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Study of the sensitivity of *Enterococcus faecalis* to the methanolic extracts of *Solanum incanum* L

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Abstract

Context: Enterococci are known germs capable of causing urinary infections, peritonitis, intra-abdominal abscesses, nosocomial bacteremia. These germs are today experiencing several forms of resistance to antibiotics sold on the market in the DRC. **Goal:** The aim of this work was to determine the sensitivity of enterococcus faecalis to the total extracts of *Solanum incanum* L., an effective reputed plant in traditional medicine for the treatment of infections caused by *Enterococcus faecalis* in the city of Lubumbashi, DRC. **Material and methods:** The preliminary phytochemical screening was carried out on the total extracts for the identification of phytochemicals active in the plant and the strain of *Enterococcus faecalismade* it possible to carry out the sensitivity tests. **Results:** The results reveal the presence of alkaloids, flavonoids, saponins, steroids and tannins. Biological tests reveal a sensitivity of *Solanum incanum* L. to total extracts of this plant. **Conclusion:** The analyzes carried out show that this plant used in Congolese traditional medicine is effective against the infections caused by *Enterococcus faecalis*. The subsequent fractionation of the total extracts and the evaluation of the antibacterial activity of the fractions which will be obtained will make it possible to demonstrate the active principles responsible for this antibacterial activity.

Keywords: Sensitivity, *Enterococcus faecalis*, Total extracts, *Solanum incanum* L..

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INTRODUCTION

Enterococci are opportunistic pathogenic bacteria that are responsible for nosocomial diseases. They are common pathogens because they cause about 10% of nosocomial diseases [1].

Enterococci can lead to infections of the urinary tract, wounds and soft tissues. They are also associated with a bacteremia that can lead to endocarditis in the presence of already damaged heart valves. *E. faecalis* is the species most frequently isolated from human intestinal samples (80-90%), with *E. faecium* accounting for 5-10% of isolates.

Strains resistant to β-lactams, aminoglycosides and, increasingly, to vancomycin have been described. Genetically engineered strains with resistance to chloramphenicol, tetracyclines, macrolides, lincosamides, quinolones and streptogramins have also been identified [2, 3].

They can lead to infections of the urinary tract, wounds and soft tissues. In this group of enterococci, we have *Enterococcus faecalis*, which is a species of *enterococcus* very often isolated in human intestinal samples (80 to 90%) [4, 5].

Enterococcus faecalis is a commensal bacterium that lives with other germs. It is found especially in the digestive tract of humans and other mammals. It can also occur in the environment (in wastewater, fresh water, on soils) [5, 6].

This bacterium can cause infections, including nosocomial infections. It is particularly monitored, especially since it has many resistance to antibiotics [3, 7].

E. faecalis is also known in the etiologies of endocarditis, as well as infections of the bladder, prostate or epididymis [1, 2].

Today the *E.faecalis* is resistant to many commonly used antibiotic agents (aminoglycosides, aztreonam, cephalosporins, clindamycin, semi-synthetic penicillins and oxacillin, as well as co-trimoxazole).

Exposure to cephalosporins is a particularly important risk factor for colonization and infection with enterococci. Hence the use of traditional medicine in the Democratic Republic of the Congo leads to efficient and cost-effective treatments [1,4].

This work would therefore determine the chemical components of *Solanum Incanum L*. and also evaluate the efficacy of *Solanum Incanum L*. on the strain of *Enterococcus faecalis*.

MATERIAL AND METHODS

Vegetable Materials

The plant material we used was constituted by the roots and fruits of *Solanum Incanum L*. This plant was harvested during an ethnobotanical survey carried out by traditherapeutes in the city of Lubumbashi [8].

Preparation of total extracts

Each plant material was obtained after drying in the shade and in the open air, by manual spraying using a mortar and a wooden pestle. The crude alcoholic extracts were obtained by maceration for 48 hours in an oven in a bechet. After maceration, the mixture was filtered and evaporated until the dry extract was obtained [9].

Preliminary phytochemical screening

Preliminary phytochemical screening was carried out according to classical methods based on colored reactions [10]. This screening focused on the detection of bioactive substances, including alkaloids, tannins, anthraquinons, anthocyanins, flavonoids, quinons, saponins, steroids and terpenoids[11].

Microorganism

The bacterial strain used in this study is a strain of *Enterococcus Faecalis*. It was supplied to us by the laboratory of microbiology of the University Clinics of Lubumbashi where it was preserved in the pure state and lyophilized.

Evaluation of antibacterial activity

Evaluation of the antibacterial activity was carried out by the conventional dilution method [12, 13].

