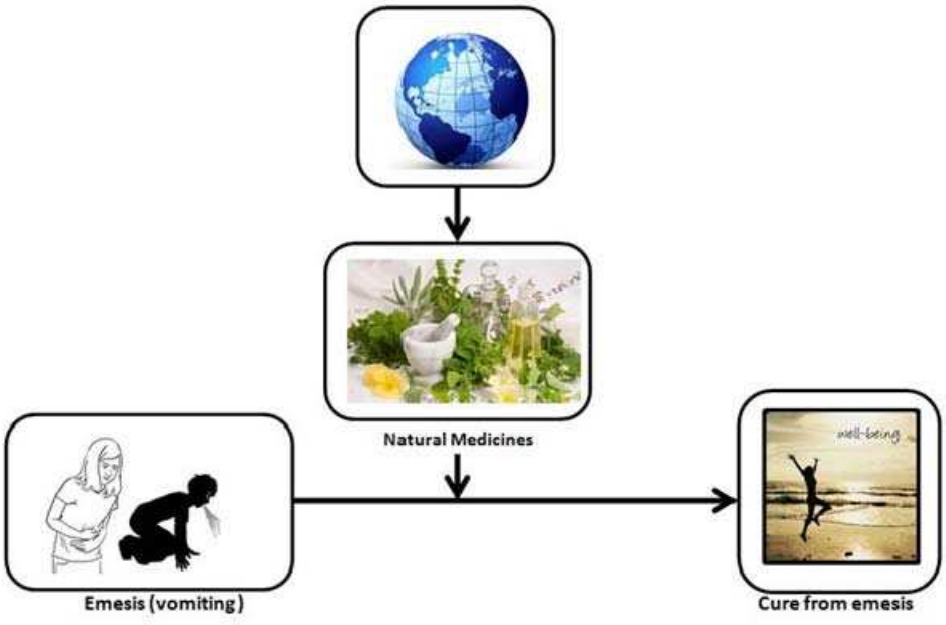
Natural antiemetics: An overview

Salman Ahmed, Muhammad Mohtasheemul Hasan* and Syed Waseemuddin Ahmed
Department of Pharmacognosy, Faculty of Pharmacy, University of Karachi, Karachi, Sindh, Pakistan

Abstract: Emesis encompasses the forceful expulsion of the contents of stomach via the mouth or sometimes the nose. The adverse effects of currently available anti-emetic agents potentiate the natural product researchers to explore the natural anti-emetics with fewer side effects. The presented communication constitutes a review on anti-emetic effect of two hundred and forty five plants belonging to seventy-eight families found in different parts of the world. It also outlined the anti-emetic effect of plant extracts and isolated secondary metabolites studied through a variety of animal models of emesis. The reported anti-emetic plants in different countries and cultures and the scientific studies on extracts may help in the identification of promising single chemical compound(s) that may be used as a potential leads for developing safe anti-emetic agents in future. Moreover the reported secondary metabolites having the same effect may open the door for the search of same secondary metabolites from other natural sources. This review will provide useful information for the discovery of natural anti-emetic compounds and fill the gaps in knowledge.

Keywords: Emesis, anti-emetics, natural products, drug development.



Graphical abstract

INTRODUCTION

Emesis is an unpleasant activity that results in the expulsion of stomach contents through the mouth and clearly associated with gastrointestinal motor activity. It is a response of biological systems for drug side effects, disease co-morbidities and defence against food poisoning. The current anti-emetic drugs to control nausea and vomiting can be classified as anti-dopaminergic drugs, serotonin antagonists, antihistamines, anti-cholinergic drugs, corticosteroids, NK_1-receptor inhibitors, cannabinoids, $5\text{-}HT_{1A}$, $GABA_B$ and CB_1-receptors agonists. The side effects of these anti-emetic drugs are given much attention to the application of traditional medicines. There is a need to concentrate on all folk natural products useful in emesis for their pharmacological evaluation, isolating single drug entity responsible for anti-emetic effect and developing suitable formulation used against emesis.

*Corresponding author: e-mail: mohassan@uok.edu.pk

Table 1: Anti-emetic plants used in different parts of the world

Plant	Family	Part(s) used	Country
Abrus precatorius Linn.	Fabaceae	Seeds	China (Ahmed *et al*., 2013)
Abutilon indicum (L.) Sweet.	Malvaceae	Bark (juice)	India (Ahmed *et al*., 2013)
Acacia farnesiana (L.) Willd.	Mimosoideae		Bangladesh (Hossan *et al*., 2009)
Acalypha fimbriata Schumach. & Thonn.	Euphorbiaceae	Leaves and stem	Africa (Ajibesin *et al*., 2008)
Acalypha indica Linn.		Leaves	India (Rameshkumar*et al*., 2013)
Acalypha wilkesiana cv. godseffiana Muell Arg.		Leaves and stem	Africa (Akinyemi *et al*., 2005)
Achyranthes aspera Linn.	Amaranthaceae	Whole plant	Pakistan (Ahmad, 2007)
		Seeds (tea)	Pakistan (Qureshi *et al*., 2010)
Achillea millefolium Linn.	Asteraceae	Whole plant	India (Ahmed *et al*., 2013)
Aconitum heterophyllumWall. ex Royle.	Ranunculaceae	Tubers	Pakistan (Hazrat *et al*., 2011)
		Roots	Pakistan (Gorsi and Miraj, 2002)
Aconitum palmatum D. Don.		Roots	India (Ahmed *et al*., 2013)
Acorus calamus L.	Acoraceae	Whole plant	China (Motley, 1994)
Acorus gramineus Sol. ex Aiton		Rhizome	China (Ling *et al*., 2012)
Adenanthera pavonina Linn.	Mimosoideae	Leaves	Africa (Holdsworth, 1977)
Adhatoda zeylanica Medic.	Acanthaceae	Whole plant	India (Ahmed *et al*., 2013)
Aegle marmelos (L.) Correaex Roxb.	Rutaceae	Roots	Nepal (Singh *et al*., 2012)
			India (Rasiya and Nayar, 2011)
Afzelia africana Sm. ex Pers.	Fabaceae	Aerial parts	Africa (Ahmed *et al*., 2013)
Ageratum conyzoides Linn.	Asteraceae	Leaves (juice)	New Guinea (Ahmed *et al*., 2013)
			India (Behera *et al*., 2006)
Ajuga bracteosa Wall.	Labiatae	Whole plant (powder cooked with cow's ghee)	Pakistan (Ahmed *et al*., 2013)
Alhagi maurorum Medik.	Fabaceae	Whole plant	India (Ahmed *et al*., 2013)
Alhagi pseudalhagi(Bieb.) Desv.			
Allium sativum L.	Amaryllidaceae	Seeds	Palestine (Jaradat, 2005)
Alisma orientale (Sam.) Juz.	Alismataceae	Rhizomes	China (Ahmed *et al*., 2013)
Allium humile Kunth.	Liliaceae	Leaves (chewing)	Pakistan (Sher and Hussain, 2009)
Alpinia katsumadai Hayata.	Zingiberaceae	Seeds	China (Ahmed *et al*., 2013)
Alpinia officinarum Hance.		Rhizome	
Alternanthera sessilis (L.) R. Br. Ex DC.	Amaranthaceae	Whole plant	Pakistan (Arshad *et al*., 2011)
Amomum cardamomum Linn.	Zingiberaceae	Seeds	China (Ahmed *et al*., 2013)
Amomum globosum Lour. Fl. Cochinch.			
Amomum kravanh Pire ex Gagnep.		Fruits	India (Ahmed *et al*., 2013)
Amomum tsao-koCrevost & Lemarié.		Fruits and seeds	China (Ahmed *et al*., 2013)
Amomum villosum Linn.		Seeds	
Amomum xanthioides Wall. ex Baker.		Fruits and seeds	
Amorphophallus campanulatas (Roxb.) Blume ex Decne.	Araceae	Tuber	India (Ahmed *et al.*, 2013)

