A Comparison of the Chemical Constituents of Barbadian Medicinal Plants within Their Respective Plant Families with Established Drug Compounds and Phytochemicals Used to Treat Communicable and Non-communicable Diseases

D Cohall[1], S Carrington[2]

ABSTRACT

Objective: *Barbados has a strong base in the practice of folklore botanical medicines. Consistent with the rest of the Caribbean region, the practice is criticized due to lack of evidence on the efficacy and safety testing. The objectives of this review article are i) to categorize and identify plants by their possible indications and their scientific classification and ii) to determine if the chemical constituents of the plants will be able to provide some insight into their possible uses in folklore medicine based on existing scientific research on their chemical constituents and also by their classification.*

Method: *A review of the folklore botanical medicines of Barbados was done. Plants were primarily grouped based on their use to treat particular communicable and non-communicable diseases. Plants were then secondarily grouped based on their families. The chemical profiles of the plants were then compared to established drug compounds currently approved for the conventional treatment of illnesses and also to established phytochemicals.*

Results: *The extensive literature review identified phytochemical compounds in particular plants used in Barbadian folklore medicine. Sixty-six per cent of reputed medicinal plants contain pharmacologically active phytochemicals; fifty-one per cent of these medicinal plants contain phytochemicals with activities consistent with their reported use.*

Conclusion: *Folklore botanical medicine is well grounded on investigation of the scientific rationale. The research showed that fifty-one per cent of the identified medicinal plants have chemical compounds which have been identified to be responsible for its associated medicinal activity. To a lesser extent, approved drug compounds from drug regulatory bodies with similar chemical structure to the bioactive compounds in the plants proved to validate the use of some of these plants to treat illnesses.*

Keywords: Barbadian, folklore, medicinal plants, phytochemical

Una Comparación de los Elementos Constitutivos Químicos de las Plantas Medicinales Barbadenses dentro de sus Respectivas Familias de Plantas, con los Compuestos Medicinales Convencionales y los Fitoquímicos Usados para Tratar las Enfermedades Comunicables y las no Comunicables

D Cohall[1], S Carrington[2]

RESUMEN

Objetivo: *Barbados tiene una sólida base en la práctica de las medicinas botánicas del folklore De conformidad con el resto de la región caribeña, la práctica se critica debido a la falta de evidencia sobre la eficacia y la seguridad. Los objetivos de este artículo de revisión son (i) categorizar e identificar las plantas por sus posibles indicaciones y su clasificación científica, y (ii) determinar si los elementos constitutivos químicos de las plantas podrían proporcionar algún entendimiento de sus posibles usos en la medicina de folklore, a partir de la investigación científica existente sobre sus elementos químicos constitutivos, y también de su clasificación.*

Método: *Se realizó una revisión de las medicinas botánicas folklóricas de Barbados. Las plantas fueron agrupadas principalmente a partir de su uso para tratar enfermedades comunicativas y no comunicati-*

From: [1]Faculty of Medical Sciences, The University of the West Indies, Cave Hill, St Michael, Barbados and [2]Faculty of Pure and Applied Sciences, The University of the West Indies, Kingston 7, Jamaica.

Correspondence: Dr D Cohall, Faculty of Medical Sciences, The University of the West Indies, Cave Hill, St Michael, Barbados. E-mail: damian.cohall@cavehill.uwi.edu

vas específicas. Se agruparon entonces secundariamente sobre la base de sus familias. Se procedió entonces a comparar los perfiles químicos de las plantas con los compuestos medicinales establecidos, aprobados corrientemente para el tratamiento convencional de enfermedades. Igual procedimiento se realizó con los fitoquímicos establecidos.

Resultados: *La extensa revisión de la literatura identificó compuestos fitoquímicos en plantas específicas usadas en la medicina folklórica de Barbados. Sesenta y seis por ciento de las plantas medicinales que gozan de reputación contienen elementos fitoquímicos farmacológicamente activos; el cincuenta y un por ciento de estas plantas medicinales contiene fitoquímicos con principios activos correspondientes al uso reportado.*

Conclusión: *La medicina botánica folklórica está bien cimentada en la investigación de los principios científicos. La investigación mostró que el cincuenta y un por ciento de las plantas medicinales identificadas tienen compuestos químicos que han sido identificados como responsables de la actividad medicinal asociada. En menor grado, los compuestos medicinales aprobados – provenientes de las instituciones que regulan los medicamentos con estructuras químicas similares a los compuestos bioactivos de las plantas – han servido como pruebas que validan el uso de algunas de estas plantas en el tratamiento de ciertas enfermedades.*

Palabras claves: Barbadense, folklore, plantas medicinales, fitoquímicos

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INTRODUCTION

Barbados is an island found in the Lesser Antilles of the West Indies. Its vegetation is strongly influenced by the seasonal climate associated with the island's geographical location, which supports the rich diversity of plants. It has an estimated 650 species of flowering plants found in the wild, two of which are considered endemic to the island (1).

