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OSTEOPROTECTIVE EFFECT OF FEW INDIAN HERBS: AN UPDATE

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Abstract ▶ Natural herbs have been widely used in orthopedic clinical practice in India, China and other countries since ancient times. The increase of aging population and the prevalence of osteoporosis, demands new therapeutic agents and nutritional supplements for the promotion of bone health. The Indian diet includes rich medicinal herbs. This review intends to highlight scientific information on naturally-occurring herbs like onion, garlic, clover, walnut, beans etc., consumed regularly in Indian diet which has been documented to possess osteoprotective properties. Focus has been put on literature available in the last ten years on Indian medicinal plants used for bone metabolic disorders like osteoporosis.

Key Words: Indian medicinal plants, herbs and bone, osteoprotective.

Introduction

Traditional herbal medicines have been used for the treatment of various diseases, since they are considered less toxic and free from side effects when compared with synthetic drugs[1]. Natural herbs have been widely used in orthopedic clinical practice in India, China and other countries since ancient times. India being one of the richest countries in herbal resources, the food items enacts to be medicine and it is vice versa. This review intends to highlight scientific information on naturally-occurring herbs consumed regularly in Indian diet which have been documented to possess osteoprotective properties.

The common vegetables, salads and herbs commonly consumed in the diet significantly inhibited bone resorption at a dose of 1 g/day. These included: arugula, broccoli, cucumber, cabbage, red cabbage, dill, garlic, wild garlic, leeks, lettuce, onions, Italian parsley, common parsley and tomatoes. Women (45-55 years) who had consumed high amounts of fruits and vegetables in childhood showed higher bone mineral density (BMD) of the femoral neck than those that had consumed medium/low amounts. Pubertal children who have consumed fruit and vegetables >3 times per day showed better bone health, and the radius in particular. Not only in human beings, experimental studies in rats maintained of human diet (vegetables, fruits, nuts, seeds, mushroom, etc.) have identified certain food types that inhibited bone resorption[2].

Herbs and bone

***Cissus quadrangular* Linn.** (*C. q*) belongs to family Vitaceae, is an indigenous medicinal plant of India. It is

known as 'asthisanghara' in Sanskrit, meaning "which will strengthen the bones" and perandai in Tamil. The use of this plant by the common folk for promoting fracture healing process is an old practice. Commonly known as "bone setter" or "bone knitter", the plant is referred to as "Asthesamdhani" in Sanskrit and "Hadjod" in Hindi because of its ability to join bones. It has been prescribed in ancient Ayurvedic texts by *Bhava Prakash* and *Chakra Dutta* as a general tonic especially for the fractured patient. Since then it has been in extensive use by bone setters both for external application and as an internal medicine to be taken with milk. The stem part of *C. q* has been reported to contain triterpenes including β and β amyrins, β-sitosterol, ketosteroid, β-carotene and vitamin C. The plant has also been shown to have antioxidant flavanoid, quercetin. These phytoconstituents are known to induce osteoblastic differentiation of mesenchymal cells. Maternal treatment with *C. q* is effective against diabetes-induced delayed fetal skeletal ossification[3, 4]. The effect of *C. q* in inducing alkaline phosphatase (ALP) activity was found to be mediated through MAPK activity in murine osteoblastic cells[5].

C. quadrangularis influenced fracture healing by increasing metabolism and uptake of minerals calcium, sulphur and strontium. *C. quadrangularis* improved in early regeneration of all connective tissues involved in the healing and quicker mineralization of callus during fracture healing. Bone remodeling includes fibroblastic phase (first week), collagen phase (second week) and osteochondroital phase (third and fourth weeks). Bone healing duration examined in fractured rats envisaged the quickest bone remodeling process with eventual time reduction. This hastening in the fracture healing was attributed to the stimulation of all the cells of mesenchyma origin, namely the fibroblasts, chondroblasts and osteoblasts (OB). *C. quandrangularis* builds up the chemical composition of the fractured bone namely mucopolysachrides, collagen, calcium (Ca) and phosphorus (P)[6]. Petroleum ether extracts of *C. q* stimulated osteoblastogenesis and mineralization in bone marrow mesenchymal cells (BMSC) and murine osteoblastic cell lines[4, 5]. *In vitro* studies have shown that ethanolic extracts of *C. q* increased mRNA and proteins related to the bone formation pathway and (Insulin like growth factor) IGF-I, IGF-II, and IGF binding protein[7, 8]. *C. quandrangularis* can reduce ovariectomy (OVX) induced bone loss and it does this in the long bones in a site-specific manner with more effects on the cancellous bone of femur followed by tibia. It probably reduces bone resorption primarily by down regulating pro inflammatory cytokines TNF-β, IL-1β, and IL-6 which are increased after OVX in mice[9]. It is also effective in improving histological, biomechanical and biochemical changes of trabecular and cortical tibial bone in diabetic rats with increase in ALP, Type I collagen (COL-I) and decrease in tartrate resistant acid phosphatase (TRAP)[3]. In single blind clinical controlled human trial, serum PTH level was in peak at 21st day of fracture healing, osteoblastic activity was also maximum at the end of third week as evidenced in animals. It is also having influence on accelerating the fracture healing process and further it helps in reducing period of immobilization and early rehabilitation[10].