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Table 1: Continue

Plant	Family	Part(s) used	Country
Amorphophallus paeoniifolius (Dennst.) Nicols *var. campanulatus* (Decne.) Sivadasana.	Araceae	Corm/tuber	India (Sharma *et al.*, 2000)
Anaphalis triplinervis (Sims.) C.B. Clarke	Asteraceae	Dried flowers and leaves (tea)	Pakistan (Khan *et al.*, 2011)
Anemone rivularis Buch. Ham. ex DC.	Ranunculaceae	Whole plant	China (Jingwei, 1982)
Anethum graveolens Linn.	Apiaceae	Whole plant	Africa (Ahmed *et al.*, 2013)
		Seeds	Arab (Ahmed *et al.*, 2013)
Anethum sowa Roxb. ex Flem.		Leaves	India (Sharma *et al.*, 2000)
Angelica archangelica L.		Roots, fruit, seeds	Palestine (Jaradat, 2005)
Annona reticulata Linn.	Annonaceae	Leaves	India (Jain and Srivastava, 2005)
Annona Squamosa Linn.		Ripe fruit	India (Ahmed *et al.*, 2013)
Aphelandra arnoldii Mildbr.	Acanthaceae	Whole plant (decoction)	Panama (Joly *et al.*, 1990)
*Apium graveolens*Linn.	Apiaceae		India (Ahmed *et al.*, 2013)
Aquilaria agallocha Roxb.	Thymelaeaceae	Stem wood	China (Ahmed *et al.*, 2013)
Aquilaria sinensis (Lour.) Gilg.		Bark	
Arisaema intermedium Bl.	Aracaceae	Stem (extract)	India (Semwal *et al.*, 2010)
Artemisia scoparia Waldst. & Kit.	Asteraceae	Whole plant (decoction)	Pakistan (Tareen *et al.*, 2010)
Arundo donax Linn.	Poaceae	Roots	China (Ahmed *et al.*, 2013)
Arundo phragmites Linn.		Stem	India (Ahmed *et al.*, 2013)
Atractylodesjaponica Koidz.	Asteraceae	Rhizomes	China (Ahmed *et al.*, 2013)
Atractylodes lancea DC.		Roots	
Averrhoa carambola Linn.	Oxalidaceae	Fruits	India (Ahmed *et al.*, 2013)
			Bangladesh (Rahmatullah *et al.*, 2009a)
Azadirachta indica (L) A. Juss	Meliaceae	Bark	Pakistan (Ahmad, 2007)
		Flowers	India (Natarajan *et al.*, 2010)
Baptisia australis (L.)R.Br.	Fabaceae	Root	America (Moerman, 1998)
*Ballota nigra*Linn.	Lamiaceae	Whole plant	India (Ahmed *et al.*, 2013)
Berberis vulgaris Linn. var. asperma Don.	Berberidaceae		Iran (Ahmed *et al.*, 2013)
Bixa orellana Linn.	Bixaceae	Leaves (infusion)	India (Ahmed *et al.*, 2013)
Blighia sapida Konig.	Sapindaceae	Aerial parts	
Calendula arvensis Linn.	Asteraceae	Flowers and leaves	Pakistan (Ahmed *et al.*, 2013)
Calendula officinalis Linn.		Florets	India (Ahmed *et al.*, 2013)
			Pakistan (Khattak, 2012)
Callicarpa arborea Roxb.	Verbenaceae	Bark	India (Lalfakzuala *et al.*, 2007)
*Cannabis sativa*Linn.	Cannabaceae	Whole plant	India (Ahmed *et al.*, 2013)
Capparis aphylla Roth.	Capparidaceae	Bark	Pakistan (Ahmad, 2007)
*Cassia angustifolia*Vahl.	Fabaceae	Leaves	Pakistan (Ahmed *et al.*, 2013)
Cassia auriculata Linn.	Caesalpiniaceae	Flowers and seeds	India (Nisha and Rajeshkumar, 2010)
Cassia holosericea Fresen.	Fabaceae	Leaves	India (Chopra *et al.*, 1956)
			Pakistan (Ahmed *et al.*, 2013)
Cassia italica Miller. Lam. ex F.W. Ander.			India (Chopra *et al.*, 1956)