Globally, plants are classified according to shared physical characteristics and traditionally some 300 such groups have been recognised as plant families but the application of molecular approaches to phylogeny is resulting in major taxonomic revisions and the recognition today of some 500 families (2). Similarly, the different plant species of Barbados were identified and placed within their respective families. The objective of this review article is to probe deeper than the physical classification of plants considered to have medicinal properties in Barbados and to determine their chemical characteristics which will be used to explain their possible uses in folklore medicine. Particular attention will be directed to plants used for treatment of infectious ailments inclusive of communicable diseases and chronic non-communicable diseases.

Medicinal plants have been considered as the cornerstone in the development of the pharmaceutical sciences which started approximately 3000 BC (3). Since then, natural entities have been a source of drugs and this sub-division of pharmacology is called pharmacognosy. The investigation of folklore medicinal claims or ethnic medicine is called ethnopharmacology. These established areas within the discipline of pharmacology have led to the development of highly recognized herbal remedies, mainly nutraceuticals, from medicinal plants. These herbal remedies have seen sales in the pharmaceutical markets growing as much as 20% per year, exceeding conventional medication (4).

Compounds isolated from plants which are considered to be beneficial to health are termed phytochemicals and many conventional drugs have their beginnings from plant sources. The phytochemical group of alkaloids is a remarkable example of conventional drugs whose active compounds were derived from plants. Drugs such as morphine, quinine, atropine and vincristine are all alkaloids derived from their res-pective plants. Other phytochemicals of interest are flavon-oids, phenolic acids, terpenoids, esters, phytosterols and saponins.

Even with this elaborate background on the use of plants as precursors to conventional drugs and the rise in sales of herbal remedies globally, most medicinal plants and products have yet to be subjected to the same rigorous efficacy and safety trials as conventional drugs (5). The use of herbal remedies is still highly criticized by the medical fraternity due to possible drug-herb interactions and also toxicity associated with the bioactive compounds in the plants. These drug-herb interactions may increase or decrease the pharmacological and toxicological effects of either components and may also interfere with long term medication due to complications which may arise due to synergistic effects of the treatment forms (4).

The Caribbean has a rich base of folklore practices involving the use of medicinal plants. These practices are historically linked to the immigrants from West Africa and the East Indies, and to the original native inhabitants, Amerindians, from some territories in the Caribbean (6). Many of these plants used in Caribbean folklore medicine seem to be rarely investigated. It is the intent of this study, while only focussing on the medicinal plants of Barbados, to demonstrate that through the investigation of the chemical properties of these plants within their respective families, some of these folklore claims can be preliminarily validated. This is possibly due to similarities of the plants' chemical components to established drug compounds or phytochemicals. This preliminary valida-

tion would only justify potential uses, and documented studies on the purified and characterized phytochemicals inclusive of toxicological and efficacy studies would be required before any such claim of the plants' medicinal use(s) could be fully validated.

METHODS

A review of the Barbadian folklore medicinal uses of plants was done. Plants were primarily grouped based on their Barbadian folklore uses to treat particular communicable and non-communicable diseases. Non indigenous medical plants with similar indications in the Caribbean were also identified in the review. The communicable diseases considered for this review are mainly viral infections inclusive of the common cold, the flu, chicken pox and topical bacterial and fungal infections. The non-communicable diseases considered are cancer, cardiovascular related disorders and diabetes mellitus. Plants were then secondarily grouped based on their families. The chemical profiles of the plants were then compared to established drug compounds currently approved for the conventional treatment of illnesses, and also established phytochemicals.

RESULTS

The extensive literature review identified phytochemical compounds in particular plants used in Barbadian folklore medicine and in some cases, in other territories in the Caribbean. Sixty-six per cent of reputed medicinal plants contain pharmacologically active phytochemicals; fifty-one per cent of these medicinal plants contain phytochemicals with activities consistent with their reported use. The literature review also indicated that some related plants had similar uses in Barbadian folklore medicine. The tables show the data collected from the investigation conducted on these plants.

