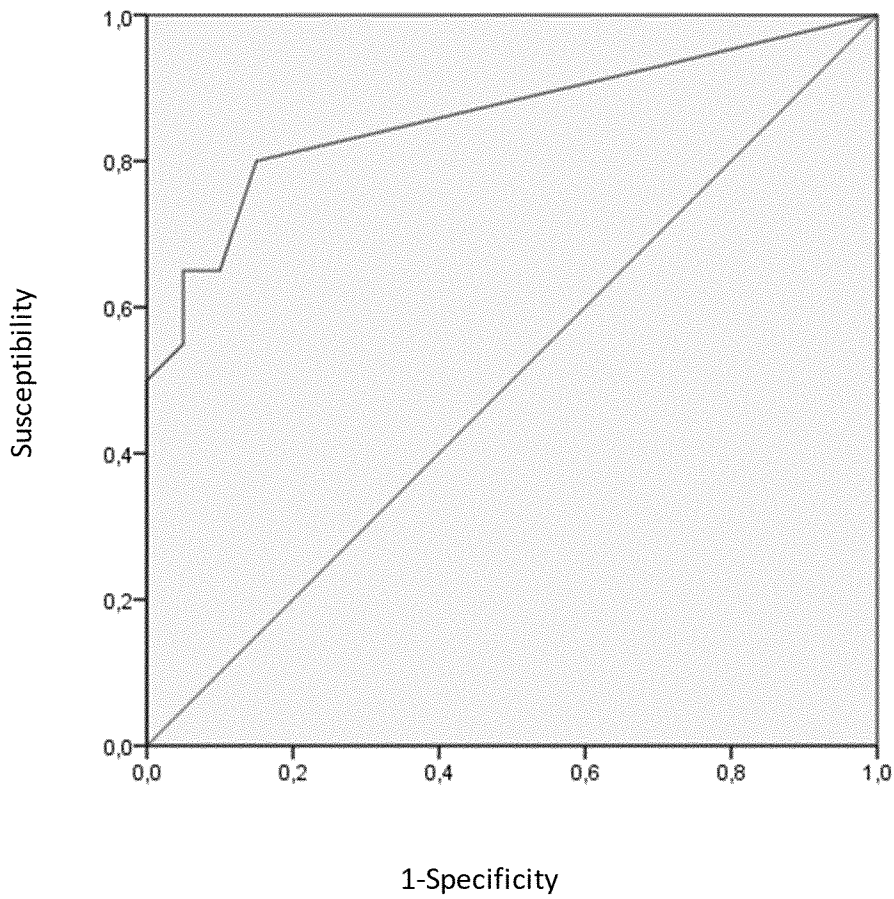


The diagonal segments are produced by the draws

Fig. 12

Fretibacterium Genera

ROC CURVE



The diagonal segments are produced by the draws

Fig. 13

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/059761

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01N33/569 C12Q1/6886 G01N33/574 C12Q1/689
ADD.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
G01N C12Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data, BIOSIS, EMBASE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 2018/010171 A1 (MOUGEOT FARAH K B [US] ET AL) 11 January 2018 (2018-01-11) para 2, 16, 86-87, 92 ; Table 9 ; claim 4, 6 ----- -/--	9 1-8

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 12 June 2020	Date of mailing of the international search report 22/06/2020
-------------------------------------------------------------------------------	----------------------------------------------------------------------

Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Vadot-Van Geldre, E
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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/059761