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Table 1: Continue

Plant	Family	Part(s) used	Country
		Roots (maceration)	Pakistan (Marwat *et al.,* 2011)
Cassia obtusifolia Linn.		Whole plant	India (Sharma *et al.,* 2012)
Cassia purpurea Roxb.		Leaves	India (Chopra *et al.,* 1956)
			Pakistan (Ahmed *et al.,* 2013)
Cereus jamacaru DC.	Cactaceae	Fruits and roots	Brazil(De Albuquerque *et al.,* 2007)
Cetraria islandica (L.) Ach	Parmeliaceae	Whole moss	India (Ahmed *et al.,* 2013)
Chaenomeles cathayensis (Hemsl.) Schneid.	Rosaceae	Fruit	China (Yeung, 1985)
Changium smyrnioides Wolff.	Apiaceae	Roots	China (Ahmed *et al.,* 2013)
Chaenomeles speciosa (Sweet.) Nakai.	Rosaceae	Fruits (decoction taken internally)	China (Duke and Ayensu, 1985)
Chichorium intybus Linn.	Asteraceae	Flowers	Pakistan (Hussain *et al.,* 2008)
		Aerial parts	Pakistan (Khattak, 2012)
		Roots (powder with milk)	Pakistan (Sher and Hussain, 2009)
*Cinnamomum cassia*Blume.	Lauraceae	Whole plant	India (Ahmed *et al.,* 2013)
Cinnamomum tamala Linn.		Leaves and Bark	Nepal (Kunwar *et al.,* 2009)
Cinnamomum verum J. Presl.		Fruits	India (Ahmed *et al.,* 2013)
Citrus acida Roxb.	Rutaceae	Fruit peel	Bangladesh (Rahmatullah *et al.,* 2010)
Citrus aurantifolia (L.) Osbeck.		Fruits	India (Ahmed *et al.,* 2013)
			China (Duke and Ayensu, 1985)
			Burkina Faso (Sourabie *et al.,* 2013)
		Bark	India (Singh and Singh, 2009)
Citrus deliciosa Tenore.		Fruit peel	China (Ahmed *et al.,* 2013)
Citrus grandis (L.) Osbeck		Fruit pericarp (smell)	Pakistan (Qureshi *et al.,* 2011)
Citrus limon (L.) Burm. f.		Fruits and leaves	Arab (Ahmed *et al.,* 2013)
		Fruits (extract with salt)	Bangladesh (Rahmatullah et al., 2009a)
			India (Semwal *et al.,* 2010)
Citrus medica Linn.		Fruit (juice with sugar and water)	India (Rasiya and Nayar, 2011)
Citrus nobilis Lour.		Fruit peel	China (Ahmed *et al.,* 2013)
Citrus reticulata Blanco.			
		Fruits	India (Ahmed *et al.,* 2013)
Citrus sinensis (L.) Osbeck		Fruit pericarp (rubbed and snuffed)	Pakistan (Qureshi *et al.,* 2011)
Citrus unshiu (Swingle) Marcow.		Fruit peel	China (Ahmed *et al.,* 2013)
Cleomescaposa DC.	Capparaceae	Leaves	Pakistan (Khan, 2009)
Commiphora leptophloeos (Mart.) J.B. Gillett.	Burseraceae	Leaves, flowers and bark	Brazil (De Albuquerque *et al.,* 2007)
Coriandrum sativum Linn.	Apiaceae	Fruits and leaves (juice)	Pakistan (Khan and Khatoon, 2008)
Cousinia stocksii C. Winkler	Asteraceae	Whole plant (juice)	Pakistan (Tareen *et al.,* 2010)
Croton oblongifolius Roxb.	Euphorbiaceae	Roots (paste with water)	India (Alawa and Ray, 2012)
Croton sonderianus Mull. Arg.		Bark	Brazil(De Albuquerque *et al.,* 2007)

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Table 1: Continue

Plant	Family	Part(s) used	Country
Cuminum cyminum Linn.	Apiaceae	Fruits	India (Sharma *et al.,* 2000)
Curcuma domestica Valeton	Zingiberaceae	Rhizome	India (Jadhav, 2006)
*Curcuma petiolata*Roxb.			India (Ahmed *et al.,* 2013)
Cynodon dactylon (L.) Per.	Poaceae	Whole grass (juice with sugar / infusion with milk)	Iran (Ahmed *et al.,* 2013)
			India (Behera *et al.,* 2006)
		Whole plant	Pakistan (Ahmed *et al.,* 2013)
Cyperus articulates Linn.	Cyperaceae		India (Ahmed *et al.,* 2013)
Cyperus longus Linn.		Roots and bark	Brazil (Nogueira *et al.,* 2012)
Cyperus rotundus Linn.		Leaves	India (Behera *et al.,* 2006, Nisha and Rajeshkumar, 2010, Samydurai *et al.,* 2012)
		Roots (paste with honey)	Pakistan(Ahmad, 2007, Mahmood *et al.,* 2011b, Panhwar and Abro, 2007)
Dalbergia sisso Roxb.	Fabaceae	Bark	Pakistan (Ahmad, 2007)
Delonix regia Rafin.	Leguminosae	Leaves	Africa (Lawal *et al.,* 2010)
Desmodium gangeticum (L.) DC.	Fabaceae	Roots	India (Ahmed *et al.,* 2013)
Diospyros kaki Thunb.	Ebenaceae	Sepals	China (Ahmed *et al.,* 2013)
Dracocephalum moldavica Linn.	Labiatae	Whole plant	Iran (Miraldi *et al.,* 2001)
Elephantopus scaber Linn.	Asteraceae	Roots and leaves (extract)	India (Bhat *et al.,* 2013)
Elephantorrhiza burkei Benth.	Mimosoideae	Tubers (infusion)	Africa (Motlhanka and Nthoiwa, 2013)
Elettaria cardamomum Maton.	Zingiberaceae	Fruits (boiled in water)	Pakistan (Qureshi *et al.,* 2011)
Emblica officinalis Gaertn.	Phyllanthaceae		India (Ahmed *et al.,* 2013)
Eriobotrya japonica Lindl.	Rosaceae	Leaves	China (Ahmed *et al.,* 2013)
		Fruits	India (Ahmed *et al.,* 2013)
Eruca sativa Miller.	Cruciferaceae	Leaves	Pakistan (Ahmad, 2007)
*Erythrina herbacea*Linn.	Fabaceae	Roots and berries (decoction taken internally)	America (Moerman, 1998)
*Eupatorium fortunei*Turcz.	Asteraceae	Leaves and stem	China (Ahmed *et al.,* 2013)
Eugenia caryophyllata Thunb.	Myrtaceae	Seeds	Arab (Ahmed *et al.,* 2013)
Evodia rutaecarpa (Juss.) Benth.	Rutaceae	Fruits	China (Ahmed *et al.,* 2013)
Faidherbia albida (Delile) A.Chev.	Mimosoideae	Whole plant	Africa (Wickens, 1969)
Fagonia bruguieri DC.	Zygophyllaceae		Pakistan (Panhwar and Abro, 2007)
Fagonia cretica Linn.		Leaves	India (Ahmed *et al.,* 2013)
*Ferronia elephantum*Correa.	Rutaceae	Fruits	
Ferula assa-foetida Linn.	Apiaceae	Whole plant	India (Sharma *et al.,* 2000)
*Ficus benghalensis*Linn.	Moraceae	Roots	India (Ahmed *et al.,* 2013)
		Bark	India(Nisha and Rajeshkumar, 2010)
Ficus hispida Linn.		Fruits	India (Ahirwar, 2013)
*Ficus racemosa*Linn.			India (Ahmed *et al.,* 2013)
Ficus religiosa Linn.		Bark, fruit and seeds	Pakistan (Hussain *et al.,* 2010)