Pomegranate is the fruit of *Punica granatum* L. (Punicaceae) that has been used extensively in the folk medicine of many cultures. It is one of the oldest edible fruits. India is a native land of the pomegranate which is grown in coastal and mountainous areas. The presence of estrogenic compounds in pomegranate seeds makes it a potential alternative or supplement to hormone replacement therapy (HRT) in postmenopausal women. In addition to estrogenic activity, it also has antioxidant activity. Pomegranate contains other steroids such as testosterone and β-sitosterol in seeds. Isoflavones (genistein and daidzein), anthocyanins, ascorbic acid, ellagic acid, gallic acid, caffeic acid, catechin, Epigallocatechin gallate (EGCG), quercetin, rutin, numerous minerals, particularly iron and amino acids are in pomegranate juice[11]. The ethanolic extract of pomegranate significantly enhanced OB growth and differentiation markers (ALP activity and collagen content) and inhibits TNF-β induced IL-6 and NO production in MC3T3-E1cells[12]. Pomegranate consumption was able to significantly prevent the decrease in BMD and bone microarchitecture impairment and thus preventing the bone loss associated with OVX in mice. Moreover, the exposure of RAW264.7 cells to serum harvested from mice that had been given a pomegranate-enriched diet, elicited reduced osteoclast (OC) differentiation and bone resorption, as shown by the inhibition of the major OC markers. In addition, pomegranate substantially stimulated ALP activity at day 7, mineralization at day 21 and the transcription level of osteogenic markers in MC3T3-E1cell line[13].

Onion (*Allium cepa*) belongs to the family Alliaceae. Onion is an important source of valuable phytonutrients as flavonoids, fructooligosaccharides (FOS) and thiosulfinates and other sulphur compounds[14]. Onion extract inhibited loss of bone in an osteoporotic rat model[15]. β-L-glutamyl-*trans*-S-1-propenyl-L-cysteine-sulfoxide (a β-glutamyl peptide) isolated from onion inhibited bone resorption in rats *in vivo* and OC *in vitro*[16]. Water solution of onion powder inhibited the receptor activated nuclear factor βB ligand (RANKL) plus macrophage-colony stimulating factor (M-CSF)-induced differentiation of BMSC and RAW 264.7 macrophage cells to OCs[17]. Onion administration provided significant changes in the levels of ALP, free radicals, total

antioxidant capacity, antioxidants, BMD in humans and also decreased *in vitro* osteoclastogenesis, thus showed a positive modulatory effect on the bone loss by improving antioxidant activities[18].

Garlic (*Allium sativum* Linn.) which belongs to the family Alliaceae is a common spicy flavoring agent used since ancient times. Garlic is gaining attention as being beneficial to bone. The estrogenic activity of garlic acid helps in the maintenance of skeletal health in the same manner as estradiol (E_2)[19]. Garlic acid significantly reduced the increase in urinary levels of hydroxyl proline, Ca, PO_4, creatinine and serum levels of TRAP and ALP which occurred after OVX and reversed the reduction in bone density[20]. The immunomodulatory effect of garlic, as well as the modulation of (Interleukin) IL-1, IL-6, (Tumor necrosis factor) TNF-β production was studied in a double-blind randomized controlled clinical trial in postmenopausal women[21].

