

Knowledge, practice and use of *aegle marmelos* (l.) Correa leaves among naturopathy and ayurvedic practitioners of vadodara city and desk review on various commercial formulations available in health and disease specially diabetes

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Abstract

The *Aegle marmelos* (L.) Correa (Bael), is indigenous to India and its leaves, bark, roots and fruit have been used for over 5000 years in the Indian traditional system of medicine like the Ayurveda, Naturopathy and in various folk medicine to treat various diseases including diabetes. This study was conducted to assess Knowledge, Practice and Use (KPU) of *Aegle Marmelos* (L.) Correa leaves among 20 Ayurvedic (AP) and Naturopathic practitioners (NP) in Vadodara city as well as desk reviews on various commercial formulations of *Aegle Marmelos* (L.) Correa (Bael) used in health and disease specially diabetes using internet

Desk reviews were done using Pub Med and other web sources along with personal visits to various libraries across Gujarat state. For KPU, Purposive selection of AP (n=10) and NP (n=10) was done using snow ball sampling technique from Vadodara city in the form of key informant interviews based on their oral consent to share data among.

Desk reviews revealed that *Aegle Marmelos* (L.) Correa leaves were being recognized as a remedy for the treatment of diabetes in both Ayurveda and Naturopathy. Many Ayurvedic formulations were available commercially as poly herbal formulations (PHF) rather than single drug in the market of various reputed brands which contained *Aegle Marmelos* (L.) Correa leaves in the form of various powder, tablets, capsules, etc. Naturopathy did not contain any commercial brands of *Aegle Marmelos* (L.) Correa leaves as it believes in fresh doses of the plant. KPU results revealed that AP used bael leaves for the treatment of diabetes and the dosage for the treatment ranged from 5-10g/day in various forms such as powder, decoction and dry extract in the form of capsules (1 capsule contains 0.5mg of extract which is equivalent to 5mg of leaf powder). NP also used bael leaves for the treatment of diabetes and the dosage ranged from 40-50 fresh leaves in the form of juice mixed with water to make a volume of around 100ml.

Bael leaves were reported to be used by these practitioners as anti-diabetic agent. This information extracted warrants further clinical trials to prove the efficacy of the anti-diabetic properties of these leaves.

Keywords: *Aegle marmelos* (L.) Correa, Ayurveda, Diabetes, commercial formulations, Naturopathy, traditional medicine

Introduction

In India, drugs of herbal origin have been used in traditional systems of medicines such as Unani and Ayurveda since ancient times. The Ayurveda system of medicine uses about 700 species,

Unani 700, Siddha 600, Amchi 600 and modern medicine around 30 species[1]. The drugs are derived either from the whole plant or from different organs, like leaves, stem, bark, root, flower, seed, etc. Some drugs are prepared from excretory plant product such as gum, resins and latex. Ayurveda, Siddha, Unani and Folk (trial)

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medicines are the major systems of indigenous medicines. Among these systems, Ayurveda is most developed and widely practised in India. Ayurveda dating back to 1500-800 BC has been an integral part of Indian culture. World Health Organisation (WHO) has also recommended that antidiabetic medicinal plants used as alternative form of modern medicine should be encouraged, especially in countries where access to modern treatment of Diabetes mellitus is not adequate and costly[2].



Figure 1,2: Aegle Marmelos (L.) Correa fruit and leaf

बिल्वं तु दुर्जरं पक्वं दोषलं पूतिमारुतम्।

स्निग्धोष्णतीक्ष्णं तद्बालं दीपनं कफवातजित्॥१३८॥

bilvaṃ tu durjaraṃ pakvaṃ doṣalaṃ pūtimārutam।
snigdhoṣṇatikṣṇaṃ tadbālaṃ dīpanaṃ kaphavātajit।।138।। –
Charaka Samhita Sutrasthana 27

Aegle marmelos, is one such plant described in the ancient medical treatise in Sanskrit, Charak Samhita [3]. It is popular medicinal plant in Ayurvedic, Siddha systems of medicine and folk medicines used to treat a wide variety of ailments. *Aegle Marmelos* belongs to family Rutaceae, the family of citrus fruits, commonly known as *Bael* in indigenous systems of medicine and has been regarded to possess various medicinal properties. *Aegle Marmelos* (Bael) is indigenous to India and is one of the most useful medicinal plant of

