Some medicinal plants from Senegal used in the management of infectious diseases: evaluation of their antimicrobial and antiparasitic activities

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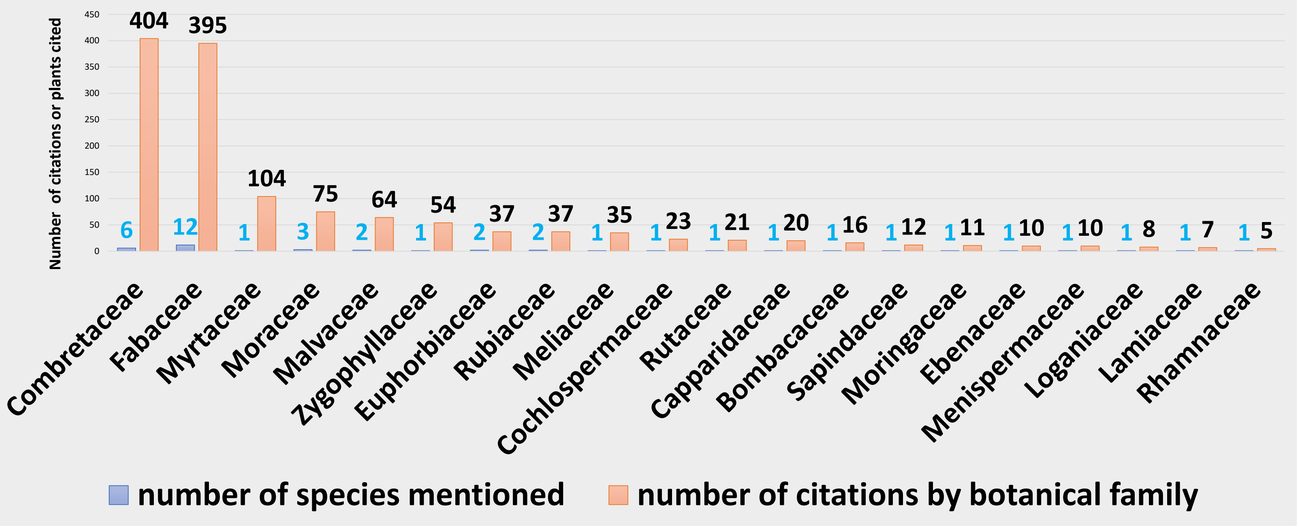
Introduction:

Infectious diseases with bacterial origin are one of the leading causes of death worldwide, with about 17 million deaths each year [1]. Beside these bacterial infections, several parasitic infections deserve special attention due to a lack of effective treatments. Among these infections, human African trypanosomiasis, or sleeping sickness, and leishmaniasis have a strong impact on morbimortality and makes them a public health problem [2]. These infectious diseases, which are part of the neglected tropical diseases, urgently need to be addressed through research and development of new antibiotics and antiparasitics. The search for new drugs can be based on plant biodiversity, which is an inexhaustible reserve of bioactive natural products. Africa, and Senegal in particular, is rich in many medicinal plants used by traditional medicine in the treatment of infectious diseases [3]. In this context, an ethnobotanical survey was conducted in Senegal among herbalists, traditional healers and households. Following this field study, the antimicrobial activity of methanolic extracts of some selected species was evaluated *in vitro* on a panel of 36 human pathogenic strains, including Gram-positive and Gram-negative bacteria and yeasts. The antiparasitic activity of the crude extracts was also evaluated *in vitro* on two parasites: *Trypanosoma brucei brucei* (Tbb) and *Leishmania mexicana mexicana* (Lmm). Finally, we also evaluated the cytotoxic activity of methanolic crude extracts on non-cancer lung fibroblasts WI-38.

Ethnobotanical survey and collection of medicinal plants

This study was carried out in Senegal between February and March 2021. A total of 127 informants participated in this study: 100 men (78.74%) and 27 women (21.26%). 41 plant species belonging to 20 botanical families used for the management of infectious pathologies were mentioned by the people surveyed (**Figure 2**). Different plant parts of 27 plant species were collected according to the number of citations (**Figure 3**).

