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Biological activity from indigenous medicinal plants of Mauritius*

A. Gurib-Fakim‡, H. Subratty, F. Narod, J. Govinden-Soulange, and F. Mahomoodally

Faculty of Science, University of Mauritius, Reduit, Mauritius

Abstract: The Mauritian population has a long tradition in the use of ethno-medicine, and the practice is still strong, especially in the treatment of minor ailments. Such interest stems from an existing culture, and many "tisanes" are still prepared from plant materials and sold in several markets around the island.

This paper will focus on the various chemical/biological screening techniques currently being used to evaluate the biological properties of medicinal plant extracts. Particular emphasis will be put on extraction and various screening for biological/pharmacological properties. Due consideration will be given to the pharmacological approaches that utilize different animal models for the in vitro and in vivo screening of medicinal plant extracts.

INTRODUCTION

Mauritius is a tropical island in the southwest Indian Ocean that has numerous plant resources. The people of Mauritius have a long-standing tradition in the use of ethno-medicine, and the practice of traditional medicine is still strong in the treatment of minor ailments. However, the use of flora had been restricted mainly to exotic plants brought by immigrants from Africa, Madagascar, India, and China nearly a century and a half ago. In a survey carried out on the traditional uses of plants both in Mauritius and Rodrigues, only a small percentage (ca. 5 %) of the endemics were being used as medicinal plants [1,2].

It is a well-established fact that plant-derived compounds offer potential sources of new antibiotics, anticancer agents, and anti-HIV agents among other pharmaceutical agents. As part of the systematic study of the flora of Mauritius for new biologically active compounds from higher plants, several indigenous/endemic medicinal plants are being tested for their potential activity. The results from a sample of these tested plants are being reported here. The plants tested are the following, and the ethno-botanical claims are listed in Appendix 1.

1. *Antidesma madagascariensis* Lam. (Euphorbiaceae)
2. *Canarium paniculatum* (Lam.) Benth. (Burseraceae)
3. *Chassalia coriaceae* Verdc. var. *coriaceae* (Rubiaceae)
4. *Erythroxylum hypericifolium* Lam. (Erythroxylaceae)
5. *Erythroxylum laurifolium* Lam. (Erythroxylaceae)
6. *Erythroxylum macrocarpum* O. E. Schulz (Erythroxylaceae)
7. *Erythroxylum sideroxyloides* Lam. (Erythroxylaceae)

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‡Corresponding author

8. *Faujasiopsis flexuosa* (Lam.) C. Jeffrey (Asteraceae)
9. *Gaertnera psychotrioides* (DC.) Baker (Rubiaceae)
10. *Labourdonnaisia calophylloides* Bojer (Sapotaceae)
11. *Labourdonnaisia glauca* Bojer (Sapotaceae)
12. *Labourdonnaisia revoluta* Bojer (Sapotaceae)
13. *Mimusops petiolaris* (DC.) Dubard (Sapotaceae)
14. *Mimusops erythroxylum* (Sapotaceae)
15. *Mimusops maxima* (Poiret) Vaughan (Sapotaceae)
16. *Momordica charantia* L. (Cucurbitaceae)
17. *Protium obtusifolium* (Lam.) Marchand (Burseraceae)
18. *Psiadia viscosa* (Asteraceae)
19. *Psiadia terebinthina* (Asteraceae)
20. *Rhizophora mucronata* L. (Rhizophoraceae)
21. *Sideroxylon cinereum* Lam. (Sapotaceae)
22. *Sideroxylon grandiflorum* DC. (Sapotaceae)
23. *Sideroxylon puberulum* DC. (Sapotaceae)
24. *Toddalia asiatica* (L.) Lam. (Rutaceae)
25. *Vepris lanceolata* (Lam.) G. Don (Rutaceae)

The following tests were carried out:

- antimicrobial activity
- contraction and relaxation of smooth muscles and aortal and tracheal muscles in both cold- and warm-blooded animals
- ability of plant extract to affect transport in everted gut sacs

It is well known that tannins influence the antibacterial and antifungal properties of plant extracts. In order to ascertain that components other than tannins are responsible for the activities, the tannins were precipitated out of the solutions with gelatin and the filtrates were retested for the antibacterial and antifungal activities.

This study constitutes one of the first assessments of the biological activities of these indigenous medicinal plants of Mauritius.