Table 1: Review of medicinal plants of Barbados used in the treatment of non-communicable diseases – their plant families, scientific names, common names, bioactive chemical profiles and validation of their potential use in therapy

Non-Communicable Diseases

Disease	*Family*	*Plant*		*Bioactive Chemical Profile*	*Validation of Potential Use*
		Scientific Name	***Barbadian Common Name***		
Cancer	Anacardiaceae	*Spondias mombin* L	Hog/Gully Plum (1)	*3β-olean-12-en-3-yl(9Z)-hexadec-9-enoate used as an inhibitor of αamylase (17). Tannins, saponins, flavonoids, alkaloids, phenols (42)*	*Saponins as cytotoxic agents: a review (80)*
	Apocynaceae	*Catharanthus roseus (L) Don (30)*	Madagascar Periwinkle (41)	*Monpterpene indole alkaloids,eg catharanthine, vindoline, vincristine, vinblastine (41)*	*Vincristine and vinblastine (3)*
Cardio-diseases (Heart-related diseases)	Apocynaceae	*Calotropis procera* (Aiton) Aiton f	French Cotton (1)	*Cardiac glycosides (calotropin),calactin and calotoxin (30)*	*Digoxin (cardiac glycoside) (3)*
	Portulacaceae	*Portulaca oleracea* L (30)	Pussley (1)	*Oxalic acid, ascorbic acid, noradrenaline and betacyanins (30)*	*Adrenaline [simialar action to noradrenaline – sympathomemetic amine] (3)*
Diabetes	Asteraceae	*Bidens pilosa* L (81)	Duppy Needles, Monkey Needles, Spanish Needles (1)	*Flavonoids, polyacetylenes, tannins (41)*	*Hypoglycaemic effect of flavonoids (75), Antidiabetic effect of gallotannin, penta-O-galloyl-glucopyranose (76)*
	Bignoniacae	*Tecoma stans* (L) Juss ex Kunth	Christmas Hope, Elder Bush (1)		
	Cecropiaceae	*Cecropia schreberiana* Miq (82)	Trumpet Tree, Pop-a-Gun (1)	*Carbohydrates, terpenoids and steroids (30)*	*Novel terpenoid-type quinones isolated from Pycnanthus angolensis of potential utility in the treatment of Type 2 diabetes (74)*
	Cucurbitaceae	*Momordica charantia* L (30)	Cerasee, Miraculous Vine, Crapaud, Pumpkin, Lizard Food (1)	*Tetracyclic triterpeniod glycosides, caroteniods, insulin like peptide (30)*	*Novel terpenoid-type quinones isolated from Pycnanthus angolensis of potential utility in the treatment of Type 2 diabetes (74)*
	Euphorbiacae	*Phyllanthus niruri* L (82)	Seed-under-Leaf (1)	*Antihepatotoxic compounds*	
Hypertension (non-specific)	Euphorbiacae	*Phyllanthus niruri L*	Seed-under-Leaf (1)	*Antihepatotoxic compounds*	
	Fabaceae	*Desmodium incanum* DC	Sweetheart (1)		*Flavonoids extracted from D Styracifolium decreased blood pressure in laboratory animals (82)*
	Rubiaceae	*Spermacoce assurgens* Ruiz and Pavon	Buttonweed (1)		
	Solanaceae	*Physalis angulata* L	Cow Pops, Poppers (1)		
Hypertension (Diuretic)	Verbenaceae	*Aegiphila martinicencis* Jacq	Spirit Weed (1)	*Flavonoids, saponins, triterpenes and essential oils (30)*	*Effects of the flavonoids extracted from Spergularia purpurea Pers on arterial blood pressure and renal function in normal and hypertensive rats (33), effect of triterpene saponins from roots of Ampelozizyphus amazonicus Ducke on diuresis in rats (10)*

Table 1 cont'd: Review of medicinal plants of Barbados used in the treatment of non-communicable diseases – their plant families, scientific names, common names, bioactive chemical profiles and validation of their potential use in therapy