India because all parts of the tree (stem, root, bark, leaves and fruits) have medicinal virtues and have a long tradition as herbal medicine. It is also an important environmental protector as leaves and bark act as a sink by absorbing dust and foul and poisonous gases from surrounding atmosphere and makes them clean. Owing to its environment friendly nature, *Aegle marmelos* is being placed among plant species group called “climate purifiers” which emit a greater percentage of oxygen in sunlight as compared to other plants [4]. Due to its endless uses, *Aegle marmelos* is also known as Mahaphala or Great fruit. Few studies report on the knowledge, practices and use of practitioners regarding medicinal plant like *Aegle marmelos*. The present study therefore aims to document various indigenous knowledge, practice and uses of *Aegle marmelos* from various Ayurvedic, Naturopathic practitioners in order to explore its ethno medicinal properties as well as desk reviews of the use of plant in various commercial formulations for the treatment of Diabetes Mellitus.

Methodology

Desk reviews

Desk reviews on various commercial formulations of *Aegle Marmelos* (*L.*) *Correa* (Bael) used in health and disease specially diabetes was extracted using internet with the help of various key words like Medicinal plant *Aegle Marmelos* (*L.*) *Correa*, diabetes, Ayurveda, Naturopathy, commercial formulations, poly herbal formulations, traditional healers, folk lore medicine, herbal formulations, Ayurvedic Pharmacopeia of India (API), etc. Based on information available on internet, various colleges and agricultural universities were identified where the detailed information on *Aegle Marmelos* (*L.*) *Correa* plant and its therapeutic role in Ayurveda and Naturopathy was extracted through personal visits. The places visited were

Junagadh Agricultural University (JAU),

Sardar Patel Agricultural University

Anand Aromatic Plant Research Station

Jamnagar Ayurveda College Jamnagar

Bael Vejalpur Research Station CSIR Panchmahal Godhra;

Knowledge, practice and use (KPU) of Aegle Marmelos (L.) Correa with practitioners of Ayurveda and Naturopathy

Sample selection

Based on the desk review, purposive selection of Ayurveda (n=10) and Naturopathy (n=10) practitioners was done using snow ball sampling technique from Vadodara and adjoining areas based on their oral consent to share data.



Tool

Key informant interviews were conducted in the form of open ended questions based on checklist related to dosage and formulations of *Aegle Marmelos (L.) Correa* in various diseases including diabetes. Questions pertaining to procurement of leaves, medicinal

properties of this plant, its role in treatment of various diseases particularly diabetes, importance of leaf parts in various diseases, various forms of leaf supplements such as decoction, powder etc, most acceptable form, dose and duration of treatment given to patients and its acceptability were asked to them after their consent with prior appointment on one to one basis (Figure 3).

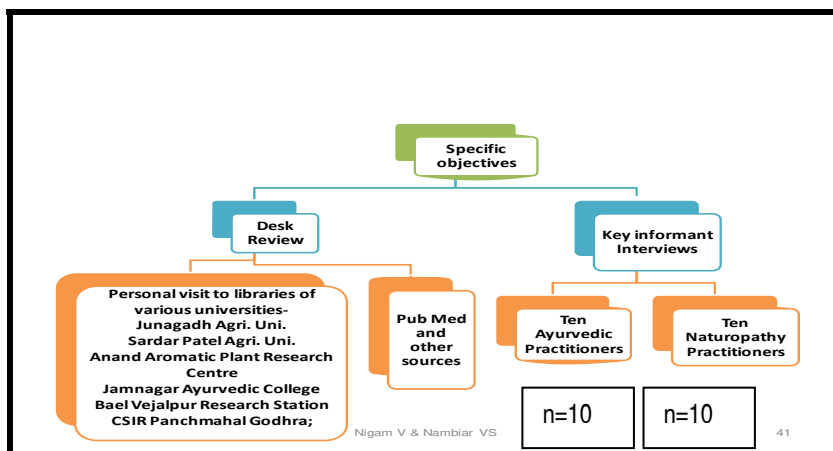


Figure 3 : Study Design

Results

Results of desk reviews of Ayurvedic formulations of Aegle Marmelos (L.) Correa for general health and disease as reported in the literature

Various university library visits and desk reviews on commercial formulations of *Aegle Marmelos (L.) Correa* available in the online market revealed that various therapeutic uses of *Aegle Marmelos (L.) Correa* leaves were available in Ayurveda such as its potency

as anti-inflammatory activity, uses in insect bites, fever, for headache, use in diarrhea, pain reliever, etc. However all the drug formulations consisted of several ingredients containing *Aegle Marmelos (L.) Correa* leaves as one of them. These poly herbal formulation of *Aegle Marmelos (L.) Correa* leaves were available commercially in the registered Ayurveda pharmacies (Table 1). Other Ayurveda formulations such as Dasmula-taila, Amritarista, Chyavana-prasa, Mahanarayana taila, Dhanya Panchaka Kvatha, Pusanuga churna, Vatsakadi Kvatha. are mentioned in Ayurvedic Pharmacopoeia of India part I [6].