MATERIALS AND METHODS

Plant materials

Most of the plant materials were collected from the Nature Reserve, and the Curator of the National Herbarium, based at the Mauritius Sugar Industry Research Institute, Reduit, Mauritius, identified the plant samples. Samples of these plants have also been deposited at the Herbarium for Medicinal Plants at the Faculty of Science of the University of Mauritius.

Sample preparation

The plant parts were dried and ground; 15–20 g of the powder was extracted in about 200 ml of methanol. The extracts were dried in vacuo. The yield was calculated as g extract/g of dry plant material. The extracts were dissolved in a mixture of methanol and sterilized water (1:1) with a concentration of 8 mg/ml. The methanol extract was also used for the preliminary chemical tests.

For the antimicrobial tests, the extracts were tested against gram-positive bacteria (*Staphylococcus aureus*), gram-negative bacteria (*Escherichia coli*, *Pseudomonas aeruginosa*, and *Salmonella typhi*) and the fungi (*Candida albicans* and *Aspergillus niger*). The bacteria and *Candida* are clinical isolates obtained from a regional local hospital. The microbiologist at the hospital confirmed

the identity. The extract of *A. niger* was obtained from the Biology Department of the Faculty of Sciences, University of Mauritius.

Antimicrobial tests

The program used for the screening is essentially the agar dilution method described by Mitscher et al. [3], designed for the evaluation of antimicrobial activity in extracts of higher plants. Test organisms were incubated at 37 °C for *Candida*, 27 °C for *Aspergillus* sp. for 48 h, and at 37 °C for 24 h for the bacteria. The lowest drug concentration at which no growth was observed was considered to be the minimum inhibitory concentration (MIC).

Precipitation with gelatine

To investigate whether tannins are solely responsible for the antibacterial effect of the plant extracts, tannins were removed from the extract by precipitation with gelatin prior to testing.

The plant extract, obtained from 10 g of the plant material, was dissolved in 25 ml of hot distilled water, stirred, and allowed to cool to room temperature. After filtration, a 1 % gelatin solution was added dropwise to the filtrate until no further precipitation was noticed. The mixture was centrifuged, and the supernatant layer was evaporated to dryness, resulting in a crude extract without tannins [4]. The test concentration for the extract was adjusted so that it was possible to compare the activity before and after the removal of the tannins.

Contraction and relaxation of smooth muscles, aortal and tracheal muscles for warm- and cold-blooded animals

Sprague–Dawley rats weighing between 50–100 g were sacrificed by a severe blow on the head. The abdominal cavity was opened, and a stretch of the lower part of ileum was removed, cut free of mesentery, and sectioned into pieces of 1 cm length. Each ileal strip was washed to remove any remaining food material using a hypodermic syringe filled with Krebs' solution. The strips were immersed in Krebs' solution (bubbled with carbogen, 95 % O_2, and 5 % CO_2) containing a few drops of heparin (5000 IU/L) to prevent any blood clot formation, until they were mounted in the organ bath one at a time according to the technique described by Gurib and Subratty [5]. Before mounting each strip, the glass-jacketed organ bath was filled with Krebs' solution (25 ml), and the latter was bubbled with carbogen for 5 min by Subratty and Moonsamy [6]. The organ bath solution was maintained at 37 °C with a thermostatted water pump (Lauda, Model-1), and the pH of the solution was adjusted to 7.4. Mounting of the strip in the organ bath involved inserting two triangular stainless steel hooks into the lumen, enabling the strip to be held horizontally in the bath. One of the triangular hooks was pinned to a fixed point in the apparatus, and the other one was connected to a force-displacement transducer (Model LB-5, Showa Shokki, Japan). Contractile and relaxation responses were measured isometrically with the transducer and were recorded on a multipen recorder (Rikadenki Model R50, Japan). After mounting, each organ strip was adjusted to a resting tension of 1.5 g and was allowed to equilibrate in the organ bath for about 15 min until a baseline tone was achieved before being challenged with the plant extract under test.

After stabilization, each mounted strip was challenged with 100, 200, 300, 400, 500, 600, 700, 800, 900, and 1000 µl of the test plant extract. After each 100-µl addition, the organ strip was allowed to give the maximum response before the next addition. Contractile responses were recorded as increases in the baseline tone while relaxation responses were recorded as decreases in the baseline tone taking into account the fact that during stabilization, a tension of about 1.5 g was already applied on the strips.