Non-Communicable Diseases					
Disease	***Family***	***Plant***		***Bioactive Chemical Profile***	***Validation of Potential Use***
		Scientific Name	***Barbadian Common Name***		
	Urticaceae	*Laportea aestuans* (L) Chew	Nettle (1)	*Irritant polypeptide and calcium oxalate (30)*	
Hypertension (non-specific)	Acanthaceae	*Justicia pectoralis* Jacq	Garden Balsan (1)	*Betaine, coumarin (umbelliferone) justicidin B (30)*	*Beneficial effect of laserpitin, a coumarin compound from Angelica keiskei, on lipid metabolism in stroke-prone spontaneously hypertensive rats (11)*
		Justicia secunda M Vahl	Blood Root (1)		
	Apocynaceae	*Catharanthus roseus* (L) Don (30)	Madagascar Periwinkle (41)	*Monoterpene indole alkaloids,eg catharanthine, vindoline, vincristine, vinblastine and serpentine (41)*	*Reserpine is an indole alkaloid and alsoan FDA approved antihypertensive agent (3). Serpentine is hypotensive (30)*
Hypertension (non-specific)	Asteraceae	Bidens pilosa L	Duppy Needles, Monkey Needles, Spanish Needles (1)	*Flavonoids, polyacetylenes tannins (41)*	*Effects of the flavonoids extracted from Spergularia purpurea Pers on arterial blood pressure and renal function in normal and hypertensive rats (33). Antihypertensive effects of tannins isolated from traditional Chinese herbs as non-specific inhibitors of angiontensin converting enzyme (9)*
		Ambrosia hispida Pursh	Wild Geranium, Seaside Geranium (1)	*Terpenoid, steriods (30)*	*Antihypertensive, antiatherosclerotic and antioxidant activity of triterpenoids isolated from Olea europaea, subspecies africana leaves (12)*
	Cecropiaceae	*Cecropia schreberiana* Miq	Trumpet Tree (1)		
	Combretaceae	*Terminalia catappa* L	Barbados Almond, Seaside Almond (1)	*Tannins, punicalagin (20)*	*Antihypertensive effects of tannins isolated from traditional Chinese herbs as non-specific inhibitors of angiontensin converting enzyme (9)*
	Cucurbitaceae	*Momordica charantia* L (30)	Cerasee, Miraculous Vine, Crapaud, Pumpkin, Lizard Food (1)	*Tetracyclic triterpeniod glycosides, caroteniods, insulin like peptide (30)*	*Antihypertensive, antiatherosclerotic and antioxidant activity of triterpenoids isolated from Olea europaea, subspecies africana leaves (12)*
	Euphorbiacae	*Phyllanthus amarus* Schum	Seed-under-Leaf (1)	*Antihepatotoxic compounds, Amariinic acid and related ellagitannins compounds (22)*	
	Malvaceae	*Thespesia populnea* (L) Sol Ex Correa	Mahoe, Anodyne (1)	*Antihepatotoxic compounds, thespesenone and dehydrooxoperezinone-6-methyl ether (24)*	
		Sida acuta Burman f	Broomweed (1)		
	Myoporaceae	*Bontia daphnoides* L	Wild Olive (1)		
	Passifloraceae	*Passiflora laurifolia* L	Water Lemon (1)		
	Piperaceae	*Peperomia pellucida* (L) Kunth (81)	Shine Bush (1)	*Apriole, beta-caryophyllene (30)*	
	Plantaginaceae	*Plantago major* L	English Plantain (1)	*Iridiod glycosides (aucubin, catapal and asperuloside),muliage, tannins, phenolic acids (chlorogenic and caffeic acid), sapponins and flavonoids (41)*	*Effects of the flavonoids extracted from Spergularia purpurea Pers on arterial blood pressure and renal function in normal and hypertensive rats (33), Antihypertensive effects of tannins isolated from traditional Chinese herbs as non-specific inhibitors of angiontensin converting enzyme (9) Olea europaea: A phyto-pharmacological review (13)*
	Scrophulariaceae	*Scoparia dulcis* L (81)		*8-hydroxytricetin 7-glucuronide, a β-glucuronidase inhibitor (26), 6-methoxybenzoxazolinone (81)*	*6-methoxybenzoxalinone, a hypotensive principle was isolated from the roots (81)*
	Verbenaceae	*Lantana involucrata* L	Rock Sage (1)		

Table 2: Review of medicinal plants of Barbados used in the treatment of communicable and other infectious diseases – their plant families, scientific names, common names, bioactive chemical profiles and validation of their potential use in therapy