Table 1 : Various Ayurvedic Formulations Of Aegle Marmelos (L.) Correa Available Commercially For General Health And Disease As Reported In The Literature

Name of the Company	Formulations (PHF)	Claims
Baidyanath	Dashmool (Roots)	Decoction of the root are to be taken to relieve palpitation of the heart
	Bilva Taila (Leaf)	oil prepared with bael root is used in ear diseases
	Vilwadi Gulika (Leaf)	used in insect bites, fever
	Astapatra taila (Leaf)	treatment of headache
	Kutajavaleha and Brihat Gangadhara Churna (Fruit)	useful in diarrhoea and dysentery
	Divya-Pidantaka Rasa (Leaf)	useful in joint pain, arthritis, lumbar pain, cervical spondylitis and sciatica
	Divya-Pidantaka Taila (Leaf)	relieves pain of lumbar region, knee-joints, cervical spondylitis, oedema & inflammation.
Himalaya	Chyawanprash (Fruit)	Used for digestive disorder and immunity

Result of desk reviews of the use of Ayurvedic poly herbal formulation (PHF) of Aegle Marmelos (L.) Correa

available commercially to control blood sugar reported in the literature



Desk review reveals that various Ayurvedic poly herbal formulations (PHF) were available containing various parts of *Aegle Marmelos (L.) Correa* such as leaves, fruits, stem bark and roots. Also there were mixtures of other medicinal plants such as *Murraya koenigii*, *Aloe vera*, *Pongamia pinnata* and *Elaeodendron glaucum*, *Ficus benghalensis*, *Catharanthus roseus*, *Bambusa arundinaceae*, *Salacia reticulata* and *Szygium cumini* and '*Eruca sativa*.' etc. were mentioned in review of literature.

Some of the different polyherbal formulation that have been confirmed by scientific investigation, which appear to be most effective, relatively nontoxic and have substantial documentation of efficacy having *Aegle Marmelos (L.) Correa* leaves are given in Table 2 and their ingredients involved with their claims are given in Table 3.

Table 2 : Ayurvedic Poly Herbal Formulations Of *Aegle Marmelos (L.) Correa* To Control Blood Sugar Levels Available Commercially

Formulations	Type (Single/PHF)	Constituents	Dosage
Bilvadi Leha, Brithatgandadhara churna	PHF	Bael dry leaf powder	3-6g in powdered form
Pancrease Tonic [7]	PHF	It is herbal mixture of 10 herbal extracts contains 30-40% bael leaf	2 tsp 2 times daily
ESF/AY/500 [8]	PHF	Composed of bael leaf as one out of 8 medicinal plants	Capsules 500 mg
5 EPHF [9]	PHF	Composed of bael leaf as one out of 5 medicinal plants	200mg/kg
Divya Madhunasini vati (Himalayan healthcare system)	PHF	500 mg tablet containing 15 mg bael leaf	1-2 tablets twice a day with warm water or milk one hour before breakfast or dinner
DIABAC Patanjali Ayurved products	PHF	Each tablet contains 100mg bael leaves in 1 capsule	2 tablets twice a day after meals

