



Plant Species Utilized to Treat Skeletal Fluorosis and Fluorosis Arthritis from Eastern Ghats of Andhra Pradesh, India

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Abstract

The present paper deals with Medicinal Plants used to treat Skeletal Fluorosis and Fluorosis Arthritis from Eastern Ghats of Andhra Pradesh. Skeletal fluorosis is a bone disease caused by excessive accumulation of fluorides in the bones. In advanced cases, skeletal fluorosis causes painful damage to bones and joints. A total 49 plants belonging to 44 genera, 33 families used against skeletal fluorosis by the tribal and rural people of Eastern Ghats of A. P., India. Further research is mandatory to focus on bio efficacy and safety aspects of these phytochemical agents for finding novel natural drugs.

Keywords: Medicinal plants, skeletal fluorosis, Eastern Ghats, Andhra pradesh

1. Introduction

Fluorosis occurs due to consumption of drinking water, in fluoride affected areas, for more than 3 to 6 months, wherein, the ground water contains dissolved fluorides in excess over 1.5 ppm. Skeletal fluorosis is a bone disease caused by excessive accumulation of fluorides in the bones. In advanced cases, skeletal fluorosis causes painful damage to bones and joints. Bones and joints become weak and moving them is difficult. The vertebrae in the spine fuse together and the patient is left crippled, which is the final stage. Crippling skeletal fluorosis might occur in people who have ingested 10 to 20 mg of fluoride per day for over 10 years. Whereas, in the initial stage, the symptoms sufferings of arthritis can be experienced with in a period of 6 months. Neurological symptoms develop in the form of radiculopathy or myelopathy due to mechanical compression of the spinal cord.

Mechanism of fluorosis:

1. The fluoride incorporation into the bone hydroxyapatite, altering the size and the structure of its crystals.
2. The fluoroapatite formed decreases the mechanical competence of the bone, resulting in abnormal structure and poor quality of bone, with increased risks for fractures.
3. Rickets, osteomalacia, secondary hyper para thyrodism and regional osteoporosis are often associated with skeletal fluorosis.
4. The bone diseases and deformities are more severe and complex in patients with dietary calcium and vitamin-D deficiencies. Calcium is the strongest antagonist of fluoride toxicity. The toxic effects of fluorides on the bones and teeth are more severe and complex in dietary calcium deficiency states. Calcium deficiency and fluoride interaction syndrome bone disease and deformities are more severe and complex in growing children, adolescents, pregnant and lactating mothers, because of greater demands for calcium in these groups. Adequate intakes of calcium to maintain the positive

calcium balance to counter act the toxic effects of fluoride is therefore essential for the population residing in endemic fluorosis villages.

Excessive fluoride exposure is well known to produce arthritic diseases and excessive degenerative changes may occur in bone joints resulting crippling. Dissolved fluoride contents in drinking water less than 1 to 1.5 ppm is tolerable and beyond that it is harmful. For Ex. In Nalgonda district of Telangana as per the survey of fluorides taken up in ground water used for drinking of humans, it is ranging from 0.5 to 5 ppm and in Prakasam district of Andhra Pradesh it is 0.5 to 9.00 ppm. An healthy person who start drinking this fluoride water for a period of 3to 6 months, experience pain initially, in all the small joints like fingers of hands and legs. Sporadic pain, Stiffness in joints, calcification of joints in ligaments and cartilage, painful knees, elbows, Lower back pain, and hip pain are experienced at a later date,gradually over a period of time. In fluoride affected areas, Fluorides enter in to humans not only through water but also through the vegetables, leafy vegetables also get deposited in all bone joints, causing erosion of cartilage, pain,and inflammation in joints. The synovial glands in the bone joints, are subjected to damage, effecting lubrication in the joints. The livestock like cows, sheep, buffaloes, goats are also affectedwith fluorosis through their food web and drinking water. In fluoride affected areas, fluorides are found in excess, in vegetables, leafy vegetables, even in the milk obtained from cows and buffaloes, which the people living herein, are consuming every day. Intake of fluorides from various sources by the people living in these areas, gradually lead them to serious sufferings fromOsteo arthritis, stiffness in joints, painful joints,deformities, bowing of legs, crippling, and sedentary life. There is no medical treatments for overcoming this fluorosis. whereas, some people living in these fluorine affected remote villages areas, are adopting the following simple remedial measures/practices to overcome the adverse effects of fluorosis and fluorosis osteo arthritis. Present investigation aims to identify the some medicinally important plants to treat the above said ailments.