Communicable and Other Infectious Diseases					
Disease	***Family***	***Plant***		***Bioactive Chemical Profile***	***Validation of Potential Use***
		Scientific Name	***Barbadian Common Name***		
Antibacterial (used to clean wounds)	Amaranthacae	*Amaranthus dubius* C Matius	Spinach (1)	*Tannins, betacyanins, saponins and flavonoids (41)*	*Evaluation of antibacterial properties of tannins isolated from Dichrostachys cinerea (14). Evaluation of the antimicrobial activity of saponins extract of Sorghum Bi color L Moench (15). Antibacterial activity studies of flavonoids from Salvia palaestina (16)*
		Hymenocallis caribaea (L emend Gawl) Herbert	Spider Lily, Wild Garlic (1)	*Narciclasine (27)*	*Prancristatin – has a similar structure to narciclasine isolated from plants in same family. It is an antineoplastic agent (28)*
		Hippeastrum puniceum (Lam) Ktze	Easter Lily, Barbados Lily, Amaryllis (1)	*3-O-Acetyl-narcissidine (29)*	
(also conjunctivitis*)*	Asteraceae	*Bidens pilosa* L (81)	Duppy Needles, Monkey Needles, Spanish Needles (1)	*Flavonoids, polyacetylenes tannins (41)*	*Evaluation of antibacterial properties of tannins isolated from Dichrostachys cinerea (14), Antibacterial activity studies of flavonoids from Salvia palaestina (16)*
		Sphagneticola trilobata (LC Rich) Purski	Carpet Daisy, Lad Love, Wedelia (1)		
		Ageratum conyzoides L (30)	Wild Ageratum (1)	*Essential oils (30)*	*Antibacterial activity of essential oils and their major constituents against respiratory tract pathogens by gaseous contact (43)*
	Boraginaceae	*Heliotropium indicum* L (81)	Wild Clary (1)	*Heliotrine and other hepatotoxic alkaloids (30)*	*Antimicrobial activity of pyrrolizidine alkaloids from Heliotropium subulatum (78)*
		Heliotropium angiospermum Murray	Wild Clary (1)		
		Tournefortia volubilis L	Chiger Nut, Soldier Bush (1)		
	Euphorbiacae	*Jatropha curcas* L (30)	Physic Nut, Monkey Fat Pork (1)	*Phorbol esters, curcin (lectin) (41, 44)*	*Phorbol esters: Structure, biological activity, and toxicity in animals (44). Antimicrobial activity and phytochemical screening of stem bark extracts from Jatropha curcas (52)*
		Chamaesyce hirta (L) Millisp	Milk Weed (1)	*Shikimic acid, choline (30)*	*(6S)-6-fluoroshikimic acid, an antibacterial agent acting on the aromatic biosynthetic pathway (45)*
		Ricinus communis L	Castor Oil (1)	*Ricinine (alkaloid), ricin [poisonous glycoprotein] (30)*	*Mechanism of action of the toxic lectins abrin and ricin (46)*
	Lamiaceae	*Hyptis verticillata* Jacq			
		Hyptis capitata Jacq			
		Hyptis pectinata (L) Poit		*5S-[(4S-acetyloxy)-(1S-hydroxy)-2Z-octenyl]-2(5H)-furanone (48)*	
	Rubiaceae	*Morinda citrifolia* L	Noni, Dog Dumpling, Monkey Dumpling, Forbidden Fruit and Wild Pine (1)	*Closely related (Morinda citrifolia); morindin and other anthraquinones; vitamin C (41)*	*Astaxanthin-rich algal meal and vitamin C inhibit Helicobacter pylori infection in BALB/cA mice (49)*
		Chiococca alba (L) Hitchc	Snowberry, Tim-Tom Bush (1)	*ent-kaurene-type diterpenioids (41)*	*Anti-staphylococcal activity of ent-kaurene-type diterpenoids from Croton tonkinensis (50)*
		Psychotria tenuifolia Sw	Wild Coffee (1)	*Anthraquinones (30)*	*Emodin, an antibacterial anthraquinone from the roots of Cassia occidentalis (51)*

Table 2 Cont'd: Review of medicinal plants of Barbados used in the treatment of communicable and other infectious diseases – their plant families, scientific names, common names, bioactive chemical profiles and validation of their potential use in therapy

Communicable and Other Infectious Diseases					
Disease	***Family***	***Plant***		***Bioactive Chemical Profile***	***Validation of Potential Use***
		Scientific Name	***Barbadian Common Name***		
	Scrophulariaceae	*Capraria biflora* L	West Indian Tea (1)	*Biflorin (31)*	*A double-blind, controlled trial of bioflorin (Streptococcus faecium SF68) in adults with acute diarrhoea due to Vibrio cholerae and enterotoxigenic Escherichia coli (53)*
		Scoparia dulcis L		*8-Hydroxytricetin 7-glucuronide, a β-glucuronidase inhibitor (26)*	
Antiviral	Amaranthacae	*Achyranthes aspera* L var aspera	Hug-Me-Close (1)	*Triterpene saponins, ecdysterone and other phytoecdysteroids (41)*	*The effect of triterpenoid compounds on uninfected and herpes simplex virus-infected cells in culture. II. DNA and protein synthesis, polypeptide processing and transport (58). Ecdysterone – dietary supplment (Metabolic effects of 20-OH-ecdysone in ovariectomized rats (55)*
(Chicken pox)	Verbenaceae	*Stachytarpheta jamaicensis* (L) Vahl	Vervain (1)	*Gamma-aminobutyric acid and dopamine (30)*	
		Priva lappulacea (L) Pers	Velvet Burr (1)		
		Lantana involucrata L [Lantana camara used to treat colds (30)]	Rock Sage (1)	*Lantana camara's (relative) leaves contain the triterpenoid oleanolic acid derivatives called lantadene A and B (30)*	
(Used for influenza and	Amaranthacae	*Blutaparon vermiculare* (L) Mears			
	Asteraceae	*Parthenium hysterophorus* L	Whitehead Bush (1)	*Parthenolide [against TMV] (32)*	*Phase I dose escalation trial of feverfew with standardized doses of parthenolide in patients with cancer (8)*
		Ambrosia hispida Pursh	Wild Geranium, Seaside Geranium (1)	*Terpenoid, steriods (30)*	*Specific plant terpenoids and lignoids possess potent antiviral activities against severe acute respiratory syndrome coronavirus (66)*
		Eupatorium odoratum (30)		*Might be related to Eupatorium perfoliatum: terpene lactones, germacanolides (euperfolin), guianolide (eufoliatin), diterpenes(dendroidinic acid), triterpenes, phytosterols (sitosterol, stigmasterol), polysaccharides, flavonoids, tannins and essential oils (41)*	*The effect of triterpenoid compounds on uninfected and herpes simplex virus-infected cells in culture. II. DNA and protein synthesis, polypeptide processing and transport (58). Antileishmanial activity of a guainolide from Tanacetum parthenium [L] (56)*
		Ageratum conyzoides L (30)	Wild Ageratum (1)	*Volatile oil with precocens and other chromenes, monoterpenes and flavonoids (41)*	*Antivascular and antitumour evaluation of 2-amino-4-(3-bromo-4,5-dimethoxy-phenyl)-3-cyano-4H-chromenes, a novel series of anticancer agents (57). Flavonoids, centaurein and centaureidin, from Bidens pilosa, stimulate IFN-gamma expression (79)*
		Pluchea carolinensis (Jacq) G Don (30)	Cure-for-All (1)	*Alkaloids and triterpenoids (30)*	*The effect of triterpenoid compounds on uninfected and herpes simplex virus-infected cells in culture. II. DNA and protein synthesis, polypeptide processing and transport (58)*
		Eclipta prostrate (L) L	Conga Lala (1)	*Phenolic compounds [desmethylwedelelactone] (30)*	*Phenolic compounds and their role in disease resistance (59)*
		Bidens alba (L) var *radiata* DC (Sch Bip) Ballard	Duppy Needles, Monkey Needles, Spanish Needles (1)	*Flavonoids, polyacetylenes, tannins (41)*	*Flavonoids, centaurein and centaureidin, from Bidens pilosa, stimulate IFN-gamma expression (79)*
		Syndrella nodiflora (L) Gaertn	Porter Bush (1)		