Table 3: Constituents Of These Poly Herbal Formulation And Their Claims

Name of poly herbal formulation	Constituents/ingredients	Claims
Madhumehantak churna [10](Malaviya, 2013)	Saptarangi, vijaysar, Bilvapatra, Gurmar Gymnema, Giloy and Daru haldi	1-2 teaspoonfuls of this powder consumed twice in a day either with apple juice, sugarless iced tea or plain water controls blood sugar
Pancrease tonic[11]	<i>Pterocarpus marsupium</i> , <i>Szygium cumini</i> , <i>Momordica charantia</i> , <i>Gymnema sylvestre</i> , <i>Trigonella foenum graecum</i> , <i>Azadirachta indica</i> , <i>Ficus racemosa</i> , <i>Tinospora cordifolia</i> , <i>Cinnamum tamala</i>	Therapy with Pancreas Tonic 2 capsule 3 times a day for 3 month significantly lowered HbA1c in those type 2 diabetic subject with a baseline HbA1c level between 10.0 to 12.0%.
ESF/AY/500-PHF	<i>Ficus benghalensis</i> , <i>Catharanthus roseus</i> , <i>Bambusa arundinaceae</i> , <i>Salacia reticulata</i> and <i>Szygium cumini</i> and ' <i>Eruca sativa</i> .'	The ethanolic extract of ESF/AY/500 exhibited significant antioxidant activity showing increased levels of superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), and reduced glutathione(GSH) and decreased level of lipid peroxidation
5EPHF [8]	<i>Aegle Marmelos (L.) Correa</i> , <i>Murraya koenigii</i> , <i>Aloe vera</i> , <i>Pongamia pinnata</i> and <i>Elaeodendron glaucum</i>	A dose 200 mg/kg to diabetic rats resulted in significant reduction of BS,TC,TG,LDL, creatinine and urea and improved antioxidant enzymes in alloxanized rats
Diabeta [12]	<i>Gymnema sylvestre</i> (leaves) <i>Tinospora cordifolia</i> (stems), <i>Azadirachta indica</i> (leaves), <i>Phyllanthus emblica</i> (fruits), <i>Curcuma longa</i> (roots) and <i>Aegle Marmelos (L.) Correa</i> (leaves) 15%	4 gm of mixed powder, twice a day with water controls blood sugar
DIABAC	<i>Gurmar</i> , <i>shilajeet</i> , <i>Aegle Marmelos (L.)Correa</i> , <i>Jamun mingi</i> , <i>Nyagrodha</i>	2 tablets twice a day regenerates β cells of pancreas, relieves symptoms like thirst and frequent urination

These Ayurvedic poly herbal formulations as traditional Ayurvedic remedy for diabetes work as under-
 Helps support the pancreatic function to regulate insulin secretion
 Helps the liver to regulate the carbohydrate metabolism
 Helps to recover from the weakness and body aches.
 Regulates the body weight

Helps in preventing the complications of diabetes like diabetic neuropathy, nephropathy, myopathy
 Some of the marketed formulations of *Aegle Marmelos (L.) Correa* produced by different companies in tablets, capsules and syrups form, are listed in Table 4.

Table 4: Various Ayurvedic Formulations Of *Aegle Marmelos (L.) Correa* Using Leaf, Fruit, Root And Stem Bark [13-24]

Sr. No.	Marketed formulations	Company name
1	Chyawanprash	Himalaya
2	Entrostat Syrup Ambika, Kof-Rid Syrup Ambika Medico	Ambika Medico
4	<i>Aegle Marmelos (L.) Correa</i> Capsules	La-Medicca (India) Pvt. Limited
5	Leucare capsules Shrey	Shrey Nutraceuticals & Herbals
6	Pregeight	Sydler Remedies Pvt. Ltd.
7	Ojain Tates Remedies	Tates Remedies
8	Manasamithravatakram, Pushyanugam gulika, Pushyanugam gulika, Vilwadi gulika Oushadhi	Oushadhi
11	Glucomap	Maharishi Ayurveda
12	UlcoBliss Tablets	Bliss Ayurveda
13	Capsule Bilv Giri	Ayurvedic Sanjivani
14	R-Qunol Syrup	Vatsal Ayurvedic Products (P) Ltd

Desk reviews revealed many commercial uses of *Aegle Marmelos (L.) Correa*. The Figure1 shows various brands consisting of *Aegle*

Marmelos (L.) Correa available commercially in the market.



Figure 4: Various Branded Ayurvedic Formulations Of *Aegle Marmelos (L.) Correa* (Dabur, Baidyanath, Patanjali, Divya And Himalaya Pharmacy)

Use of *Aegle Marmelos* (L.) Correa in various Naturopathic preparations available commercially to control blood sugar reported in the literature

Naturopathy or naturopathic medicine is a form of alternative medicine employing a wide array of pseudoscientific modalities that are branded as "natural," including homeopathy, herbalism, and acupuncture, in addition to diet and lifestyle counseling. Naturopaths believed in the principle of removal of toxins from the body which is the root cause of all the diseases. They relied on the fresh form of dose for the instant effect. So there were no commercial preparations available for blood sugar control.