Cinnamon belongs to the family *Lauraceae.* Cinnamon is an evergreen tree, which has been traditionally harvested in Asian countries. Various species of cinnamon are grown in various parts of southern India and a remarkable quantity is produced from Kerala. The *Cinnamomum cassia blume* (*C. cassia*) bark has been found to contain cinnamaldehyde (CA) and 2-Methoxy cinnamaldehyde (2-MCA) as its active components[22]. CA and MCA of *C. zeylanicum* reduce OC-like cell formation by inhibiting nuclear factor T cell activator 1 (NFATc1) expression. MCA exhibited remarkable inhibition rates of 95% at 2 μM on bone in pit resorption assay. CA and MCA inhibited RANKL-induced osteoclastogenesis[23]. The ethanolic extract of *C. cassia* (CCE) has estrogenic activity and the estrogenic compound competes with estrogen (E) ligands for binding to estrogen receptors, ERβ and ERβ. CCE bind with ERβ with greater affinity than ERβ. Further, CCE increased the survival of MC3T3-E1 cells and increased the ALP activity, collagen synthesis, osteocalcin (OCN) secretion and bone nodule formation. Thus, CCE has anabolic effects on preosteoblasts. However, the extract inhibited TNF-β-induced secretion of IL-6 and nitrite production by MC3T3-E1 cells[24]. The bark extract inhibited OC activity through suppression of NAFTc mediated signal transduction[23]. Thus, CCE extract can inhibit bone resorption.

Wedelia calendulacea (Less.) known also as pila bhangra is a perennial herb with erect stems, 20-40 cm. high. The presence of isoflavones and wedelolactone, which are known to act as phytoestrogens are suggested to be responsible for the antiosteoporotic activity [25], [26].

Withaferin A (WFA) from leaves of ***Withania somnifera*** commonly known as aswagandha prevented bone loss by reducing expression of OC genes TRAP and RANK and increase in bone turnover marker, OCN. In OVX rats the increase in inflammatory cytokine, TNF-β was reduced with WFA treatment comparable to E_2 administration. At cellular level, WFA promoted differentiation of BMCs and increased mineralization by inducing expression of osteoblastogenic genes. WFA treatment prevents bone loss that is comparable to alendronate and E_2[27].

Erythrina variegate (*E.v*) (Kalyanamurungai in Tamil), a member of Leguminosae Family is a showy, spreading tree, a legume with brilliant red blossoms. Commonly known as 'Indian coral tree' in Asia. Highly valued ornamental tree described as one of the gems of the floral world. Its bark and leaves are used in India, China, and Southeast Asia, to treat rheumatic joint pain, spasm of the limbs as well as lower back and knee pain, and to stimulate lactation and menstruation in women. Rats treated with the alcoholic extract prevented the OVX-induced increase in the serum OCN, ALP, and urinary deoxypyridoline (DPD) levels. Histomorphometric analysis of the proximal end of the tibia showed that the extract prevented the E deficiency-induced decrease in trabecular thickness and trabecular area, as well as restored the increase in trabecular separation in a dose-dependent manner. An ethanolic extract of this plant has been shown to prevent the bone loss in OVX rats and these effects were attributed to the genistein derivatives present in the extract including 6-prenylgenistein, 8-prenylgenistein. 6,8-diprenylgenistein isolated from *E.v* demonstrated stimulatory effects on osteogenesis in UMR 106 cells[27]. *E.v* suppressed the up-regulation of cathepsin K mRNA and the down-regulation of OPG mRNA in the tibia of OVX rats. TRAP-positive cell numbers were significantly decreased in RANKL-induced RAW 264·7 cells when cultured with *E.v* extract[28].

Wal-nut (*Jugulans regia* Linn.) methanolic fruit extract stimulates the mineralization of matrix secreated by OBs (KS483 preosteoblast-like cell line is derived from fetal mouse calvaria, which is a non-transformed stable subclone of a parental cell line KS4) when compared with treatment groups of ellagic acid (EA) and ellagic acid derivatives from walnut[29].

Phaseolus vulgaris (PV) commonly known as French **beans** is a member of Fabaceae family. Beans contribute to improving bone health. Compared with the OVX rats, methanolic extract of PV significantly decreased serum ALP and reduced serum TRAP and urinary Ca levels. It caused an increase in BMD, bone mechanical strength, increased bone Ca and improved bone microarchitecture[30]. The bean hull extract (BHE) given in aqueous solution stimulated bone formation and inhibited bone resorption

or activity in mice. BHE supplementation (800 mg/kg) significantly increased BMD and trabecular thickness in the third lumbar of vertebrae, decreased serum TRAP and PTH concentrations in mice[31].

