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SAMBA: A BAYESIAN NETWORK APPLICATION TO PREDICT CHANGES IN THE COMPOSITION AND FUNCTION OF MUCOSAL MICROBIOME IN FARMED FISH

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SUMMARY

SAMBA (Scanning Aquaculture Microbiome via Bayesian Approach) is a Guide User Interface application developed in R and powered by a Bayesian network model that indexes the frequencies of the bacterial taxa in a given biological system, correlating microbial architectures with a number of biotic and abiotic factors (e.g. sex, age, season, diet composition, genetic background, etc.). The application identifies conditional dependencies and interrelations among the distinct variables indexed in the network, allowing to predict how the taxa abundance of the pan-microbiome will vary depending on experimental variables. The application permits to predict and assign a metagenome to each inferred microbiome in order to determine its functional profile. SAMBA also permits to interrogate the Bayesian Network model to identify which experimental conditions are optimal for obtaining a given pan-microbiome and associated metagenome. At this stage, a locally run application of SAMBA was used to interrogate the pan-microbiome of farmed gilthead sea bream (a highly valued farmed fish in all the Mediterranean region) with different nutritional and genetic backgrounds across the production cycle. The application can also be used to model the host, metagenome and environment interrelations in a wide range of organisms, including humans. Interfaces of SAMBA were wrapped by Shiny, a framework to build interactive web applications by R. The application uses distinct R dependencies such as 1) *bnlearn*, for learning the structure of Bayesian Networks and estimate their parameters based on its structure using data from 16s amplicon experiments, 2) *visNetwork* and *bnviewer* for network visualization, and 3) PICRUSt2 to infer metagenomic functions from the microbiome population determined by 16s data given specific environmental conditions. SAMBA will be implemented to be accessible as a web server at www.nutrigroup-iats.org.

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