

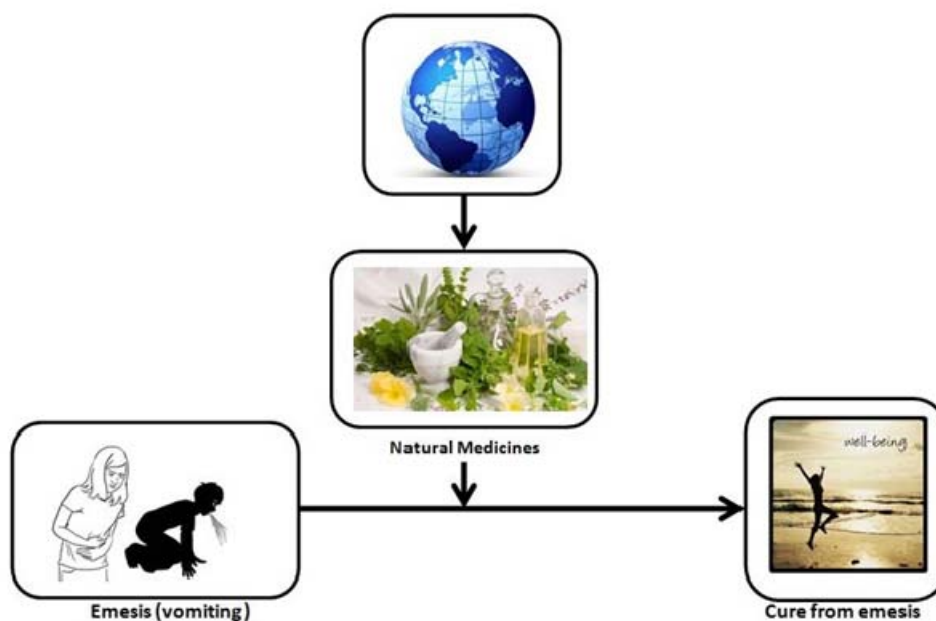
# Natural antiemetics: An overview

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**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, anticholinergic drugs, corticosteroids, NK<sub>1</sub>-receptor inhibitors, cannabinoids, 5-HT<sub>1A</sub>, GABA<sub>B</sub> and CB<sub>1</sub>-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.

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

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

Continued...

Table 1: Continue

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

Continued...

**Table 1:** Continue

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

Continued...

Table 1: Continue

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

Continued...

**Table 1:** Continue

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

Continued...

Table 1: Continue

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

Continued...

**Table 1:** Continue

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

Continued...