Dried plum, or prunes (*Prunus domestica L.*) a rich source of polyphenolic compounds is most effective fruit in both preventing and reversing bone loss in two models, androgen deficient male rats and OVX female rat models. It improved the biomechanical parameters like BMD, cortical load, trabecular architectural properties such as trabecular number and connectivity density, and trabecular separation studied by micro computed tomography. It also enhanced bone recovery during reambulation following skeletal unloading and had comparable effects to PTH in ovx rats. A 3-month clinical trial also indicated that the consumption of dried plum daily by postmenopausal women significantly increased serum markers of bone formation, total ALP, bone-specific ALP (BALP) and IGF-I[32]. Dried plum entitled its action by up-regulating bone morphogenetic protein 4 (BMP4) and IGF-I while down-regulating Nfatc1 in OVX rats[33].

Camellia sinensis (Tea) is native to mainland South and Southeast Asia, but is today cultivated across the world, in tropical and subtropical regions. It is an evergreen shrub or small tree that is usually trimmed to below two meters (six feet) when cultivated for its leaves. Tea is manufactured in four basic forms viz green tea, white tea, black tea and oolong tea. The major constituents in tea are polyphenols and flavonoids. The four major flavonoids in green tea are the catechins *i.e.* epicatechin (EC), epigallocatechin (EGC), epicatechingallate (ECG) and EGGC. EGCG is richest in the leaf bud and occurs first in the leaves. The usual concentration of total polyphenols in dried green tea leaves is about 8% to 12%. Other compound of interest in dried green tea leaves include gallic acid, quercetin, kaempferol, myricetin, caffeic acid and chlorogenic acid. Black tea extract (BTE) was effective in preserving and restoring skeletal health by reducing the number of active OCs. BTE supplementation reduced oxidative stress of mononuclear cells, serum levels of IL-6, TNF-β and RANKL. The bone breaking force, histological and histomorphometric analyses also restored the delitorious effect with BTE supplementation in OVX rats. This study suggests that BTE has both protective and restorative actions against OVX-induced mononuclear cell oxidative stress and associated bone loss[34].

There are 5 main possible mechanisms of action through which green tea protects bone health. Green tea acts on antioxidant stress, anti-inflammation, osteoblastogenesis osteoclastogenesis and osteoimmunology. Green tea elucidates its effect (1) *by mitigating bone loss through antioxidative stress action*: green tea polyphenols (GTP) supplementation improved cellular antioxidant enzymes and diminished oxidative stress damage, and also had a beneficial effect on bone mass and microarchitecture in rats. EGCG in GTP decreased the formation of oxidative stress-induced Ca stone deposit formation in rats because of EGCG's antioxidative effects. (2) *by mitigating bone loss through anti-inflammatory action*: GTP has also been proven to be beneficial in the prevention and treatment of a number of inflammatory diseases. A low-grade systemic chronic inflammation occurring in atherosclerosis leading to inflammation can also result in systemic bone loss by elevation of proinflammatory mediators, such as TNF-β, IL-β, β-interferon and prostaglandin E_2 (PGE_2) which act directly on bone or indirectly to increase osteoclastogenesis, prevent OC apoptosis, and/or inhibit OB activity. The protective effect of EGCG is due to its ability to decrease lipid peroxidation, oxidative stress and the production of NO radicals by inhibiting the expression of inducible NO synthase. (3) *by enhancing osteoblastogenesis*: the components in green tea support osteoblastogenesis by increasing OB survival, proliferation, differentiation and bone formation, (4) *by suppressing osteoclastogenesis*: The bioactive components in green tea decreases the action of OCs *in vivo* and reduce osteoclastogenesis *in vitro*. The effects of green tea include suppressing bone resorption, increasing apoptosis of OCs, and inhibiting the formation of OCs, and (5) *probably through osteoimmunological action*: GTPs may modulate osteoimmunological activity first, by inhibiting differentiation of OCs through RANKL signaling, and second, by modulating the production of cytokines by immune cells[34]. Matrix metallo protein (MMP)-2 and MMP-9 activities were lower in theaflavin-3,3'-digallate (TFDG). TFDG and EGCG inhibited the formation and differentiation of OC *via* inhibition of MMPs. TFDG may suppress actin ring formation more effectively than EGCG. Five flavanes, isolated from Huangshan Maofeng tea, showed effects on proliferation of osteoblastic cells and ameliorated H_2O_2-induced C2C12 mouse myoblast cell apoptosis. (-)-Epicatechin increased ALP activity and hydroxyproline content, (-)-Epiafzelechin significantly increased the area of mineralized bone nodules. The flavanes are effective in promoting osteblastic proliferation, differentiation and protecting against apoptosis in C2C12 cells. Thus tea has anti-osteoporotic potential linked to antioxidative activity[35].