400 mg of the total extract is dissolved in a test tube containing 8 mL of peptone broth in order to obtain a final concentration of 50 mg / mL of the total extract.

Increasing dilutions in geometric progression of 2 to 2 of this stock solution are carried out in 5 test tubes each containing 4 mL of peptone broth in order to obtain a concentration series of the extract to be tested: 50, 25, 12.5 , 6.25, 3.125 and 1.5625 mg / mL. A seventh tube containing only 4 mL of broth without plant extract served as a positive control.

The bacterial suspension was obtained by diluting the lyophilized strain in 1 mL of sterile distilled water and its visually adjusted density relative to a 0.5 Mc Faland solution. One drop of the inoculum was dispensed into each tube and then all tubes were incubated at 37 °C for 24 hours. The growth inhibition was evaluated visually by comparing the turbidity between the test tube and the positive control tube.

The minimum inhibitory concentration (MIC) is then defined as being the lowest concentration of the extract having to stop the growth of the bacterium.

RESULTS AND DISCUSSION

Solanum Incanum L. was shown to be effective on *Enterococcus Faecalis* at a minimum inhibitory concentration of 12.5 mg/mL demonstrating the efficacy of this plant in traditional use in the Democratic Republic of Congo.

Table I shows the conditions for which *Solanum Incanum L*. is used in traditional medicine; this is especially for different types of sexual infections.

We think that at this level, the traditherapeutes who use this plant have based themselves on their routine experience to affirm the effectiveness of the latter. Several studies, including those of Boily *et al*. (1986) and Madzimure *et al*. (2013), showed that most plants containing alkaloids, flavonoids, steroids and tannins had a beneficial effect on bacterial infections. Thus, we believe that, in the case of *Solanum Incanum L.*, its use could be rational starting from the analyzes of the bioactive compounds present.

Table II reveals the chemicals present in the plant, so we see the presence of alkaloids, flavonoids, saponins, steroids and tannins in both parts of the plant. These results show the richness of this plant in chemical compounds, which could probably justify the antibactirien effects observed in traditional medicine. In this respect, our findings corroborating those of Shah et al (2017) and Wu et al (2015), who also noted the richness of *Solanum Incanum L* in bioactive compounds, had an impact on most infectious diseases.

Table III shows the results of the evaluation of the antibacterial activity of the methanolic extracts of the fruits and roots on the germ. We find that the minimum inhibitory concentration for fruit extracts such as raciness is 12.5 mg / mL. These results corroborate those of Madzimure et al (2013), which showed the efficacy of total extracts of *Solanum Incanum L*. on *strychnosspinosa*-like germs[14].

Table 1: Results of the Ethnobotany Investigation

Scientific name	Used Parts	Affections	Method of preparation	Administration mode
Solanum Incanum L.	Roots	Gonorrhea, Dysentery, Sexual weakness, Dental caries, Dermatosis,	Maceration (Powder: oral administration)	Administration per os
	Fruits	Hemorrhoids, Injuries, infections.	Decoction	Local Application Enema

Table 2: Chemical screening results

S. incanum	Alkaloids	Anthocyanin	Flavonoide	Quinone	Saponin	Steroids	Tannins	Terpenoids	Total
Fruit	+	-	+	-	+	+	+	-	5/8
Root	+	-	+	-	+	+	+	-	5/8
Percentage (%)	100 %	0 %	100 %	0 %	100 %	100 %	100 %	0 %	

Table 3: Results of the evaluation of the antibacterial activity of methanolic extracts of fruits and roots on *Enterococcus faecalis*

Concentration (mg/mL)	**50**	**25**	**12.5**	**6.25**	**3.125**	**1.562**
Dilution	1	½	¼	1/8	1/16	1/32
Fruits	+	+	+ CMI	-	-	-
Roots	+	+	+ CMI	-	-	-

CONCLUSION

The chemical screening carried out in this work to determine the chemical components of *Solanum Incanum L*. revealed the presence in the fruits and roots of alkaloids, flavonoids, saponins, steroids and tannins. And sensitivity testing of total fruit and root extracts on the *Enterococcus Faecalis* germ showed a minimum inhibitory concentration of 12.5 mg / mL. These results clearly show that this plant used in traditional Congolese medicine is effective against infections caused by *Enterococcus Faecalis*. The subsequent fractionation of the total extracts would probably be necessary for the detection of the active ingredients responsible for this antibacterial activity.

Limitations of the Study

This study was limited solely to the determination of bioactive groups in the plant. It would be appropriate to go a step further, by determining the active principle by mass spectroscopy.

Contribution of authors

All authors contributed to this work. They read and approved the final version.

Conflict of interest

The Authors declare that there are no conflicts of interest.

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