Results of Key informant interviews of Ayurvedic and Naturopathic practitioners (ten each) are as given below

Table 5: General Information Regarding Practitioners

Type of Practitioners	Mean Age (Years)	Range (years)	Degree of profession
Ayurveda (n=10)	54.1	40-70	B.A.M.S or B.S.A.M
Naturopathy (n=10)	47.5	35-60	N.D.D.Y, M.B.B.S

Comparison of Ayurveda and Naturopathic practitioners

As can be seen from Table 6, both the types of practitioners had good knowledge regarding beneficial use of *Aegle Marmelos* (L.) Correa (AM), plant as a whole and leaves in particular. Seventy two percent of Ayurveda practitioners were using Bael in various forms for the treatment of various diseases such as diarrhoea, dysentery acidity, gastric ulcer, diabetes, cough cholestrolemia, oedema, fever, ophthalmic, arthritis, jaundice, food poisoning, removal of toxins, skin allergy, back-pain, loose motion, conjunctivitis etc.

All the practitioners were aware of the medicinal properties of *Aegle Marmelos* (L.) Correa. Regarding the various parts of bael that were most beneficial in the treatment of various diseases, leaves and fruits are more important-raw fruit is used for the treatment of

General information regarding the practitioners

The mean age of the Ayurveda practitioners enrolled for the study was 54.1 years (range of 35-70y). They all were qualified with either Bachelor of Ayurvedic-Medicine and Surgery (B.A.M.S) or Bachelor of Surgery and Ayurvedic Medicine (B.S.A.M), M.D. (Ayurveda) degrees and were giving treatment through *panchkarma*. The mean age of the naturopathic practitioners was 47.5 years (age range of 33-55 years) and all had a degrees such as Diploma in Naturopathy and Yoga (N.D.D.Y), M.B.B.S., Diploma in Child Health (D.C.H), Diploma in Alternative Medicine, Naturopathy and Yoga (A.D.N.Y) and running a *Nisargopchar Kendra*. The mean age of Ayurveda practitioners was 54.1 years (age range of 40-70 years). Ninety five percent of them were qualified to practice Indian Medicine in any part of India (Table 5).

diarrhoea and ripe fruit is used for the treatment of acidity and gastric ulcer.

Naturopathic practitioners knew about the medicinal properties of this plant. It was used mainly in oedema, diarrhoea and other digestive disorders. Among various parts of this plant like root, fruit, stem, leaf etc., roots and fruits were used in acidity (*vaat na rogo*), all types of pains, nervous disorders, cytica, and muscular disorders. (Table 6). Few also reported that tender new leaves are effective in not only diabetes but also constipation (dosage-15-20 triplet or trifoliate leaves- "*Akhandpaari*"). Bael fruit is used in the treatment of diarrhoea. Ripe fruit sherbet is used for the prevention of heat wave "loo". Some reported that *Bael* is used in powdered form for the treatment of diabetes and oedema. One of them said that leaves contain an alkaloid rutacin which is hypoglycaemic. 'two leaves before breakfast' is said to keep diabetes under control.

Table 6: Comparison Of Knowledge Regarding Diseases In Which *Aegle Marmelos* (L.) Correa Was Used By Ayurveda And Naturopathy Practitioners

Types of practitioners	Use of AM in diabetes	Diseases in which <i>Aegle Marmelos</i> (L.) Correa is used
Ayurveda	72%	Diarrhoea, Dysentery acidity, gastric ulcer, Diabetes, cough, cholestrolemia, oedema, fever, ophthalmia, arthritis, jaundice, conjunctivitis etc.
Naturopathy	40%	Food poisoning, diabetes, removal of toxins, skin allergy, back-pain, loose motion etc.

Comparison between Ayurveda and Naturopathic practitioners for the types of preparation of *Aegle Marmelos* (L.) Correa leaves in various treatment

Ayurvedic practitioners used various forms of preparation of leaves like tablet, powder, dry extract and decoction. Mostly powdered

form of *Aegle Marmelos* (L.) Correa leaves is used more as juice is inconvenient to be given to the patients. It can be given in powdered form or raw form. Kerala Ayurvedic centre reported that *Aegle Marmelos* (L.) Correa can be used for external applications for removal of skin allergies in the form of goli, chawanprash leham or decoction. Whereas naturopathic practitioners preferred raw

intake of the leaves in the form of paste or juice (Table 7 and Figure: 5). The most preferred form of preparations among Ayurveda practitioners were tablet, powder and dry extract (30%

each) whereas fresh juice of *Aegle Marmelos (L.) Correa* was the most preferred recommendation by Naturopathic practitioners (60%).