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Table 1: Continue

Plant	Family	Part(s) used	Country
Foeniculum vulgare Miller.	Apiaceae	Fruits	China (Ahmed *et al.*, 2013)
Forsythia suspensa (Thunb.) Vahl.	Oleaceae		
Garcinia kola Heckel.	Guttiferae	Seeds	Africa (Ahmed *et al.*, 2013)
*Gentiana kurroo*Royle.	Gentianaceae	Roots	India (Ahmed *et al.*, 2013)
Grewia asiatica Linn.	Tiliaceae	Leaves	America (Morton, 1987)
Grewia lasiodiscus K. Schum.		Roots	Africa (Ahmed *et al.*, 2013)
Glossogyne bidens (Retz.) Alston	Asteraceae	Whole plant	India (Dey and De, 2010)
Glycyrrhiza uralensis Fisch.	Fabaceae	Roots	China (Ahmed *et al.*, 2013)
*Hedychium spicatum*Ham. ex Smith.	Zingiberaceae	Rhizome (powder)	India (Ahmed *et al.*, 2013)
Heliotropium indicum Linn.	Boraginaceae	Flower and leaves	Arab (Ahmed *et al.*, 2013)
*Hemerocallis fulva*Linn.	Hemerocallidaceae	Flowers	China (Duke and Ayensu, 1985)
			India (Ahmed *et al.*, 2013)
Hemidesmus indicus (L.) R. Br.	Asclepiadaceae	Root	India (Samydurai *et al.*, 2012)
Hibiscus rosa sinensis Linn.	Malvaceae	Whole herb	Pakistan (Ahmad, 2007)
Hovenia dulcis Thunb.	Rhamnaceae	Fruits	China (Ahmed *et al.*, 2013)
Inula britannica Linn.	Asteraceae	Flowers	
Inula japonica Thunb.			
Inula linariaefolia Linn.		Fruits	
Inula salsoloides (Turcz.) Ostenfeld.		Flowers	
Ipomoea pes-caprae(L.) Sweet.	Convolvulaceae	Whole plant	India (Ahmed *et al.*, 2013)
*Iris versicolour*Linn.	Iridaceae	Rhizome	
*Jasminum officinale*Linn.	Oleaceae	Whole plant	Pakistan (Ahmed *et al.*, 2013)
Jatropha gossypifolia Linn.	Euphorbiaceae	Roots and leaves	India (Rameshkumar*et al.*, 2013)
Lindera strychnifolia Sieb. *et* Zucc.	Lauraceae	Roots	China (Ahmed *et al.*, 2013)
*Lupinus perennis*Linn.	Fabaceae	Leaves (cold tea)	America (Moerman, 1998)
Mangifera indica Linn.	Anacardiaceae	Leaves and seeds	Pakistan (Hussain *et al.*, 2010)
		Leaves (juice with black pepper and milk)	India (Behera *et al.*, 2006)
Matricaria chamomila Linn.	Asteraceae	Flowers	Austria (Pirker *et al.*, 2012)
Matricaria recutita Linn.			Brazil (Di Stasi *et al.*, 2002)
Melia azadirachta Linn.	Meliaceae	Roots	Pakistan (Ahmad, 2007)
		Bark	India (Sharma *et al.*, 2011)
Mentha longifolia (L.) Huds.	Lamiaceae	Whole plant (powder mix with sugar and eaten)	Pakistan (Ahmed *et al.*, 2013)
		Leaves and stem (decoction)	Pakistan (Sher and Hussain, 2009)
		Leaves (extract)	Pakistan (Hazrat *et al.*, 2011)
		Aerial parts	Iran (Ahmed *et al.*, 2013)
		Leaves (paste with ginger and onion)	India (Semwal *et al.*, 2010)
*Mentha piperata*Linn. emend. Huds.		Aerial parts	Turkey (Tuzlacı and Doğan, 2010)
			Iran (Ahmed *et al.*, 2013)
		Leaves (extract)	India (Ahmed *et al.*, 2013)
		Aerial parts	Egypt (Aboelsoud, 2010)
Mentha royleana Benth.		Leaves (dried with green tea)	Pakistan (Ali and Qaiser, 2009)
*Mentha spicata*Linn. emend. Nath.			India (Ahmed *et al.*, 2013)
			Pakistan (Ahmed *et al.*, 2013)
		Whole plant (powder taken orally with water)	Pakistan (Sher and Hussain, 2009)
			China (Duke and Ayensu, 1985)
		Aerial parts (infusion)	Turkey (Tuzlacı *et al.*, 2010)