Table 2 Cont'd: Review of medicinal plants of Barbados used in the treatment of communicable and other infectious diseases – their plant families, scientific names, common names, bioactive chemical profiles and validation of their potential use in therapy

Communicable and Other Infectious Diseases					
Disease	***Family***	***Plant***		***Bioactive Chemical Profile***	***Validation of Potential Use***
		Scientific Name	***Barbadian Common Name***		
		Borrichia arborescens (L) DC			
Antiviral	Caesalpiniaceae	*Senna occidentalis* (L) Link	Stinking Bush (1)	*(found in cassia occidentalis, same plant but different scientific name) achrosin, aloe-emodin, emodin, anthraquinones, anthrones, apigenin, aurantiobtusin, campesterol, cassiollin, chryso-obtusin, chrysophanic acid chrysarobin, chrysophanol, chrysoeriol (antimalarial, anti-mutagentic, antibacterial and hepatoprotective therefore most likely having antiviral activity) (34)*	*In vitro antiviral activity of the anthraquinone chrysophanic acid against poliovirus (62). Anthraquinones as a new class of antiviral agents against human immunodeficiency virus (63)*
(Used for influenza and colds)		*Guilandina bonduc* L	Horsenicker (1)	*Roots and stem show activity compounds isolated: cassane furanoditerpene, caesalpinin, caesaldekarins F and G, caesaldekarin C, Bonducellpins A, B, C and D, Diosgenin (64, 35)*	*New antiviral cassane furanoditerpenes from Caesalpinia minax (64)*
		Hymenaea courbaril L	Locust Tree, Stinking Toe Tree (1)		
	Euphorbiacae	*Croton flavens* L [*Croton lecheri* used for colds (81)]	Yellow Balsam, Seaside Sage (1)	*proanthocyanidin from Croton lechleri, a member of this same family (36)*	*SP-303 (Provir) broad spectrum against both DNA and RNA viruses especially paramyxoviruses eg RSV*
		Phyllanthus epiphyllanthus L	Monkey Spoon, Herringbone (1)	*[Phyllantus amarus; a relative which has antivial properties (hepatitis B) has alkaloids, gallotannins and triterpenes] (41)*	*Michellamine B, a novel plant alkaloid, inhibits human immunodeficiency virus-induced cell killing by at least two distinct mechanisms (65)*
		Phyllanthus amarus Schum (30)	Seed-under-Leaf (1)	*Antihepatotoxic compounds, amariinic acid and related ellagitannins compounds (22)*	*Phyllanthus amarus suppresses hepatitis B virus by interrupting interactions between HBV enhancer I and cellular transcription factors (23)*
	Lamiaceae	*Leonotis nepetifolia* (L) Ait F (30)	Lion Head, Man Piabba, Ball Bush, Hot Bush (1)	*Terpeniods, essential oils (30)*	*Specific plant terpenoids and lignoids possess potent antiviral activities against severe acute respiratory syndrome coron avirus (66)*
		Ocimum campechianum Miller [Ocimum santum, a relative, is used to treat chest colds (81)]	Duppy Basil, Mosquito Bush (1)	*Ocimum basilicum, a relative which is used as a tonic, carminative, duiretic and antihelmintic, has essential oils with ocimene, estragole, linalool; tannins and flavonoids. Ocimum tenuiflorum is used as a tonic, general medicine and for wound healing (41)*	*Chemical compositions, antiviral and antioxidant activities of seven essential oils (67) [Ocimum basilicum is one of the plants analysed in this article]*
	Malvaceae	*Urena lobata* L (30) *Thespesia populnea* (L) Sol Ex Correa	Anodyne, Mahoe (1)		
		Sida rhombifolia L *Malachra alceifolia* Jacq	Wild Okra (1)	*Mucilage (41)*	
	Rubiaceae	*Psychotria nervosa Sw (1)*	St John's Bush (1)	*(Psychotria ipecacuanha, a relative which is used as expectorant (low dose), emetic (high dose) has isoquinolines and alkaloids [emetine and cephaeline] (41)*	*Antiviral activity of emetine dihydrochloride against dengue virus infection (68)*
		Spermacoce verticillata L	Buttonweed (1)		
	Scrophulariaceae	*Capraria biflora* L	West Indian Tea (1)		
		Scoparia dulcis L		*scopadulcic acid B [diterpenoid] (37)*	*In vitro and in vivo antiviral activity of scopadulcic acid B from Scoparia dulcis, Scrophulariaceae, against herpes simplex virus type 1 (37)*