Carthamus tinctorious L. commonly known as safflower or false saffron belongs to the family Asteraceae. Oral administration of safflower seed oil at a dose of 1 ml/kg to OVX rats for 30 days significantly increased IGF-I, IGF-II, IGFBP-3 and BALP levels. The histopathological study suggested that safflower seeds have a possible role in the improvement of OVX-induced osteoporosis in rats[36]. The aqueous safflower seed extract supplementation in rats

for 3 weeks after fracture increased BMP-2 gene expression *in vivo* and also increased BMP-2 expression in MG-63 cells *in vitro.* Aqueous extract of safflower seed has promoted bone nodule formation, Ca uptake, ALP activity and intracellular concentration of $Ca^{2+}$and proliferation[37, 38] of MC3T3-E1 cells. Safflower seeds are rich in Ca, potassium and P. A significant increase in the levels of serum IGF-I in rats was observed after treatment with methanolic extract of safflower seeds for 1 week and a strong correlation between femur length and IGF-I was observed[39].

Clover is native to Europe, western Asia and northwest Africa, but planted and naturalized in many temperate areas including America and Australia. Red clover, *Trifolium pratense* belongs to Fabaceae family. In the homeopathic Materia Medica, *T. pratense* is said to stimulate the secretion of the salivary glands, to be beneficial in mumps and to have anticancer effects. It is used in the treatment of menopause symptoms, maintenance/improvement of cardiovascular health and for the reported benign effects on the breast, endometrium and neural structure besides for its safety[40]. The isoflavones biochanin A and genistein present in the leaves have estrogenic activity. Red clover extract (RCE) contain 40% isoflavones by weight (genistein, daidzein, biochanin A and formononetin present as hydrolyzed aglycones). As for the bone-preserving property, the effects of red clover have not been examined as extensively as for soy. Methanol extract of *T. pratense* shows significant competitive binding to ERβ and β. Isoflavones significantly increased bone mineral content, mechanical strength of the tibia, femoral weight, femoral density and prevented the rise of serum ALP levels in OVX rats. In addition, the treatment with isoflavones, It also significantly reduced the number of OC compared to OVX rats. The findings suggested that *T. pratense*is flavones are effective in reducing bone loss induced by OVX, probably by reduction of the bone turnover *via.* inhibition of bone resorption[41]. Luteolin-7-O-glycoside (LG), major constituents of the another clover species *T. alexandrinum* L. LG derived from aqueous methanol extract of *T. alexandrinum* L. has estrogenic effect, significantly inhibited the bone turnover markers, increased bone-ALP, OCN, COL-I, N-terminal, and C-telopeptide of type II collagen levels and promoted bone formation[42].

The Plant-based drugs are used globally for healing different illnesses in traditional systems of medicines. The medicinal plants used for bone healing is listed in **Table 1**. Eco-friendly and bio-friendly plant based approach for the healthy living is appreciated and followed throughout the world. The employment of plants in ethnomedicine is on rise worldwide. The scarce scientific evidences for the medicinal properties on bone healing is being attempted since two decades. The gist of herbs used for bone healing and its mechanism of action is given in **Figure 1**.

Table 1. List of medicinal plants used for bone fracture healing is given below [43-45].

S. No.	Medicinal plants	Common name	Vernacular Tamil name	Uses
1	*Alangium salviifolium Alangiaceae*	Sage Leaved Alangium	Alandi	Leaves and bark are used for bone fracture
2	*Allophylus serratus (Sapindaceae)*	Indian Allophylus	Siruvalli	Stem and leaves paste applied for bone fracture
3	*Amorphophallus cam. Panulates (Araceae)*	Yam	Senaikizhangu	Leaf extract is used in preparation of medicated oil for bone fracture
4	*Bambu satulda Roxb. (Bambusaceae)*	Bamboo	Moongil	Stem and leaves paste applied for bone fracture
5.	*Butea monosperma (Fabaceae)*	Flame of the forest	Palasu	bark is used for bone fracture
6	*Calotropis gigantea (Linn.) R.Br.exAit. (Apocynaceae)*	Crown flower	Erukku	Roasted leaves are bandaged locally