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Table 1: Continue

Plant	Family	Part(s) used	Country
*Mentha virdis*Linn. Huds	Punicaceae	Leaves (powder)	Pakistan (Khan *et al.*, 2012)
Mesua ferrea Linn.	Calophyllaceae	Leaves	India (Ahmed *et al.*, 2013)
*Michelia champaca*Linn.	Magnoliaceae	Flowers	India (Ahmed *et al.*, 2013)
Mimosa himalayana Gamble.	Mimosoideae	Roots	Pakistan (Sher *et al.*, 2010)
Mimosa rubicaulis Lamk.	Fabaceae		India (Dey and De, 2010)
Morinda citrifolia Linn.	Rubiaceae	Fruits	Thailand (Ahmed *et al.*, 2013)
Murraya koenigii (L.) Sprengel.	Rutaceae	Leaves	India (Ahmed *et al.*, 2013)
Nardostachys grandiflora DC.	Valerianaceae		
Nelumbiumspeciosum Wild.	Nelumbonaceae	Seeds	
*Nelumbo nucifera*Gaertn.			China (Ahmed *et al.*, 2013)
Nymphaea lotus Linn.	Nymphaeaceae	Whole plant	Africa (Ahmed *et al.*, 2013)
Ocimum basilicum Linn.	Lamiaceae	Flowers	Brazil(De Albuquerque *et al.*, 2007)
Ocimum gratissimum Linn.		Whole plant	India (Ahmed *et al.*, 2013)
Oryza sativa Linn.	Poaceae	Fruit	India (Sharma *et al.*, 2000)
Ouratea angustifolia (Vahl.) Baillon.	Ochnaceae	Roots	India (Ahmed *et al.*, 2013)
*Oxalis violacea*Linn.	Oxalidaceae	Whole plant (cold infusion)	America (Moerman, 1998)
Paeonia emodi Wall ex Hooker. f.	Paeoniaceae	Rhizome (powder with milk)	Pakistan (Khan and Islam, 2007)
Panax ginseng C. A. Meyer.	Araliaceae	Roots	China (Ahmed *et al.*, 2013)
*Panax quinquefolium*Linn.			India (Ahmed *et al.*, 2013)
Paris polyphylla Smith.	Liliaceae		Nepal (Kunwar *et al.*, 2009)
Pavonia ododrata Willd.	Malvaceae	Whole plant	India (Ahmed *et al.*, 2013)
Penstemon acuminatus Douglas.	Scrophulariaceae	Leaves (infusion)	America (Moerman, 1998)
Pinellia ternata (Thunb.) Breit.	Araceae	Tubers	China (Ahmed *et al.*, 2013)
Pinellia tripartita (Blume.) Schott.		Roots	China (Duke and Ayensu, 1985)
Pinellia pedatisecta Schott.			China (Yeung, 1985)
Phragmites australis (Cav.) Trin. ex Stead.	Poaceae	Whole plant	Arab (Ahmed *et al.*, 2013)
			Africa (Ahmed *et al.*, 2013)
		Stem	India (Ahmed *et al.*, 2013)
		Roots	China (Yeung, 1985, Duke and Ayensu, 1985)
*Phragmites communis*Trin.		Roots and rhizome	India (Ahmed *et al.*, 2013)
			China (Ahmed *et al.*, 2013)
Phyllanthus emblica Linn.	Euphorbiaceae	Leaves	Nicobarese (Verma *et al.*, 2010)
Phyllostachys bambusoide Sieb. Et Zucc.	Poaceae	Shoots	China (Ahmed *et al.*, 2013)
Phyllostachys edulis (Carrière.) J. Houz.		Stem	China (Duke and Ayensu, 1985)
Phyllostachys nigra (Lodd. ex Lindl.) Munro.		Bark	India (Ahmed *et al.*, 2013)
Phyllostachys nigra var. *henonis* Stapf.		Leaves	China (Ahmed *et al.*, 2013)
Pinellia ternata (Thunb.) Breit.	Aracaceae	Tuber	
Pinellia tuberifera Tenore.			
Piper hymenophyllum Miq.	Piperaceae	Fruits	India (Samydurai *et al.*, 2012)
Piper nigrum Linn.			

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Table 1: Continue

Plant	Family	Part(s) used	Country
Pogostemon cablin (Blanco) Benth.	Lamiaceae	Leaves	China (Ahmed *et al.,* 2013)
Polyporus umbellatus (Pers.) Fries	Polyporaceae	Sclerotia	
Poncirus trifoliata (L.) Raf.	Rutaceae	Unripe fruits	China (Yeung, 1985, Duke and Ayensu, 1985)
Poria cocos Wolf.	Polyporaceae	Sclerotium	China (Ahmed *et al.,* 2013)
Portulaca oleracea Linn.	Portulacaceae	Leaves (juice)	India (Ahmed *et al.,* 2013)
			Pakistan (Ahmad, 2007)
Portulaca quadrifida Linn.			Pakistan (Mahmood *et al.,* 2011b)
Pratia nummularis Linn.	Campanulaceae		India (Lalfakzuala *et al.,* 2007)
Prunella vulgaris Linn.	Lamiaceae	Whole plant	India (Ahmed *et al.,* 2013)
Prunus domestica Linn.	Rosaceae	Fruits	Pakistan (Said, 1970)
Prunus cerasoides D. Don		Heartwood	India (Sharma *et al.,* 2000)
Pteridium aquilinum var. *esculentum* G.Forst.	Polypodiaceae	Roots	America (Moerman, 1998)
Pueraria montana var. *lobata* (Willd.) Sanjappa & Pradeep.	Fabaceae	Flowers and root	China (Yeung, 1985, Duke and Ayensu, 1985)
Pueraria tuberosa (Roxb.ex Willd.) DC.		Tuber	India (Ahmed *et al.,* 2013)
Pueraria thunbergiana (Sieb. & Zucc.) Benth.		Whole plant	
*Punica granatum*Linn.	Punicaceae	Flowers and bark (powder)	Pakistan (Ahmed *et al.,* 2013)
			India (Ahmed *et al.,* 2013)
Quercus muehlenbergii Engelm.	Fagaceae	Bark (infusion)	America (Moerman, 1998)
Raphanus Sativus Linn.	Brassicaceae	Seeds	Arab (Ahmed *et al.,* 2013)
Rauvolfia serpentine Benth.ex Kurz.	Apocynaceae	Roots	India (Nisha and Rajeshkumar, 2010)
Reldia minutiflora var. *veraguensis* (Wiehler) L.P. Kvist & L.E. Skog.	Gesneriaceae	Stem (infusion)	Panama (Joly *et al.,* 1990)
Rheum nobile Hook.f.&Thom.	Polygonaceae	Flowering stem	Tibet (Tsarong, 1994)
Rhizophora apiculata Bl.	Rhizophoraceae	Bark	India (Rameshkumar *et al.,* 2013)
Rubus parviflorus Nutt.	Rosaceae	Leaves (infusion)	America (Moerman, 1998)
Rumex acetosa Linn.	Polygonaceae	Whole plant	Pakistan (Khan and Khatoon, 2008)
Salvia verticillata L. subsp. *amasiaca*	Labiatae	Leaves (decoction)	Turkey (Tuzlacı and Doğan, 2010)
*Samanea saman*Merr.	Leguminosae		WestIndies (Ayensu, 1981)
Sanguinaria canadensis Linn.	Papaveraceae	Roots	India (Ahmed *et al.,* 2013)
*Scirpus kysoor*Roxb.	Cyperaceae	Stem	
Sida acuta Burm.f.	Malvaceae	Roots	
Sisymbrium irio L. ex Steud.	Brassicaceae	Fruits	Pakistan (Mahmood *et al.,* 2011a)
Senna spectabilis var. *excelsa* (Schrad.) H.S. Irwin & Barneby.	Caesalpiniaceae	Bark and leaves	Brazil (De Albuquerque *et al.,* 2007)
Sisymbrium irio L. ex Steud.	Brassicaceae	Seeds	Pakistan (Mahmood *et al.,* 2011b)
*Solanum aethiopicum*Linn.	Solanaceae	Leaves (juice)	Africa (Ahmed *et al.,* 2013)
Solanum anguivi Lam.			India (Sharma *et al.,* 2000)
Solanum melongena Linn.		Leaves and fruit	Bangladesh (Rahmatullah *et al.,* 2010)
Solanum paniculatum Linn.		Flower, fruit and root	Brazil (De Albuquerque *et al.,* 2007)
*Solanum surattense*Burm.f.		Whole plant	Pakistan (Ilahi, 2008)
Solanum xanthocarpum Schrad.& Wendl.			India (Nisha and Rajeshkumar, 2010)