Table 2 Cont'd: Review of medicinal plants of Barbados used in the treatment of communicable and other infectious diseases – their plant families, scientific names, common names, bioactive chemical profiles and validation of their potential use in therapy

Communicable and Other Infectious Diseases					
Disease	***Family***	***Plant***		***Bioactive Chemical Profile***	***Validation of Potential Use***
		Scientific Name	***Barbadian Common Name***		
	Verbenaceae	*Stachytarpheta jamaicensis* (L) Vahl	Vervain (1)	*Gamma-aminobutyric acid and dopamine (30)*	
		Lantana camara L (81)	Sage (1)	*Lantadenes compounds (69)*	
Antifungal	Apocynaceae	*Asclepias curassavica* L (81)	Indian Root, Red Head (1)	*Carlenolides and esterified triterpenes (30)*	
		Calotropis procera (Aiton) iton f	French Cotton (1)	*Bitter cardiac gylcosides (calotropin, calactin and calotoxin) and several other hydrocarbon compounds (30)*	*Haemolytic and antifungal activities of saponins or anti-atpase and antiviral activities of cardiac glycosides (70)*
	Caesalpiniaceae	*Hymenaea courbaril* L	Locust Tree, Stinking Toe Tree (1)	*Caryophyllene epoxide (39)*	*An antifungal terpenoid defends a neotropical tree (Hymenaea) against attack by fungus-growing ants (39)*
		Senna alata (L) Roxb	Christmas Candle (1)	*Alkaloids, lectins, sapronins, cyanogenic, glycosides, isoflavones and phytoestrogens (73)*	*In vitro and antifungal properties of Cassia alata (18, 73). Current and potential use of alkaloids in health (5)*
	Euphorbiacae	*Jatropha curcas* L	Physic Nut, Monkey Fat Pork (1)	*Phorbol esters, curcin (lectin) (41, 72)*	*Antifungal activities of ethanolic extract from Jatropha curcas seed cake (71)*
		Chamaesyce hirta (L) Millisp	Milk Weed (1)	*Shikimic acid, choline (30)*	

DISCUSSION

Many of the medicinal plants found in Barbados are not indigenous to Barbados and can be found in other tropical climate regions. Many of the articles used in this review were written by researchers from universities and research institutions in the Caribbean, Venezuela, Nigeria and India. It was also observed that the chemical profiles of some of these plants were investigated with various solvent extracts. However, the phytochemicals reported in this study were not linked to a particular solvent extract but are mainly chemical constituents with possible therapeutic effects on the illnesses being investigated.

In some cases, the chemical investigation of the plants was not able to identify specific bioactive compounds but the phytochemical group which was associated with the medicinal effects, whether it be tannins, alkaloids, flavonoids and cardiac glycosides, were identified. Many of these phytochemical groups are known individually to have specific health benefits, for example, the flavonoids which have antioxidant and antibacterial properties, and are also enzyme inhibitors (7).

The literature review also indicated that considerable amounts of research reported preliminary investigations with the crude extracts of the plants and not the specific bioactive ingredient. Therefore, no phytochemical profile for these plants was reported as the data only mentioned which solvent was used to extract the plant material. Additional chemical and pharmacological investigation would have to be done on these plants to identify the bioactive chemical profile which may be related to the indications for the specific illnesses. Some articles reported the chemical profile of some of the plants but did not associate any of the chemical constituents with the folklore uses.