7	*Cassia auriculata* L., (Caesalpiniaceae)	Matura tea tree	Avarai	Leaf paste mixed with egg albumin is applied on the fractured or dislocated area daily once for a week.
8	*Cassia occidentalis L. (Fabaceae)*	Coffee weed	NattamTakarai Paeyaavarai	The plant parts are used for healing bone fracture
9	*Commiphoramukuli (Bursaraceae)*	Guggul	*Guggal*	Used in treatment of Arthritis and fracture healing
10	*Dodonaea viscose L. (Sapindaceae)*	Hop Bush	Virali	Leaf paste with egg albumin and lime are applied to aid in bone setting
11	*Emblica officinalis L. (phyllanthaceae)*	Indian goose berry	Nelli	Induce osteoclast apoptosis through downregulating the expression of IL-6 and NF-βB
12	*Jatropha gossypifolia L. (Euphorbiaceae)*	Bellyache Bush	Amanaku	Root extract is given orally
13	*Moringa oleifera Lam. (Moringaceae)*	Drumstick	Murungai	Bark paste is applied locally
14	*Murrayapaniculata Linn. (Rutaceae)*	Orange Jasmine	Vengarai	Leaves pounded with egg albumin are applied as a plaster
15	*Ormocarpum cochinchinense (Lour.) (Fabaceae)*	South Indian Caterpillar Bush	Elumbotti	Leaves used for curing bone fracture
16	*Panax Notoginseng (Araliaceae)*	Ginseng	Aswagandha	Root is used for bone fracture
17	*Phaseolusmungo (Fabaceae)*	Black gram	Ulundhu	Applied on animal bone fractures for bone setting
18.	*Prunus cerasoides (Rosaceae)*	Himalayan cherry	Patumugam	Fresh bark paste is applied as plaster
19	*Senecio aureus (Asteraceae)*	Sarsaparilla	Nannari	Plant decoction is used to treat fractures
20	*Sida acuta Burm. (Malvaceae)*	Morning mallow	Vattathirippi	Leaf paste along with white egg yolk is applied
21	*Taxus wallichiana Planch. (Taxaceae)*	Beetal	Vetrilai	Bark paste is applied locally

22	*Terminalia arjuna (Roxb) W&A (Combretaceae)*	Arjun	Marudam	Bark is used for bone fracture healing.thedecotion or ksheerpak is taken orally to hasten healing
23	*Tinospora cordifolia (willd.) hook (Meninspermaceae)*	Heart-leaved moonseed	Shindhilkodi amirtavalli	Stem paste is used as bandage for treatment of bone fracture and dislocation of bones
24	*Zingiber officinale (Zingiberaceae)*	Ginger	Ingi	To treat osteoporosis
25	*Ziziphus oenoplia* (L.) Mill., (*Rhamnaceae*)	Jackal jujube	Elandhai	Leaves used to plaster over fractured bone