Continued...

Table 1: Continue

Plant	Family	Part(s) used	Country
Sphaerathus indicus Linn.	Asteraceae	Leaves (juice)	India (Behera et al., 2006)
Spondias tuberosa Arruda.	Anacardiaceae	Leaves, bark and fruit	Brazil(De Albuquerque *et al.*, 2007)
Syzygium cumini (L.) Skeels.	Myrtaceae	Seeds (powder)	Pakistan (Qureshi *et al.*, 2011)
Syzygium aromaticum(Linn.) Merr. & Perry.		Flowering buds	India (Ahmed *et al.*, 2013)
			China (Ahmed *et al.*, 2013)
Tamarindus indica Linn.	Fabaceae	Fruit pulp	Bangladesh (Rahmatullah *et al.*, 2009b)
		Bark	India (Singh and Singh, 2009)
Tanacetum parthenium (L.) Sch. Bip.	Asteraceae	Flowering heads (sniffing)	Italy (Guarrera, 2005)
Taverniera abyssinica A. Rich.	Fabaceae	Roots	South central Ethiopia (Leporatti and Ivancheva, 2003)
Tephrosia purpurea (Linn.) Pers.		Roots	India (Tomar, 2009)
Terminalia chebula Retz.	Combretaceae	Fruits	India(Hiremath and Taranath, 2013)
Tinospora cordifolia Miers.	Menispermaceae	Stem	India (Mahajan, 2007)
Thymus decussates Benth.	Labiatae	Whole plant	Egypt (Batanouny, 1999)
Urtica dioica Linn.	Urticaceae	Leaves	India (Gangwar *et al.*, 2010)
*Vaccinium oxycoccos*Linn.	Ericaceae	Whole plant (infusion)	America (Moerman, 1998)
Vaccinium scoparium Leiberg.		Leaves (infusion)	
*Valeriana officinalis*Linn.	Valerianaceae	Roots	Iran (Ahmed *et al.*, 2013)
Vetiveria zizanioides (L.) Nash	Poaceae	Roots	India (Singh *et al.*, 2013)
Vigna trilobata Verdc.	Fabaceae	Leaves	India (Joshi, 2000)
Vigna unguiculata (L.) Walp.		flower	Arab (Ahmed *et al.*, 2013)
*Vitex iringensis*Gürke.	Verbenaceae	Leaves (infusion)	Africa (Ahmed *et al.*, 2013)
Yucca baccata Torr.	Agavaceae		America (Moerman, 1998)
Zingiber officinale Roscoe.	Zingiberaceae	Rhizome	China (Ahmed *et al.*, 2013)
			India (Ahmed *et al.*, 2013)
			Bangladesh (Rahmatullah *et al.*, 2009b)
Ziziphora clinopodioides Lam.	Labiatae	Whole plant (decoction)	Pakistan (Tareen *et al.*, 2010)
Zigyphus jujuba Mill.	Rhamnaceae	Fruit	Pakistan (Ahmad, 2007)
Ziziphus mauritiana Lamk.		Kernel	India (Sharma *et al.*, 2000)
		Roots	Nepal (Kunwar *et al.*, 2009)

Table 2: Antiemetic effect of medicinal plants in different animal models

Plant	Extract of Part
Acalypha fimbriata Schumach. & Thonn.	Leaves and stems [CC][a]
Acalypha ornata Hochst.	Leaves, stems [CC][a]Roots [CC][b]
Acalypha wilkesiana cv. *godseffiana* Muell Arg.	Leaves and stems [CC][a]
Adenanthera pavonina Linn.	Leaves [CC][a]
*Alpinia katsumadai*Hayata.	Seeds [CC][a]
*Amomum kravanh*Pire ex Gagnep.	Fruits [CC][a]
*Alpinia officinarum*Hance.	Rhizome [CC][a]
*Amomum tsao-ko*Crevost & Lemarié.	Fruits [CC][a]
*Amomum xanthioides*Wall. ex Baker.	Fruits [CC][a]
Brazilian propolis	Bee glue [CC][a]
Carissa carandus Linn.	Fruits [CC][a]
*Cassia angustifolia*Vahl.	Leaves [CC][a]

Continued...