Figure 2: Number of plant species and citations by botanical family



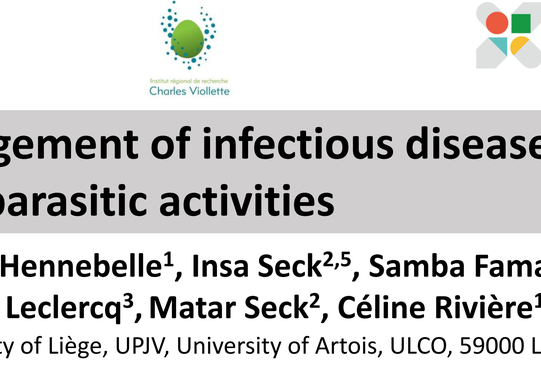
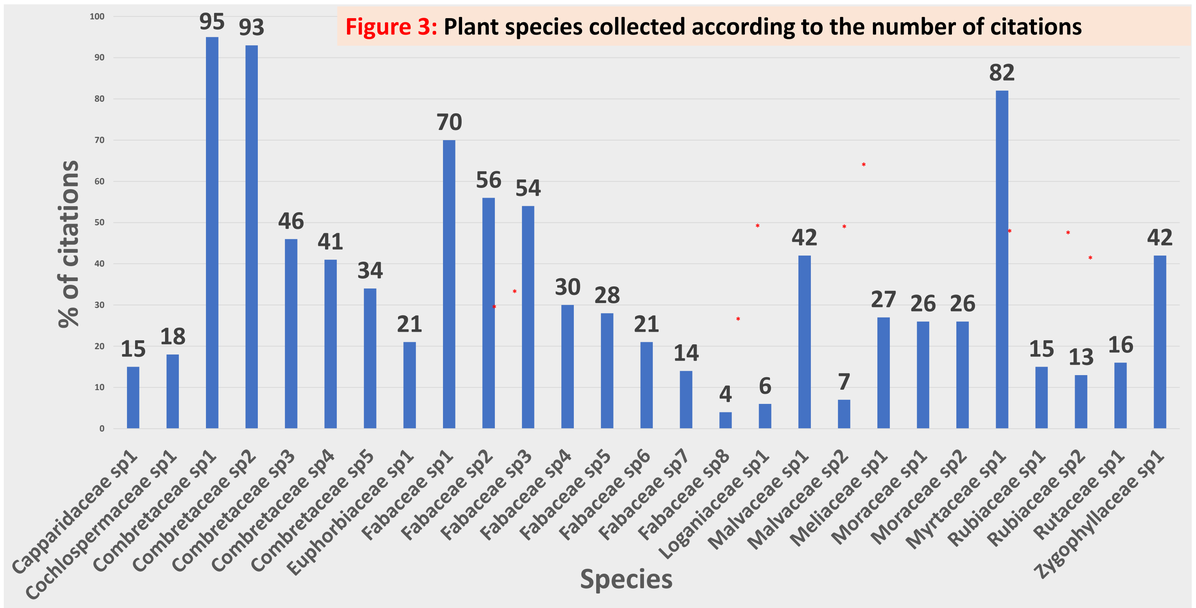


Figure 1: Map of Senegal: survey areas

Figure 3: Plant species collected according to the number of citations



In vitro antiparasitic activity

Figure 4: Anti-trypanosomal and anti-leishmanial activities of the crude methanolic extracts at 50 µg/mL

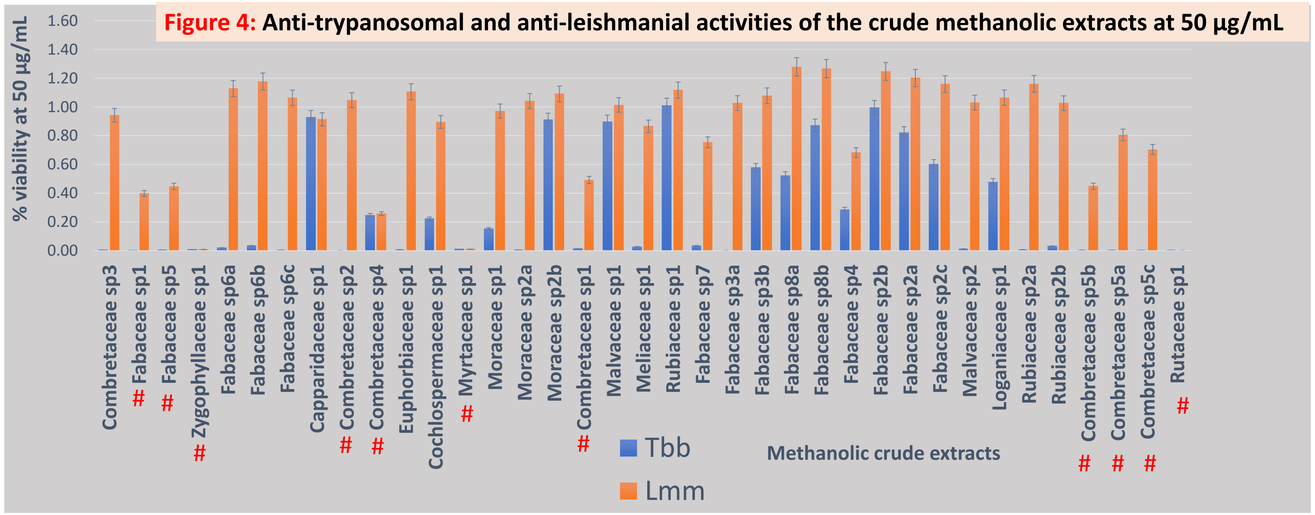


Table: **Anti-trypanosomal and anti-leishmanial activities as well as cytotoxic activities against WI38 cells of the crude methanolic extracts. The IC_{50} in µg/mL (concentration inhibiting 50 % of the growth of parasites) and SI (selectivity indexes) of the most active plants (#) were determined.**