Table 7: Comparison Between The Types Of Preparation Of *Aegle Marmelos (L.) Correa* Leaves Used By Ayurveda And Naturopathic Practitioners

Types of Practitioners	Types of Preparation					
	Tablet	Powder	Dry extract	Juice	Decoction	None of these
Ayurvedic	30%	30%	30%	—	10%	—
Naturopathic	—	20%	—	60%	10%	10%

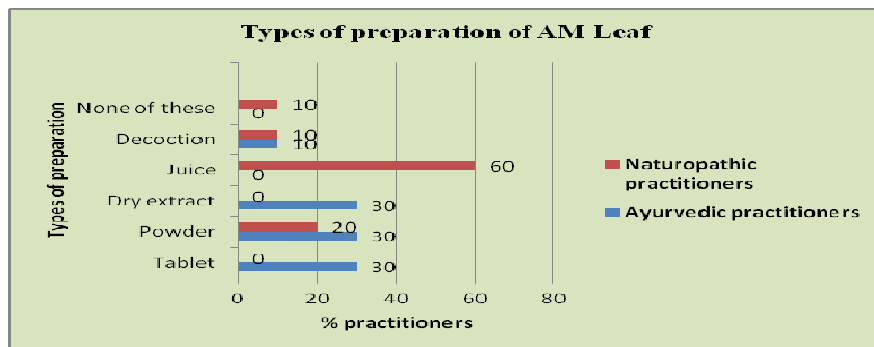


Figure 5: Types Of Preparation Of Am Leaf

Parts of *Aegle Marmelos (L.) Correa* plant used in various treatment according to various practitioners

As seen from the Table 8 and Figure 6-7, leaf is the maximum part of the plant utilized for medicinal purpose in comparison to fruit, root, bark and stem. Out of various parts, Ayurveda practitioners used 70% leaf in comparison to other parts whereas naturopathic

practitioners used 50% leaves for the treatment of various diseases. This finding is similar to the result of Chanda and Dave (2009) who screened out various medicinal plants for their antioxidant potential and concluded that generally, any part of the plant can be used for antioxidant studies but most commonly used part is leaf followed by fruit which is generally used for treating gastrointestinal disorders.

Table 8: Parts Of *Aegle Marmelos (L.) Correa* Leaves Used In Various Treatment According To Various Practitioners

Types of Practitioners	Leaves	Fruit	Root	Bark	Neither
Ayurveda	70%	20%	5%	5%	—
Naturopathic	50%	10%	—	—	40%

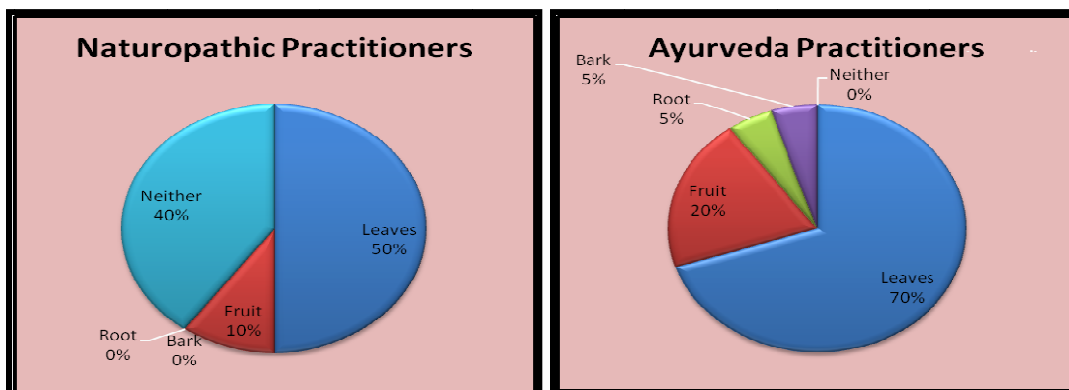


Figure 6,7: Use Of Plant Parts By The Naturopathic Practitioners And Ayurvedic Practitioners



Forms of preparation

Many different plants have been used individually or in poly herbal formulations for treatment of diabetes and its complications. One of the major problems with this herbal formulation is that the active ingredients are not well defined. It is important to know the active component and their molecular interaction, which will help to

analyze therapeutic efficacy of the product and also to standardize the product. As can be seen from Table 9, *Aegle Marmelos (L.) Correa* was utilized for the medicinal purpose either singly or in combination. The Ayurveda practitioners used 45% *Aegle Marmelos (L.) Correa* leaves in single and 50% in combination whereas Naturopathic practitioners used 50% *Aegle Marmelos (L.) Correa* leaves singly and 40% in combination.