**Table 1:** Continue

| Plant  | Family         | Part(s) used                  | Country   |
|--|----------------|-------------------------------|---|
| <i>Sphaerathus indicus</i> Linn.                     | Asteraceae     | Leaves (juice)                | India (Behera et al., 2006)                               |
| <i>Spondias tuberosa</i> Arruda.                     | Anacardiaceae  | Leaves, bark and fruit        | Brazil(De Albuquerque et al., 2007)                       |
| <i>Syzygium cumini</i> (L.) Skeels.                  | Myrtaceae      | Seeds (powder)                | Pakistan (Qureshi et al., 2011)                           |
| <i>Syzygium aromaticum</i> (Linn.)<br>Merr. & Perry. |                | Flowering buds                | India (Ahmed et al., 2013)<br>China (Ahmed et al., 2013)  |
| <i>Tamarindus indica</i> Linn.                       |                | Fabaceae                      | Fruit pulp  |
|  |                | Bark                          | India (Singh and Singh, 2009)                             |
| <i>Tanacetum parthenium</i> (L.)<br>Sch. Bip.        | Asteraceae     | Flowering heads<br>(sniffing) | Italy (Guarrera, 2005)                                    |
| <i>Taverniera abyssinica</i> A. Rich.                | Fabaceae       | Roots                         | South central Ethiopia (Leporatti<br>and Ivancheva, 2003) |
| <i>Tephrosia purpurea</i> (Linn.)<br>Pers.           |                | Roots                         | India (Tomar, 2009)                                       |
| <i>Terminalia chebula</i> Retz.                      | Combretaceae   | Fruits                        | India(Hiremath and Taranath, 2013)                        |
| <i>Tinospora cordifolia</i> Miers.                   | Menispermaceae | Stem                          | India (Mahajan, 2007)                                     |
| <i>Thymus decussates</i> Benth.                      | Labiatae       | Whole plant                   | Egypt (Batanouny, 1999)                                   |
| <i>Urtica dioica</i> Linn.                           | Urticaceae     | Leaves                        | India (Gangwar et al., 2010)                              |
| <i>Vaccinium oxycoccos</i> Linn.                     | Ericaceae      | Whole plant (infusion)        | America (Moerman, 1998)                                   |
| <i>Vaccinium scoparium</i> Leiberg.                  |                | Leaves (infusion)             |   |
| <i>Valeriana officinalis</i> Linn.                   | Valerianaceae  | Roots                         | Iran (Ahmed et al., 2013)                                 |
| <i>Vetiveria zizanioides</i> (L.) Nash               | Poaceae        | Roots                         | India (Singh et al., 2013)                                |
| <i>Vigna trilobata</i> Verdc.                        | Fabaceae       | Leaves                        | India (Joshi, 2000)                                       |
| <i>Vigna unguiculata</i> (L.) Walp.                  |                | flower                        | Arab (Ahmed et al., 2013)                                 |
| <i>Vitex iringensis</i> Gürke.                       | Verbenaceae    | Leaves (infusion)             | Africa (Ahmed et al., 2013)                               |
| <i>Yucca baccata</i> Torr.                           | Agavaceae      |                               | America (Moerman, 1998)                                   |
| <i>Zingiber officinale</i> Roscoe.                   | Zingiberaceae  | Rhizome                       | China (Ahmed et al., 2013)                                |
|  |                |                               | India (Ahmed et al., 2013)                                |
|  |                |                               | Bangladesh (Rahmatullah et al., 2009b)                    |
| <i>Ziziphora clinopodioides</i> Lam.                 | Labiatae       | Whole plant<br>(decoction)    | Pakistan (Tareen et al., 2010)                            |
| <i>Zizyphus jujuba</i> Mill.                         | Rhamnaceae     | Fruit                         | Pakistan (Ahmad, 2007)                                    |
| <i>Zizyphus mauritiana</i> 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   |
|--|---|
| <i>Acalypha fimbriata</i> Schumach. & Thonn.                 | Leaves and stems [CC] <sup>a</sup>                      |
| <i>Acalypha ornata</i> Hochst.                               | Leaves, stems [CC] <sup>a</sup> Roots [CC] <sup>b</sup> |
| <i>Acalypha wilkesiana</i> cv. <i>godseffiana</i> Muell Arg. | Leaves and stems [CC] <sup>a</sup>                      |
| <i>Adenanthera pavonina</i> Linn.                            | Leaves [CC] <sup>a</sup>                                |
| <i>Alpinia katsumadai</i> Hayata.                            | Seeds [CC] <sup>a</sup>                                 |
| <i>Amomum kravanh</i> Pire ex Gagnep.                        | Fruits [CC] <sup>a</sup>                                |
| <i>Alpinia officinarum</i> Hance.                            | Rhizome [CC] <sup>a</sup>                               |
| <i>Amomum tsao-ko</i> Crevost & Lemarié.                     | Fruits [CC] <sup>a</sup>                                |
| <i>Amomum xanthioides</i> Wall. ex Baker.                    | Fruits [CC] <sup>a</sup>                                |
| <i>Brazilian propolis</i>                                    | Bee glue [CC] <sup>a</sup>                              |
| <i>Carissa carandus</i> Linn.                                | Fruits [CC] <sup>a</sup>                                |
| <i>Cassia angustifolia</i> Vahl.                             | Leaves [CC] <sup>a</sup>                                |

Continued...