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	IAN GANLY ET AL: "Periodontal pathogens are a risk factor of oral cavity squamous cell carcinoma, independent of tobacco and alcohol and human papillomavirus : Periodontal pathogens are a risk factor for oral cancer", INTERNATIONAL JOURNAL OF CANCER, vol. 145, no. 3, 22 January 2019 (2019-01-22), pages 775-784, XP055653573, US ISSN: 0020-7136, DOI: 10.1002/ijc.32152 abstract ; pg 776, col 2, para bridging pg 777 ; Fig 1-2	1-9
X	----- KR 2018 0003348 A (UNIV YONSEI IACF [KR]) 9 January 2018 (2018-01-09)	9
A	example 1 ; para 19-20, 24, 27, 29, 42, 45, 63	1-8
X	----- JENN-REN HSIAO ET AL: "The interplay between oral microbiome, lifestyle factors and genetic polymorphisms in the risk of oral squamous cell carcinoma", CARCINOGENESIS., vol. 39, no. 6, 13 April 2018 (2018-04-13), pages 778-787, XP055653798, GB ISSN: 0143-3334, DOI: 10.1093/carcin/bgy053 abstract ; pg 779, col 2, para bridging pg 780 - pg 780, col 1, para 2 ; pg 780, col 2, para bridging pg 781 ; Table 1	1-9
A	----- J. DOWNES ET AL: "Description of Alloprevotella rava gen. nov., sp. nov., isolated from the human oral cavity, and reclassification of Prevotella tanneriae Moore et al. 1994 as Alloprevotella tanneriae gen. nov., comb. nov.", INTERNATIONAL JOURNAL OF SYSTEMATIC AND EVOLUTIONARY MICROBIOLOGY, vol. 63, no. Pt 4, 29 June 2012 (2012-06-29), pages 1214-1218, XP05562746, GB ISSN: 1466-5026, DOI: 10.1099/ijs.0.041376-0 title ; abstract	1-9
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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2020/059761

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Hongli Gong ET AL: "Microbiota in the Throat and Risk Factors for Laryngeal Carcinoma", Applied and environmental microbiology, 1 December 2014 (2014-12-01), page 7356, XP055469383, United States DOI: 10.1128/AEM.02329-14 Retrieved from the Internet: URL:http://aem.asm.org/content/80/23/7356.full.pdf#page=1&view=FiH Table 2 ; pg 7360, col 2, para 1-2 -----	1-9
X	EIMEAR HURLEY ET AL: "Comparison of the salivary and dentinal microbiome of children with severe-early childhood caries to the salivary microbiome of caries-free children", BMC ORAL HEALTH, BIOMED CENTRAL LTD, LONDON, UK, vol. 19, no. 1, 14 January 2019 (2019-01-14), pages 1-14, XP021270393, DOI: 10.1186/S12903-018-0693-1	9
A	abstract ; pg 4, col 1, para 2-3 ; Fig 3-6 -----	1-8
A	WARNKE-SOMMER JULIA D ET AL: "Evaluation of the oral microbiome as a biomarker for early detection of human oral carcinomas", 2017 IEEE INTERNATIONAL CONFERENCE ON BIOINFORMATICS AND BIOMEDICINE (BIBM), IEEE, 13 November 2017 (2017-11-13), pages 2069-2076, XP033278632, DOI: 10.1109/BIBM.2017.8217979 Table 1 -----	1-9
A	AXEL WOLF ET AL: "The salivary microbiome as an indicator of carcinogenesis in patients with oropharyngeal squamous cell carcinoma: A pilot study", SCIENTIFIC REPORTS, vol. 7, no. 1, 1 December 2017 (2017-12-01), XP055653483, DOI: 10.1038/s41598-017-06361-2 abstract ; Fig 1, 3 ; Table 1 ----- -/--	1-9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/059761

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>YENKAI LIM ET AL: "The Performance of an Oral Microbiome Biomarker Panel in Predicting Oral Cavity and Oropharyngeal Cancers", FRONTIERS IN CELLULAR AND INFECTION MICROBIOLOGY, vol. 8, 1 January 2018 (2018-01-01), XP055653404, DOI: 10.3389/fcimb.2018.00267 cited in the application abstract ; Fig 2 -----</p>	1-9

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2020/059761

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2018010171	A1	11-01-2018	NONE
KR 20180003348	A	09-01-2018	NONE