Extensive ethnopharmacological research has been done to validate folklore medicinal plants used for communicable diseases, more specifically bacterial infections. Many of the plants were tested particularly against the *Staphylococcus aureas* and *Escherichia coli* strains, which are two of the most common bacterial pathogens causing clinical diseases. However, for non-communicable disease states, the most extensive ethnopharmacological research was carried out in oncology studies and chronic diseases such as hypertension and diabetes. Specific bioactive compounds were identified from plants which were used to treat cancer, hypertension and diabetes.

There was a small amount of data which showed similarity of bioactive compounds in the chemical profiles of the plants to approved drug compounds used in conventional pharmacotherapy of the indicated illnesses. This may be due to the vast number of drug candidates which are still undergoing research but not yet approved by the regulatory bodies. Data indicated that the compounds of some plants were approved for similar indications to their local folklore uses such as the vinca alkaloids, vincristine and vinblastine, from the plant *Cathranthus roseus* in the family Apocynaceae. These two compounds are approved anticancer agents. To the contrary, some of the approved compounds with similar chemical structure to compounds found in the chemical profile of plants were used to treat other illnesses not indicated by the local folklore claim. For example, the plant compound, parthenolide, isolated from the plant *Parthenium hysterophorus*, was found in this review

to be an effective antiviral compound specifically against the tobacco mosaic virus. However, this compound is being used in a phase I dose escalation clinical trial of feverfew (a plant extract with parthenolide but isolated from the plant *Tanacetum parthenium*) in patients with cancer (8). This would indicate that these plant compounds have multiple uses for treatment of different disease states, both communicable and non-communicable conditions. Nevertheless, some antineoplastic agents were used to validate antimicrobial chemotherapeutic effects. The rationale was that the mechanism of action of these compounds may be related to the compound's property as an anti-metabolite or its direct effect on nucleic acid synthesis and processing.

In cases where no current approved drug compound was found, a study was identified in which a similar phytochemical was being clinically or pre-clinically tested. Likewise, the literature review also showed that some plants were tested for conditions other than those indicated in folklore. This occurrence points to the effectiveness of screening in the drug discovery pipeline. It could also be linked to the variety of folklore uses of the same plant in different territories. These other uses were not reported, as the purpose of this study was to validate the folklore use of medicinal plants in Barbados.

A common practice in folklore herbal therapy is polypharmacy. Polypharmacy is the use of more than one drug, or substances for therapy. This practice is normally monitored extensively in the clinical setting because of the possibilities of drug-drug interactions. It becomes more critical when polypharmacy is practiced with conventional drugs and herbal remedies and/or when it is a combination of herbal preparations. The perception of the use of medicinal plants in folklore suggests that plant based therapies are safe and do not result in adverse effects. Chemical investigation of these plant-based therapies have suggested otherwise. There are a lot of uncharacterized compounds in these plants which present many opportunities for drug-herb or herb-herb interactions. These drug-herb or herb-herb interactions can precipitate toxic effects or in some instances, render the therapeutic effect of a conventional drug or the more promising herbal preparation.

Medicinal plants indicated for the same illnesses may have different bioactive compounds working on their respective drug targets. However, if multiple plants in the same family are indicated for a particular disease, it is likely that the bioactive profiles and active constituent may be the same but may vary in content. It is extremely difficult to administer treatment without standardizing the bioactive component of these plants due to the heightened possibility of synergism that could elicit toxic effects in such an instance. Therefore, caution must be taken when soliciting information on herbal remedies from users of traditional healing methods. In some instances, one plant can have multiple common names, such as *Bidens pilosa*, which is known by the names Duppy Needles, Monkey Needles and Spanish Needles in Barbados. In this instance, a confounder can be introduced by identifying the medicinal effect of the plant with a unique common name of the plant.

Based on the findings of this review, it can be concluded that folklore medicine is well grounded in its unusual scientific approach. Sixty-six per cent of reputed medicinal plants contain pharmacologically active phytochemicals; fifty-one per cent of these medicinal plants contain phytochemicals with activities consistent with their reported use. The research has helped to show that the plants used in folklore medicine have chemical compounds which have been identified to be responsible for their associated medicinal properties. To a lesser extent, approved drug compounds with similar chemical structure to some of these bioactive compounds from the plants were found. This was attributed to the possible long turnaround of the drug discovery pipeline. However, there is still need for more investigations in the use of these plants as alternative medicines or in conjunction with conventional therapy. This focus of the suggested investigations should be on standardization of bioactive compounds, therapeutic dosing of these plant compounds, toxicity and drug-herb interactions.

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