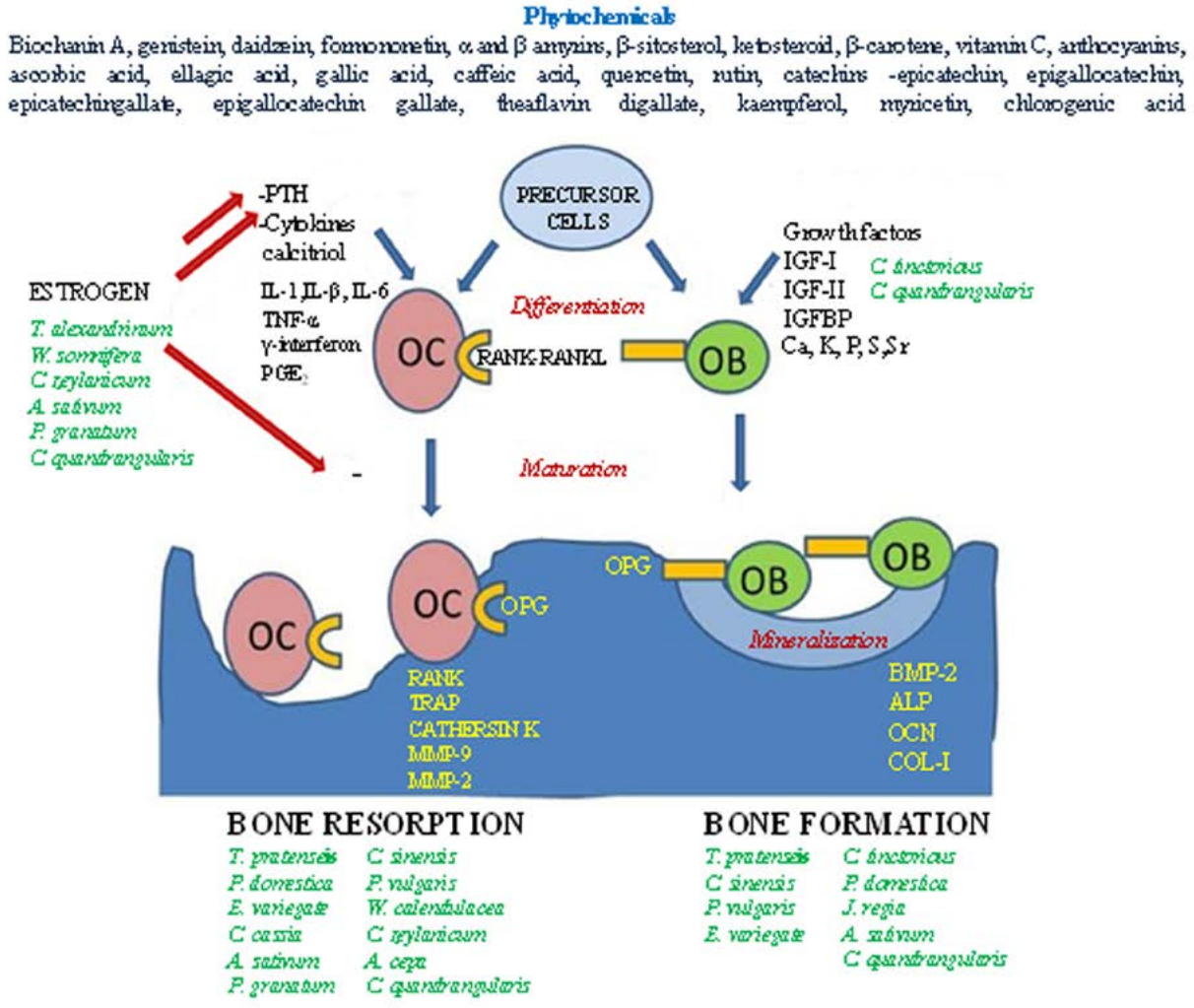

Figure1: The schematic diagram represents the mechanism of action of herbs discussed in this review.

ALP-Alkaline phosphatase , BMP-BoneMorphogenetic Protein, Ca-Calcium, COL-I-Type I collagen, IFN-Interferon, IL-Interleukin, M-CSF-Macrophage-Colony Stimulating Factor, MMP-Matrix Metallo Protein, OB-Osteoblast, OC-Osteoclast, OCN-Osteocalcin, OPG- Osteoprotgerin, P-Phosphorus, PGE_2-Prostaglandin E_2 , S-Sulphur, Sr-Strontium, RANK-Receptor Activator of Nuclear Factor βB, RANKL-Receptor Activator of Nuclear Factor βb ligand, TRAP-Tartrate Resistant Acid Phosphatase.

Conclusion

Breakthrough research, evidences for science and knowledge helps us to maintain bone health. Bone-building herbs, reduces the fracture risk naturally. Natural products for the management of osteoporosis are largely phytoestrogens, which include isoflavones, lignins, flavonoids, and coumestans that share structural and functional similarities with naturally occurring or synthetic estrogens. Phytoestrogens exhibit estrogen-like effects at various reproductive and non-reproductive tissues. Traditional medicines have been re-evaluated by clinicians, because these medicines have fewer side effects and because they are more suitable for long-term use as compared to chemically synthesized medicines. Most of plant-derived medicines have been developed on the basis of traditional knowledge in health care and in many cases. There is a correlation between the indications of pure substances and those of respective crude extracts used in traditional medicine. Many herbs were scientifically validated on its efficacy in last few decades in their osteoprotective effects. Thus the natural herbs promoting bone health may be targets for therapeutic approach towards enhancing bone formation or deducing bone loss in maintaining bone health.

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