Preparation of plant extracts for challenging organ strips

The organ strips were challenged in vitro with the dried plant extract (132 mg) and were dissolved in methanol (1 ml) (aqueous plant extracts were dissolved in water). Addition of this solution (100 µl) to the organ bath already containing Krebs' solution (25 ml) afforded a final bath concentration (FBC) of 0.528 mg/ml or 528 ppm plant extract in the organ bath.

For each series of experiments, a control strip was included and challenged either with methanol (100 µl addition) or water (100 µl addition) depending on what solvent was used to dissolve the plant extract.

Effects of plant extracts on transport across rat everted gut sacs

The selected plant material (10 g) was extracted with 50 ml solvent (water) in a Soxhlet apparatus at 90 °C for 5 h. The solvent was evaporated under vacuum at 50 °C, and the precipitate was collected in 10 ml water. The paste-like extract was diluted in distilled water for further experiments. Adult male Swiss albino rats weighing 10–150 g were used. Intestinal segments were everted according to the method describe by Wilson and Wiseman [7]. The aqueous extract of the plant was added to the mucosal compartment fluid. Tyrosine in the serosal solution was determined by a spectrophotometric method [8]. Glucose was measured using a commercially available glucose oxidase kit (Boehringer Mannheim, Gmbh, Mannheim). The amount of tyrosine and glucose transported from the mucosal compartment was characterized as "uptake" while the serosal gain of the substances is treated as "release". Uptake and release of glucose and tyrosine are expressed as µmol/g tissue wet wt/h. Na^+ and K^+ concentration in the serosal solution were determined by atomic absorption (Unicam 929). The quantity of Na^+ and K^+ taken in the serosal solution was calculated from the respective change in the volume of fluids and expressed in terms of amount per gm-wet wt of the tissue. All chemicals were procured from Sigma (UK). All data were analyzed using Microsoft Excel. The difference between the mean ±SEM between the controls and experimental groups were examined using the one-way analysis of variance (ANOVA) test. P values less than 0.05 were considered as significant.

CHEMICAL ANALYSES

A simple qualitative analytical high-performance liquid chromatography (HPLC) procedure using appropriate standards has been used to identify secondary plant metabolites in the tested extracts.

The fractionation of the plant material was performed by subjecting dried powdered plant material to Soxhlet extraction using a gradient elution. The methanol fraction of each plant part was prepared at a concentration of 40 mg/ml in HPLC grade methanol for HPLC analysis. HPLC analysis was performed by a Hewlett Packard HPLC apparatus Series 1100 consisting of a quaternary pump serial # DE91606269, an automatic sampler with standard injection serial # DE91608244, a thermostatted Lichrosorb RP-C18 5 µm reverse-phase analytical column (Colcom 4.6 × 250 mm) serial # DE91609521, a degasser serial # JP73016308, and a UV diode array detector (DAD) serial # DE91605894. HPLC analyses were performed according to the method described in the literature [9].

RESULTS AND DISCUSSION ON THE BIOLOGICAL ACTIVITY OF THE PLANT EXTRACTS AND THE VALIDATION OF THE TRADITIONAL USES

The aqueous and methanol extracts of the leaf and stem of *Antidesma madagascariensis* (Euphorbiaceae), and *Faujasiopsis flexuosa* (Asteraceae) showed maximum activity against four of the test bacteria, namely: *E. coli*, *P. aeruginosa, S. typhimurium*, and *S. aureus* with an MIC of 4–8 mg/ml. No antifungal activity was detected with the stem and leaf water extracts from both plants. *A. madagascariensis* and *F. flexuosa* extracts showed antifungal activity against *Aspergillus* species, but were

detected with the chloroform methanol extract, and the MIC was 16 mg/ml. *A. madagascariensis* chloroform/methanol extract also showed activity against *Candida* with an MIC of 16 mg/ml.