Table 2: Continue

Plant	Extract of Part
Cassia holosericea Fresen.	Leaves [CC][a]
Cassia italica Miller. Lam. ex F.W. Ander.	Leaves [CC][a]
Cassia purpurea Roxb.	Leaves [CC][a]
Cassia siamea Lamk.	Leaves [CC][a]
*Cinnamon loureiroi*Nees.	Bark [CC][c]
Cinnamomum tamala Linn.	Rhizomes [CC][a]
Citrus unshiu (Swingle) Marcow.	Fruit peels [CF][a]
Cleome brachycarpa Vahl.	Leaves [CC][d]
Cleomescaposa DC.	Leaves [CC][a]
Cleome viscosa Linn.	Leaves [CC][d]
Cyamopsis tetragonoloba Taubert.	Leaves [CC][a]
Delonix regia Rafin.	Leaves [CC][a]
Diospyros kaki Linn.	Sepals [AF,CF][a]
Emblica officinalis Gaertn.	Fruits [AD][a]
Eriobotrya japonica Lindl.	Leaves [CF][a]
*Eupatorium fortunei*Turcz.	Leaves and stem [CC][a]
Euphorbia helioscopia Linn.	Whole plant [CC][e]
Euphorbia hirta Linn.	
Euphorbia prostrata Aiton.	
Euphorbia milii var. *splendens* Des Moul.	
Foeniculum vulgare Mill.	Fruits [CF][a]
Forsythia suspensa Vahl.	Fruits [AF, CF][a]
Ganoderma lucidum (Curtis) P.Karst.	Whole mushroom [CR][a]
Garcinia kola Heckel.	Seeds [CC][a]
Grewia asiatica Linn.	Leaves [AD, CC][a]
Grewia lasiodiscus K. Schum.	Roots [CC][a]
Hovenia dulcis Thunb.	Fruits [AF, CF][a]
*Hypnea pannosa*J. Ag.	Red algae [CC][a]
Inula linariaefolia Linn.	Fruits [CF][a]
Iyengaria stellata Børgesen	Whole brown algae [CC][f]
Jatropha integerrima Jacq.	Whole plant [CC][e]
Lallemantia royleana Benth.	Leaves [CC][a]
Lindera strychnifolia Sieb. *et* Zucc.	Roots [AF][a]
Luffa cylindrica (L.) Roem.	Leaves[g], flowers[g], fruit peel[h] [CC]
Matricaria chamomila Linn.	Flowers [CC][a]
Mikania cordata (Bumr.f.) B.L. Robinson	Whole plant [CC][i]
*Nelumbo nucifera*Gaertn.	Seeds [AD,CC][a]
Panax ginseng C. A. Meyer.	Roots [CP][a]
*Panax quinquefolius*Linn.	Berry [CR][a]
Peltophorum roxburghii Linn.	Leaves [CC][a]
Piper longum Linn.	Fruits [CC][a]
Piper methysticum G. Forst.	Fruits [CC][a]
Piper nigrum Linn.	Fruits [CC][a]
Pistacia vera Linn.	Leaves and nuts [IC, CC][a]
Pinellia ternata (Thunb.) Breit.	Tubers [CF][a]
Pogostemon cablin (Blanco) Benth.	Leaves [CF][a]
Polygonum lapathifolium (s.l.)	Flowers [CC][i] Roots [CC][k]
Poria cocos Wolf.	Sclerotium [CF][a]
Prosopis cineraria Linn.	Leaves [CC][a]
Prosopis juliflora DC.	Leaves[CC][a]

Continued...

Table 2: Continue

Plant	Extract of Part
Prunus domestica Linn.	Fruits [AD][a]
Putranjiva roxburghii Wall.	Whole plant [CC][e]
Ricinus communis Linn.	
Rumex Vesicarius Linn.	Leaves [CC][l]
*Samanea saman*Merr.	Leaves [CC][a]
*Scutellaria baicalensis*Georgi.	Roots [CR][a]
Syzygium aromaticum Merr. & Perry.	Flowering buds [CC][a]
*Tamarindus indica*Linn.	Leaves [CC][a]
Tithonia diversifolia (Hemsl.) A. Gray.	Leaves [CC][m]
Thymus transcaspicus Klokov.	Aerial parts [IC, CC][a]
*Valeriana officinalis*Linn.	Roots [IC, CC][a]
Valoniopsis pachynema (G. Martens) Børgesen	Whole green algae [CC][f]
Vigna trilobata Verdc.	Leaves [CC][a]
Vitis vinifera Linn.	Seeds [CR][n]
*Zingiber officinale*Roscoe.	Rhizome [CD, CH][a]

Key: AD= Apomorphine-induced emesis in dogs; AF= Apomorphine -induced emesis in frogs;CC=Copper sulfate-induced emesis in chicks; CD= Cisplatin-induced emesis in dogs; CF= Copper sulfate-induced emesis in frogs; CH= Cyclophosphamide-induced emesis in house musk shrew;CP= Cisplatin-induced emesis in ferrets;CR= Cisplatin-induced pica in rats;IC= Ipecac-induced emesis in chicks.
References: a=(Ahmed *et al.,* 2013); b=(Ahmed and Onocha, 2013a); c=(Khan *et al.,* 2014); d=(Muhammad and Ahmed, 2013); e=(Mughal and Mahboob, 2013) ; f=(Ahmed *et al.,* 2012); g=(Khan *et al.,* 2013b); h=(Kanwal *et al.,* 2013); i=(Bulbul *et al.,* 2013a); j=(Bulbul *et al.,* 2013c); k=(Bulbul *et al.,* 2013b); l=(Khan *et al.,* 2013a); m=(Ahmed and Onocha, 2013b); n=(Wang *et al.,* 2005).