**Table 2:** Continue

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

Continued...

**Table 2:** Continue

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

**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          | <i>Cannabis sativa</i> flowers and buds                    | CB <sub>1</sub> receptor activation   |
| Chalcones             | <i>Alpinia katsumadai</i> Hayata. seeds                    | Antioxidant action  |
| Diarylheptanoids      | <i>Zingiber officinale</i> Roscoe. rhizome                 | 5-HT <sub>3</sub> receptor antagonism   |
|                       | <i>Alpinia katsumadai</i> Hayata. seeds                    | 5-HT <sub>3</sub> receptor antagonism   |
|                       | <i>Alpinia officinarum</i> Hance. rhizome                  | 5-HT <sub>3</sub> receptor antagonism   |
| Flavonoids            | <i>Alpinia officinarum</i> Hance. Rhizome                  | 5-HT <sub>3</sub> , 5-HT <sub>4</sub> and/or NK <sub>1</sub> receptors antagonism |
|                       | <i>Pogostemon cablin</i> leaves                            | antagonism  |
|                       | <i>Forsythia suspensa</i> Vahl., fruits                    | Antioxidant action  |
| Glucosides            | <i>Forsythia suspensa</i> Vahl. fruits                     | 5-HT <sub>3</sub> , 5-HT <sub>4</sub> and/or NK <sub>1</sub> receptors antagonism |
|                       | <i>Alpinia officinarum</i> Hance. Rhizome                  | antagonism  |
|                       | <i>Forsythia suspensa</i> Vahl. fruits                     | Antioxidant action  |
| Hydroxycinnamic acids | <i>Inula linariaefolia</i> L. flowers                      | $\delta$ (enkephalinergic)-receptor antagonism and/or dopamine inhibition         |
|                       | Brazilian Propolis, bee glue                               |   |
| Lignans               | <i>Magnolia obovata</i> Thunb. bark                        | 5-HT <sub>3</sub> , 5-HT <sub>4</sub> and/or NK <sub>1</sub> receptors antagonism |
| Phenylpropanoids      | <i>Syzygium aromaticum</i> (L.) Merr. & Perry. flower buds | 5-HT <sub>3</sub> , 5-HT <sub>4</sub> and/or NK <sub>1</sub> receptors antagonism |
|                       | <i>Sassafras albidum</i> (Nutt.) Nees. fruit               |   |
| Polysaccharides       | <i>Pinellia ternata</i> . tubers                           | $\delta$ (enkephalinergic)-receptor antagonism and/or dopamine inhibition         |
| Saponins              | <i>Panax quinquefolius</i> berry                           | 5-HT <sub>3</sub> and NK <sub>1</sub> receptors antagonism                        |
|                       | <i>Panax quinquefolius</i> berry                           | Antioxidant action  |

Continued...

**Table 3:** Continue

| Secondary metabolites | Plants and part(s)                    | Possible mechanism of action in animal models                                     |
|-----------------------|---------------------------------------|---|
| Sesquiterpene         | <i>Inula linariaefolia</i> L. flowers | 5-HT <sub>3</sub> , 5-HT <sub>4</sub> and/or NK <sub>1</sub> receptors antagonism |
|                       | <i>Pogostemon cablin</i> leaves       |   |
|                       | <i>Magnolia obovata</i> Thunb. bark   | Antioxidant action  |
| Triterpenes           | <i>Brazilian Propolis</i>             | 5-HT <sub>3</sub> , 5-HT <sub>4</sub> and/or NK <sub>1</sub> receptors antagonism |
|                       | <i>Inula linariaefolia</i> 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     |
| <u>Amaryllidaceae</u> | 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     |
| Araceae               | 08     | Guttiferae        | 01     | <u>Portulacaceae</u> | 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     |
| <u>Combretaceae</u>   | 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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