Plant extracts						
Microorganisms	*E. coli*	*P. aeruginosa*	*S. typhimurium*	*S. aureus*	*A. niger*	*C. albicans*
A. madagascariensis						
Leaf and stem water extract	+ (8)	+ (8)	+ (8)	+ (4)	–	–
STEM FRACTIONS						
Hexane fraction	–	+ (32)	–	+ (16)	–	–
Methanol:chloroform (1:1)	–	+ (16)	–	+ (16)	+ (16)	+ (16)
Methanol fraction	+ (8)	+ (8)	+ (8)	+ (8)	–	–
LEAF FRACTION						
Hexane fraction	–	–	–	–	+ (16)	–
Methanol:chloroform (1:1)	–	+ (32)	–	–	+ (16)	–
Methanol fraction	+ (8)	+ (8)	+ (8)	+ (2)	+ (16)	–
F. flexuosa						
Leaf and stem water extract	+ (4)	+ (8)	+ (4)	+ (4)	–	–
STEM FRACTION						
Hexane fraction	–	–	–	+ (16)	–	–
Methanol:chloroform (1:1)	+ (32)	+ (8)	+ (8)	+ (8)	+ (16)	–
Methanol fraction	–	–	–	+ (8)	–	–
LEAF FRACTION						
Hexane fraction	–	–	–	–	+ (16)	–
Methanol:chloroform (1:1)	+ (8)	+ (8)	+ (8)	+ (4)	+ (16)	–
Methanol fraction	+ (8)	+ (8)	+ (8)	+ (4)	+ (16)	–

The extracts obtained from the plant extracts of *A. madagascariensis* and *F. flexuosa* were shown to induce contraction in isolated rat ileal strips in vitro.

Preliminary phytochemical tests [10] have shown that both plants are characterized by the presence of alkaloids, phenols, flavonoids, and saponins. These classes of compounds are known to have established antimicrobial profile and hence the use of these plants against infectious diseases may be rationalized by the presence of these compounds in these plants [11,12].

The aqueous extract of the leaf and stem of *Toddalia asiatica* and *Vepris lanceolata* (Rutaceae) showed reasonable activity against gram +ve and gram –ve bacteria, the MIC ranging from 2 to 32 mg/ml. The leaf fractions also manifested activity against *Candida* at an MIC of 8–16 mg/ml.

Although the above plant extracts are used successfully against infectious diseases, these plants are also used by the laypeople against asthma. The pharmacological assays performed using these plant extracts show that they have a tendency to induce contractile response both in rat ileal and rat aortal strip in vitro. Hence, there is a need to evaluate the effects of these extracts on precontracted airway muscle so as to ascertain the use against asthma as the latter is known to be a respiratory ailment characterized by the contraction of the smooth muscle of the smaller bronchi and leading to difficulty in breathing.

Several members of the indigenous/endemic Sapotaceae family have been tested for biological activity. The methanol extracts of the leaf and stem of the genus *Labourdonnaisia* species (*L. glauca*, *L. revolute*, *L. calophylloides*), *Sideroxylon* species (*S. cinereum*, *S. puberulum*, *S. grandiflorum*) and *Mimusops* (*M. maxima*, *M. erythroxylum*, and *M. petiolaris*) all showed activity against all of the tested bacteria, and the MIC ranged from 0.5–8 mg/ml. Upon fractionation, only the polar fractions retained their activity at the tested concentration of 8 mg/ml.

The above-mentioned species have been found to be characterized by the presence of isoquercitrin, quercetin, and (+)-catechin. Luteolin has been isolated from *S. cinereum*.

The presence of these components could help explain the antimicrobial profile of the plant extracts.

The *Erythroxylum* species (Erythroxylaceae) tested also showed an interesting antimicrobial profile. The fractionated extracts of *E. sideroxyloides*, *E. laurifolium*, *E. hypericifolium*, and *E. macrocarpum* all showed activity against *S. aureus* with an MIC ranging from 1–8 mg/ml. Once again, activity was limited to the polar fractions. *E. macrocarpum* was the only plant whose extracts showed activity against all of the tested bacteria. With respect to the antifungal activity, only *E. hypericifolium* leaf extract showed activity against *A. niger*. The extracts did not have any effect on the *Candida* species.

The chemical tests performed on the extracts have shown the presence of quercitrin (quercetin-3-*O*-rhamnoside), isoquercitrin (quercetin-3-*O*-glucoside), and (+)-catechin in leaves of 4 endemic *Erythroxylum* species, namely, *E. sideroxyloides* Lam., *E. laurifolium* Lam., *E. macrocarpum* O. E. Schulz, and *E. hypericifolium* Lam. The presence of these phytochemicals have been based on HPLC analysis of the leaf methanol fraction [13].

After further pharmacological tests have been performed on the toad and rat ileal strips, the following observations were made on the leaf methanol extracts of the plants: *E. sideroxyloides* showed sustained contractile responses on toad and rat ileal strips. For the rat tracheal and aortal strips, the methanol leaf extracts showed slight relaxation followed by contractile responses and a biphasic response—contraction followed by relaxation, respectively.