Table 9: Comparison Between Forms Of The Preparation

Types of Practitioner	Single	PHF	%	Type of combination	Can't Say
Ayurveda	45%	50%	30%	(AM+ Curcumin longa (Haldi) + pterocarpus Marsupium (Vijaysar)	5%
			20%	(AM+Azadirachta indica (neem) + Curcumin longa	
Naturopathic	50%	40%	20%	(AM +piper nigrum)	10%
			20%	(AM + Azadirachta indica + Curcumin longa)	

PHF-Poly Herbal Formulations

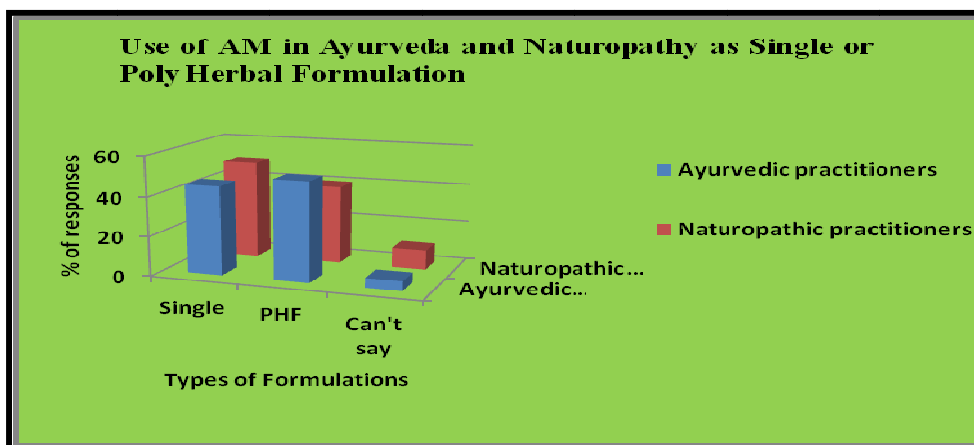


Figure 8: Percent Response Of Ayurveda And Naturopathy Practitioners On The Use Of Aegle Marmelos (L.) Correa As Single And Phf

Dosage of *Aegle Marmelos (L.) Correa* given in diabetes

Dosage of *Aegle Marmelos (L.) Correa* leaves regarding treatment for diabetes was not fixed. Twenty percent told that depending upon the body weight maximum 2 grams twice a day (1g-4 tablets each of 250 mg of *Aegle Marmelos (L.) Correa* leaves) was sufficient. However the duration depended upon the severity of the diabetic condition but maximum 45 days supplementation was sufficient for reversal to the normal condition. Practitioners from Kerala Ayurvedic Centre did not make use of the AM in the treatment of diabetes but recommended standard drug like Diarid, GlysoKit and Nishakathakaadi Kasayam Kwath which did not include *Aegle Marmelos (L.) Correa*. No single drug or component

were used but compounds were mixed in polyherbal formulation and decoction was advised.

There was no standardized dosage formulation agreed upon by all the practitioners. 50% of the Naturopathic practitioners were of the opinion that *Aegle Marmelos (L.) Correa* leaf in fresh form alone is sufficient to control high blood sugar. According to them, juice of 22-40g fresh leaves made to a final volume of 100ml with water could be given to patient every day in the morning empty stomach. Duration varied from 45-60 days for significant reduction in blood sugar levels.

However 40% were in favour of poly-herbal formulation. Forty percent Naturopathic practitioners were of the opinion that *Aegle Marmelos (L.) Correa* alone is not effective enough. Twenty percent said that *Aegle Marmelos (L.) Correa* should be combined with other herbs like Neem and Curcumin (Haldi). So according to



them, one tsp of dry *Aegle Marmelos (L.) Correa* leaf powder with half teaspoon of Neem and Curcumin (haldi) in the form of polyherbal formulation twice a day is very effective treatment for uncontrolled diabetes.