Table 3: Anti-emetic mode of action of secondary metabolites (Ahmed *et al.,* 2013)

Secondary metabolites	Plants and part(s)	Possible mechanism of action in animal models
Cannabinoids	*Cannabis sativa*flowers and buds	CB_1 receptor activation
Chalcones	*Alpinia katsumadai* Hayata. seeds	Antioxidant action
Diarylheptanoids	*Zingiber officinale* Roscoe. rhizome	5-HT_3 receptor antagonism
	Alpinia katsumadai Hayata. seeds	5-HT_3 receptor antagonism
	Alpinia officinarum Hance. rhizome	5-HT_3 receptor antagonism
Flavonoids	*Alpinia officinarum* Hance. Rhizome	5-HT_3, 5-HT_4 and/or NK_1 receptors antagonism
	Pogostemon cablin leaves	
	Forsythia suspensa Vahl., fruits	Antioxidant action
Glucosides	*Forsythia suspensa* Vahl. fruits	5-HT_3, 5-HT_4 and/or NK_1 receptors antagonism
	Alpinia officinarum Hance. Rhizome	
	Forsythia suspensa Vahl. fruits	Antioxidant action
Hydroxycinnamic acids	*Inula linariaefolia* L. flowers	δ (enkephalinergic)-receptor antagonism and/or dopamine inhibition
	Brazilian Propolis, bee glue	
Lignans	*Magnolia obovata* Thunb. bark	5-HT_3, 5-HT_4 and/or NK_1 receptors antagonism
Phenylpropanoids	*Syzygium aromaticum* (L.) Merr. & Perry. flower buds	5-HT_3, 5-HT_4 and/or NK_1 receptors antagonism
	Sassafras albidum (Nutt.) Nees. fruit	
Polysaccharides	*Pinellia ternata.* tubers	δ (enkephalinergic)-receptor antagonism and/or dopamine inhibition
Saponins	*Panax quinquefolius*berry	5-HT_3 and NK_1 receptors antagonism
	*Panax quinquefolius*berry	Antioxidant action

Continued...

Table 3: Continue

Secondary metabolites	Plants and part(s)	Possible mechanism of action in animal models
Sesquiterpene	*Inula linariaefolia* L. flowers	5-HT_3, 5-HT_4 and/or NK_1 receptors antagonism
	Pogostemon cablin leaves	
	Magnolia obovata Thunb. bark	Antioxidant action
Triterpenes	*Brazilian Propolis*	5-HT_3, 5-HT_4 and/or NK_1 receptors antagonism
	Inula linariaefolia L. flowers	

Table 4: Number of antiemetic plants with respect to family

Family	Plants	Family	Plants	Family	Plants
Acanthaceae	02	Convolvulaceae	01	Oxalidaceae	02
Aceraceae	01	Cruciferaceae	01	Paeoniaceae	02
Acoraceae	02	Cyperaceae	04	Papaveraceae	01
Agavaceae	01	Ebenaceae	01	Parmeliaceae	03
Alismataceae	01	Ericaceae	02	Phyllanthaceae	01
Amaranthaceae	02	Euphorbiaceae	14	Piperaceae	01
Amaryllidaceae	01	Fabaceae	13	Rubiaceae	01
Anacardiaceae	03	Mimosoideae	03	Poaceae	12
Annonaceae	02	Fagaceae	01	Polygonaceae	02
Apiaceae	07	Gesneriaceae	01	Polypodiaceae	01
Apocynaceae	02	Gentianaceae	01	Polyporaceae	03
Aracaceae	08	Guttiferae	01	Portulacaceae	02
Araliaceae	02	Hemerocallidaceae	01	Ranunculaceae	03
Asclepiadaceae	01	Iridaceae	02	Rhamnaceae	03
Asteraceae	21	Labiatae	17	Rhizophoraceae	01
Berberidaceae	01	Lauraceae	04	Rosaceae	06
Bixaceae	01	Liliaceae	02	Rutaceae	14
Boraginaceae	01	Magnoliaceae	01	Scrophulariaceae	01
Brassicaceae	03	Malvaceae	04	Solanaceae	06
Burseraceae	01	Meliaceae	02	Thymelaeaceae	02
Cactaceae	01	Menispermaceae	01	Tiliaceae	03
Caesalpiniaceae	02	Moraceae	04	Urticaceae	01
Calophyllaceae	01	Myrtaceae	01	Valerianaceae	02
Campanulaceae	01	Nelumbonaceae	03	Verbenaceae	02
Cannabaceae	01	Nymphaeaceae	02	Vitaceae	01
Capparaceae	03	Ochnaceae	01	Zingiberaceae	14
Combretaceae	01	Oleaceae	01	Zygophyllaceae	02

Current world-wide interest in traditional medicine has led to rapid development and studies of many remedies employed by various cultures of the world. The current information is recorded in alphabetical order of plant scientific name, family, parts used and country name where it is used for the treatment of nausea and vomiting (table1). In this report we have enumerated 293 medicinal plants of 81 families used as antiemetic drugs in different countries. table2 shows antiemetic effects of medicinal plants in different animal models like chemically induced emesis by apomorphine in cats, dogs and frogs; cisplatin-induced pica in rats; cisplatin-induced emesis in dogs, ferrets and least shrews;copper sulfate-induced emesis in chicks and frogs; cyclophosphamide-induced emesis in house musk shrew; ipecac-induced emesis in chicks.

The search for new antiemetic agents from natural sources continues to emphasize mechanism based approaches, involving discrete based cellular and biochemical targets. Some of the bioactive compounds fall under this category include cannabinoids, chalcones, diarylheptanoids, flavonoids, glucosides, hydroxycinnamic acids, lignans, phenylpropanoids, polysaccharides, saponins and terpenes (table3). The last table (Table4) presents the family wise number of ethnomedicinal plants.

Electronic literature searches were conducted on the following databases: Science direct, Pub Med and Plants for a future. Ethnomedicinal surveys of Africa, America, Arab, Bangladesh, Brazil, China, Egypt, India, Iran, Italy, Nepal, Pakistan, Thailand, Tibet, Turkey and West Indies

were used to report the use of medicinal plants as anti-emetic. The databases were searched from the earliest possible date till March, 2014. The search terms included Ethno-medicinal survey of anti-emetic plants, anti-emetic plants, and plants against vomiting, traditional anti-emetic remedies.

CONCLUSION

The provided information describes that still many herbal folk remedies for emesis have not undergone through scientific investigations and careful assessment of their side effects. It point towards promising registered anti-emetics of the future with high efficacy and less side effects. Traditional knowledge based drug development may be possible by using the survey of globally used medicinal plants for the treatment of nausea and vomiting. It is a need of time to consider all such folk based herbal medicines for determining their pharmacological activities, isolating the single compound entity responsible for anti-emetic effect and developing suitable formulation against emesis. The modern techniques for the separation, structural elucidation, screening and combinatorial synthesis will revitalize the plant extracts as a source of new drugs. The anti-emetic effect of isolated phytoconstituents in different animal models invite further considerable research on pharmacognosy, chemistry, pharmacology and clinical therapeutics to fill the gap in knowledge for new drug discovery.

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