E. hypericifolium only showed relaxation responses followed by sustainable contraction on toad ileal strip. The methanol leaf extract showed weak contractile responses against rat tracheal strip and sustainable contraction against rat aortal strip.

The methanol leaf extract of *E. laurifolium* showed contraction leading to tetanus. Biphasic response was observed on rat ileal strips. The extract also showed biphasic responses—relaxation followed by contraction on rat tracheal strip and relaxation on rat aortal strip.

The methanol extract of the leaf of *E. macrocarpum* showed sustainable contraction on the toad ileal strip, leading to tetanus and with no significant response on the rat ileal strip. The same extract showed biphasic responses (relaxation followed by contraction) both for rat tracheal strip and aortal strips. The aqueous extract of the leaf, on the other hand, showed strong relaxation on the toad ileal strip with weak and nonsustainable-type contraction on the rat ileal strip. There was also strong sustainable contraction on the rat tracheal strip and also on the aorta. The methanol and water extracts of the twig, on the other hand, showed strong sustainable contractile responses on the following: toad ileal strips, rat ileal strips, rat tracheal strips, and rat aortal strips [14].

Canarium paniculatum and *Protium obtusifolium* extracts from the Burseraceae family have also been tested for their antimicrobial activities. The wood and leaf extracts of *C. paniculatum* and *P. ob-*

tusifolium, respectively, showed activity against all of the test bacteria. The MIC was found to be at 8–0.5 mg/ml. Upon fractionation of the extracts of *C. paniculatum*, maximum activity against the tested bacteria were observed in the methanol extracts.

Canarium paniculatum (Burseraceae) was reported to contain (–)-catechin, gallic acid, methyl gallate ester, pentagalloyl glucose, epigallocatechin-3-*O*-gallate, methyl gallate, and epigallocatechin [15].

It must be pointed out that the activity of the plant extracts disappeared after the tannins have been precipitated. Thus, one can conclude that the activity was due solely to the presence of the tannins.

Chassalia coriaceae and *Gaertnera psychotrioides* (Rubiaceae)

A few members of the Rubiaceae family have also been tested for the antimicrobial activities. The leaf and bark extracts of *G. psychotrioides* and *C. coriaceae* have been tested.

C. coriaceae (Rubiaceae) was characterized by the presence of quercetin-3-*O*-β-D-glucopyranosyl (1->6)-α-L-rhamnopyranoside [15].

The crude methanol extracts of the leaf of *C. coriaceae* manifested activity against *P. aeruginosa*. It is worth pointing out that the isolated component quercetin-3-β-rutinoside was not active, thus suggesting that other components present in the extracts may be responsible for the activity. Antimicrobial activity was observed at a concentration of 8000 ppm. Biological activity was maintained even after the tannins have been precipitated out, thus confirming that other components are responsible for the biological activity.

The crude methanol extract of the leaf of *C. coriaceae* (Rubiaceae) showed severe contraction on the smooth ileal toad muscle. Thus, the astringency of the plant extract has to some extent been confirmed by the activity of the leaf extract in its action against the isolated intestine strip, not withstanding the fact that it's an important criterion in the treatment of infectious diseases such as diarrhea and dysentery.

The crude methanol leaf extract of *G. psychotrioides* showed maximum activity against all of the test bacteria with an MIC of 0.5 mg/ml. *G. psychotrioides* (Rubiaceae) was reported to contain luteolin.

Some members of the Asteraceae family, namely, the *Psiadia* species have been tested for their antimicrobial activities. The crude methanol leaf extracts of *P. terebinthina* and *P. viscosa* have been shown to exhibit antimicrobial properties against: *E. coli, Bacillus cereus, Staphylococcus aureus*, and *P. aeruginosa* at a concentration varying from 8 mg to 1 mg/ml. Although the plant is believed to be useful against asthma, the fractionated extracts failed to relax carbachol-contracted guinea pig tracheal rings.

Several compounds have been isolated from this plant, namely: kaempferol-3-methyl ether, quercetin-3-methyl ether, kaempferol 3,7-dimethyl ether, 3-caffeoyl quinic acid, 3,4-dicaffeoyl quinic acid, and a new compound: 5-(2-furan-3-yl-ethyl)-5,6,8a-trimethyl-3,4,4a,5,6,7,8,8a-octahydronaphthalene-1-carbaldehyde. The latter has been shown to show antifungal activities against *Cladosporium cucumerinum*.