Twenty percent Naturopathic practitioners said that 10-20 green leaves of *Aegle Marmelos (L.) Correa* crushed with 5-7 piper nigericum (*kali mirch*) and taken early morning helped in maintaining normal sugar levels. Ten percent could not agree upon form and dosage. Also they insisted upon inclusion of green leafy vegetables and fruits to form part of their daily diet. Raw diet was important part of treatment along with drug therapy. Forty percent of the Naturopaths did not use either leaf or fruit of *Aegle Marmelos (L.) Correa* since their line of treatment is based on detoxification of body and its self healing, so they used less of medicinal herbs and that too common culinary items like Bitter-gourd (karela) and Fenugreek (methi) were used by them in the treatment of diabetes. Forty five percent Ayurveda practitioners agreed that treatment with *Aegle Marmelos (L.) Correa* leaves only is enough to control high blood sugar. According to them one tsp dry *Aegle Marmelos (L.) Correa* leaf powder can be given with warm water twice a day to control high blood sugar levels. Fifty percent Ayurveda practitioners believed that *Aegle Marmelos (L.) Correa* leaves are not sufficient to cause change in high insulin levels and combined therapy in the form of polyherbal formulation is more effective. Other herbs and spices like curcumin, *Azadirachta indica* (neem) and *pterocarpus Marsupium* (Vijaysar) could be combined with *Aegle Marmelos (L.) Correa* in dry powdered form twice a day. The duration varied from 2-3 months. However 5% of Ayurveda doctors could not agree upon any fixed dosage and form of therapy.

Various Ayurvedic pharmacopeia preparations involving *Aegle Marmelos (L.) Correa* leaf

According to Ayurvedic practitioners, various Ayurvedic pharmacopeia preparations like Bilvadi tablets, Bilvadi Ras, Bilvadi ghanvati, Bilvadi churna, bilvadi taila, bilvamuladi gutika, Lakshmana louh (Bhaishajyaratnavali), jeera kabilwadi leha, dashmularishta, murraba, sherbet (of fruit) made from *Aegle Marmelos (L.) Correa* were the specific formulations being prescribed for the treatments. Others reported that both single or PHF can be given.

Ayurveda practitioners used *Aegle Marmelos (L.) Correa* leaves for the treatment of diabetes. Dosage for the treatment ranged from 5-10g/day in various forms such as powder, decoction and dry extract in the form of capsules (1 capsule contains 0.5mg of extract which is equivalent to 5mg of leaf powder). Naturopathic practitioners used the *Aegle Marmelos (L.) Correa* leaves for the treatment of diabetes and the dosage ranged from 20-40g fresh leaves in the form of juice mixed with water to make a volume of around 100ml (Figure 9)

Conclusions

From the several pharmacological activities and various poly herbal formulation narrated above, it is concluded that *Aegle Marmelos (L.) Correa* (Bael) is a plant of multiple medicinal properties. This plant has been used in traditional system of medicine for the treatment of various diseases. Studies in the desk review easily predict the fact that whole plant has sufficient medicinal value. Knowledge, practice and use of *Aegle Marmelos (L.) Correa* and its desk reviews focused on an overall use of plant leaves used in Ayurveda and its future prospects for the further scientific investigation. It also helped to throw some light on dose formulation for treatment of diabetes.

Desk reviews revealed that *Aegle Marmelos (L.) Correa* leaves were being recognized as a remedy for the treatment of diabetes in both Ayurveda and Naturopathy. Many Ayurvedic formulations were available commercially in the market of various reputed brands such as Dabur, Himalaya, Oshidhi, Patanjali etc. which contained *Aegle Marmelos (L.) Correa* leaves in the form of various powder, tablets, capsules, etc. These formulations were selling the products and drugs in poly herbal formulations (PHF) rather than single drug. Naturopathy did not contain any commercial brands of *Aegle Marmelos (L.) Correa* leaves as it believes in fresh doses of the plant.

Ayurvedic practitioners gave 5-10g/day in various forms such as powder, decoction and dry extract in the form of capsules whereas Naturopathic practitioners recommended 20-40 fresh *Aegle Marmelos (L.) Correa* leaves for the treatment of diabetes in the form of juice mixed with water to make a volume of around 100ml. Several branded Ayurveda poly herbal formulation of *Aegle Marmelos (L.) Correa* leaves were available in many pharmacies but *Aegle Marmelos (L.) Correa* leaves were not available as a single drug.

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Conflict of Interest

The authors wish to declare that there is no conflict of interest.

Ethical approval

The study was approved by Ethics Committee of Department of Foods and Nutrition, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat (The Ethical Clearance No: IECHR/2013/20).

Informed consent

Informed written consent was obtained from all individual participants included in the study.



Author's Contributions

1) Ms. Vinita Nigam have made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data and drafting the manuscript

2) Dr. Vanisha S Nambiar has revised it critically for important intellectual content and has given final approval of the version to be published.

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