Methanolic crude extracts	WI38 (CC_{50} µg/mL)	Tbb (IC_{50} µg/mL)	SI	Lmm (IC_{50} µg/mL)	SI
Combretaceae sp5a	>100	11.53 ± 3.25	>8.66	-	-
Combretaceae sp5b	>100	16.67 ± 0.61	>5.99	-	-
Combretaceae sp5c	66.15 ± 0.75	6.26 ± 0.18	10.56	-	-
Rubiaceae sp2b	>100	34.25 ± 3.51	>2.91	-	-
Fabaceae sp6a	>100	49.35 ± 3.41	>2.02	-	-
Zygophyllaceae sp1	14.02 ± 3.30	13.37 ± 4.36	1.04	20.01 ± 0.53	0.7
Fabaceae sp1	66.28 ± 0.08	3.58 ± 1.47	18.5	-	-
Combretaceae sp2	78.28 ± 6.87	17.29 ± 0.15	4.52	-	-
Rubiaceae sp2a	>100	25.66 ± 6.16	>3.89	-	-
Combretaceae sp1	77.93 ± 3.12	12.33 ± 2.45	6.32	-	-
Myrtaceae sp1	66.15 ± 1.71	12.09 ± 2.82	5.47	62.64 ± 6.73	1.05
Combretaceae sp3	>100	11.84 ± 3.77	>8.44	-	-
Combretaceae sp4	>100	31.05 ± 7.73	>3.22	-	-
Rutaceae sp1	41.42 ± 14.13	2.1 ± 0.09	19.7	0.61 ± 0.04	67.03

Tbb = *Trypanosoma brucei brucei* ; ***Lmm*** = *Leishmania mexicana mexicana* ; **WI38** = human normal fibroblast cells ; a, b, c = plant parts ; **IC_{50} of positive controls (in µg/mL):** camptothecin (WI38) 0.021 ± 0.001, suramine (Tbb) 0.022 ± 0.001, pentamidine (Lmm) 0.087 ± 0.008 ; **Selectivity indexes** are calculated by **$SI=IC_{50(WI38)}/IC_{50(Tbb\ or\ Lmm)}$**

The crude methanolic extracts (Combretaceae sp5C, Fabaceae sp1 and Rutaceae sp1) showed a high anti-trypanosomal activity with a relatively good SI. The crude methanolic extract (Rutaceae sp1) was the most promising extract for its anti-leishmanial activity.

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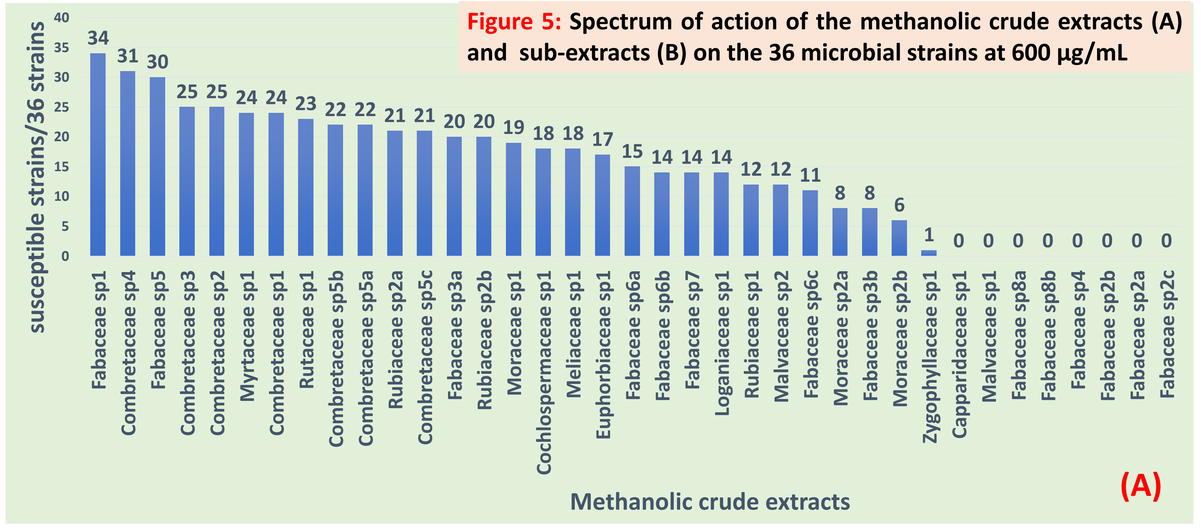
In vitro antimicrobial activity

Figure 5: Spectrum of action of the methanolic crude extracts (A) and sub-extracts (B) on the 36 microbial strains at 600 µg/mL



Plant species with a high antiparasitic activity also showed a promising antibacterial activity. We noticed that the botanical family Combretaceae contains several plant species with antibacterial properties.

Conclusion

This study allowed to identify 41 plants used in traditional medicine in Senegal for the management of infectious pathologies. The biological screening carried out confirmed the antimicrobial and antiparasitic potential of some plant species. The cyclohexane and dichloromethane sub-extracts of species belonging to Combretaceae and Rutaceae families are the most active. Bioguided fractionation was performed on these species to identify the active natural products.

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