3-Caffeoyl quinic acid (chlorogenic acid) and 3,4-dicaffeoyl quinic acid have been reported to inhibit the myeloperoxidase enzyme [15].

Quercetin-3-methyl ether showed sustained activity against *E. coli*, in vitro, at a concentration of 50 mg/ml while kaemferol-3,7-dimethyl ether did not show any sustained activity against any of the bacteria tested.

RESULTS AND DISCUSSION ON THE EFFECTS OF THE EXTRACTS OF *MOMORDICA CHARANTIA* ON TRANSPORT ACROSS RAT EVERTED INTESTINAL SACS

Incubation of the rat everted intestinal sacs with *M. charantia* extracts resulted in the inhibition of transport of tyrosine and glucose. However, the uptake of tyrosine was less inhibited compared to that of glu-

cose except at higher concentration of the substrate (tyrosine) (Table 1). With varying concentrations of substrate (glucose 2–10 mM), it was found that *M. charantia* significantly inhibited the uptake of glucose ($p < 0.05$) while for tyrosine were not significantly different ($p > 0.05$) at concentrations of 0.5 and 1.0 mM.

Table 1 Effects of *M. charantia* on the uptake of varying concentration of substrates (glucose and tyrosine) by everted intestinal sacs of rats. The intestines were incubated in Krebs–Henseleit buffer (pH = 7.4) at 37 °C.

Substrate concentration in the medium (mM)	Uptake (μmol/g tissue wet wt/h)		
Tyrosine	Control ($N = 7$)	*Momordica* extract (3.62 mg/ml) ($N = 7$)	p value
0.5	1.7 ± 0.12	1.3 ± 0.03	(NS)
1.0	3.2 ± 0.12	2.2 ± 0.41	(NS)
1.5	8.3 ± 0.13	5.1 ± 0.50	$p < 0.05$
2.0	13.5 ± 0.17	9.7 ± 0.62	$p < 0.05$
Glucose			
4	28.2 ± 0.62	14.7 ± 0.52	$p < 0.05$
6	38.4 ± 0.65	17.8 ± 0.53	$p < 0.05$
8	49.3 ± 0.15	19.5 ± 0.53	$p < 0.05$
10	65.3 ± 0.65	26.9 ± 0.62	$p < 0.05$

The intestines were incubated in Krebs–Henseleit buffer (pH = 7.4) at 37 °C.
N = number of sacs used. Values are expressed as mean ±SEM of 7 experiments.
(NS) = not statistically significant.

The present findings show that aqueous extract of *Momordica* inhibits glucose and sodium ion transport significantly. Tyrosine uptake, on the other hand, was only inhibited at high concentration of the substrate, whereas K^+ uptake was not significantly affected in the presence of the plant extract (Table 2).

Table 2 Effects of *M. charantia* extracts on the transport of Na^+ and K^+ across the everted gut sacs of rat intestine incubated in Krebs–Henseleit buffer (pH = 7.4) at 37 °C.

	Control ($N = 7$) without the plant extract	M. charantia extract (3.62 mg/ml) ($N = 7$)	p value
Na^+ transport (mmol/g tissue wet wt)	93.3 ± 4.2	69.9 ± 7.2	$p < 0.05$
K^+ transport (mmol/g tissue wet wt)	54.2 ± 3.1	56.5 ± 7.9	(NS)

N = number of sacs used. Values are expressed as mean ±SEM. (NS) = not statistically significant.

Our findings tend to indicate that *M. charantia* inhibits glucose uptake in a noncompetitive manner whereas tyrosine uptake in the presence of the plant extract did not fit to a relatively simple kinetic model [16]. Experimental findings also show that *M. charantia* inhibits the uptake of glucose across the everted intestine sac model in a dose dependent manner (Table 1). Therefore, the possible mechanism of inhibition of glucose by the everted sacs of rats by *M. charantia* could possibly involve the Na^+ - K^+ pump. It is hypothesized that phytochemicals in the extract may alter the sodium-potassium gradient at

the level of the enterocytes of the small intestine. Available reports show that saponins, which have glycoside moieties (e.g., Momordicosides and Momordines), have been isolated from the plant of *Momordica* [16]. Moreover, it has been shown that saponins reduce the permeability barrier to sodium at the brush border of the small intestine, thus discharging the electrochemical gradient and removing the driving force for sugar transport [17]. The fact that Na^+ ions uptake was also inhibited in the presence of *M. charantia* in the present study seals the above hypothesis.

In conclusion, based on the data generated in this study, we propose that *M. charantia* extract may possess hypoglycemic properties by inhibiting the glucose transport at the site of intestinal brush border membranes, thus leading to a washout of glucose from the small intestine.

CONCLUSION

Ever since Mauritius has been inhabited, many exotic plants have been used for their medicinal properties. Recent surveys have shown that indigenous and endemic species have gradually started to get incorporated in the pharmacopeia. Among the families concerned are the Erythroxylaceae, Sapotaceae, and Rubiaceae, to name but a few. The biological activities of the plant extracts which have been tested are very promising and especially for their anti-infective potential. One major conclusion that can be drawn here is that true to what has been said to date about the potential of the flora in the tropics in terms of drug development, the flora of Mauritius is an interesting microcosm.

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APPENDIX 1

Name of the plant	Family	Vernacular names	Traditional uses
Antidesma madagascariensis	Euphorbiaceae	Bois bigaignon	Leaf and stem decoction is used against dysentery, to wash skin infections, and also against intestinal worms.
Canarium paniculatum	Burseraceae	Bois colophane	The crushed leaves are applied on skin infections.
Chassalia coriaceae	Rubiaceae	Bois corail	The leaves are used as an astringent.
Erythroxylum hypericifolium	Erythroxylaceae	Bois a balai	All the *Erythroxylum* species are used indiscriminately against kidney stones and fever.
Erythroxylum laurifolium	Erythroxylaceae	Bois de ronde	Leaf and stem decoction is used against fever and as a diuretic.
Erythroxylum macrocarpum	Erythroxylaceae	Bois piment	Leaf and stem decoction is used against fever and as a diuretic.
Erythroxylum sideroxyloides	Erythroxylaceae	Bois de ronde	Leaf and stem decoction is used against fever and as a diuretic.
Faujasiopsis flexuosa	Asteraceae	Bois cassant	Leaf decoction is used against fever and diabetes.
Gaertnera psychotrioides	Rubiaceae	Bois banane	Leaf decoction is used against infantile eczema and to wash rheumatic pains.
Labourdonnaisia calophylloides	Sapotaceae	Natte a petites feuilles	Leaf decoction is used as an astringent.
Labourdonnaisia glauca	Sapotaceae	Bois de natte	Leaf decoction is used as an astringent.
Labourdonnaisia revolute	Sapotaceae	Bois de natte a petites feuilles	Leaf decoction is used as an astringent.
Mimusops petiolaris	Sapotaceae	Makak	Leaf decoction is used as an astringent.
Mimusops erythroxylum	Sapotaceae	Makak	Leaf decoction is used against dysentery and diarrhea.
Mimusops maxima	Sapotaceae	Makak	Leaf decoction is used against dysentery and diarrhea.
Momordica charantia	Cucurbitaceae	Margoze	Juice extracted from the leaves and fruits is used against diabetes, fever.
Protium obtusifolium	Burseraceae	Bois colophane	
Psiadia terebinthina	Asteraceae	Baume de l'Ile Plate	Leaf decoction is used against fever and asthma, while the leaf poultice is applied on boils and other skin ailments.
Psiadia viscosa	Asteraceae	Baume de l'Ile Plate	Leaf poultice is used against skin infections, and a leaf infusion is used against asthma.
Rhizophora mucronata	Rhizophoraceae	Manglier	Leaf infusion is used to lower blood sugar.

(*continues on next page*)

Appendix 1 (*Continued*).

Name of the plant	Family	Vernacular names	Traditional uses
Sideroxylon cinereum	Sapotaceae		
Sideroxylon grandiflorum	Sapotaceae	Tambalacoque	Leaf decoction is reported to have astringent properties and is used to wash throat infections.
Sideroxylon puberulum	Sapotaceae	Manglier rouge	Leaf decoction is reported to have astringent properties and is used to wash skin infections.
Toddalia asiatica	Rutaceae	Patte poule	Leaf infusion is used against fever and pulmonary infections.
Vepris lanceolata	Rutaceae	Patte poule piquant	Leaf decoction is used to wash wounds and against pulmonary infections and rheumatic pains.