2. Study area

The Eastern Ghats are a long chain of broken hills that pass mainly through three states viz., Orissa,Andhra Pradesh and Tamilnadu (Legris and Meher-Homji, (1982) [5]. They run about 1750 km with an average width of about 100 km between Mahanadi and Vaigai rivers along the Indian east coast. In Andhra Pradesh and Telangana they situated between 120 38' – 22° N latitudes and 780 50' – 840 46' E longitudes. The altitudes range from 300 – 1000 M above MSL and the vegetation varies from semi-evergreen forests to scrub jungles. Tribes like Koyas, Kondareddis, Valmikis, Chenchus, Lambadas, Jatapus, Savaras, Bagatas, Porjas, Khonds,Yanadis and Yerukalas are inhabitants of the forest regions of Eastern Ghats.

3. Material and methods

Several field trips have been conducted during 2014-2019 in the tribal pockets of Eastern Ghats of A. P., India and contacted different age group peoples and collected information on Skeletal Fluorosis and Fluorosis Arthritis. Information was gathered from traditional healers / vaidyas / gurus/ men and women of the tribal community and housewives. Repeated enquiries were made with the tribal doctors /Gurus to know about their knowledge of healing, treatment of diseases and mode of drug preparation. The methodology were adopted which were described Jain (1981, 1987, and 1989); Chadwick and Mars (1994) and Martin (1995). After completion of the field visit each plant was critically studied and identified with the help of Gamble's "Flora of the Presidency of Madras" (Gamble, 1915-1936) using the field observations. The identifications were later confirmed with the help of Flora of Andhra Pradesh (Pullaiah and Chennaiah, 1997, Pullaiah and Ali Moulali, 1997, Pullaiah, 1997) and by comparison with authentic literature which are locally available.

4. Results and discussion

In the present study 49 species of plants included in 44 genera and 33 families have been recorded from Eastern Ghats of A. P., India. Detailed information like remedies, part used, dosage and mode of preparation are presented in (Tables 1&2). Natural products from plants have played a remarkable role to cure and avert different diseases from ancient times Phillipson,(2001)Grindlay ,(1986) Kong, ,(2003) . A study conducted by World Health Organization (WHO) has reported that about 80% of world's population relies on traditional medicine⁵⁰. In USA, nearly 121 drugs are prescribed today, where 90 of them come from the natural sources particularly from plants in a direct or indirect manner Benowitz (1996) Herbal remedies can form an alternative source to relieve symptoms in patients having arthritis as well as to address the drawbacks associated with present treatment methods with allopathic drugs. In Andhra Pradesh Several researchers like Raju and Reddy (2005). Rao *et al.* (2006), Reddy *et al.* (2006), Murty *et al.* (2012) Narasimha rao and Prayaga Murty (2014) have been worked on the ethnobotanical aspects but they have not recorded any data on skeletal arthritis .

Table-1: Plants used for the treatment of skeletal fluorosis

S.NO	Name of species Family Local name	Plant part used	Dose	Method of preparation and use
1	Cissus quadrangularis Vitaceae Nalleru	Tender rhizome	50 grams	In a new earthen vessel dry red chillies, jeera, are fried in castor oil and by adding tamarind, fried cissus stem, sea salt. Chutney is prepared and eaten with cooked Rice / Jowar / Ragi.
2	Citrus aurantifolia Rutaceae Acid lime. Nimma	Fruit and fruit juice		Used in their food regularly. Used as lemon pickle. Used as lemon juice and consumed every day.
3	Tamarindus indica Caesalpiniaceae Tamarind tree	Fruit pulp Tender leaves Seeds cotyledons		Used in preparation of curries. A delicious soup called Rasam/ Pachhipulusu is prepared by using Tamarind fruit pulp, sea salt, Fried dried chillies crushed, crushed onion pieces and water. Every day, in their meal, mutton/chicken or small sized fresh water fish are taken along with the above pachhipulusu. They say that their body pains and discomfort disappear with this food. Tender leaves used in preparation chutnies and used in curries. 5 grams of Seeds cotyledons powder is prepared and mixed in milk with misri or jaggery and given orally every day for 2 months for cartilage development.
4	Phyllanthus emblica Euphorbiaceae Vusiri	Fruits		Used in preparation pickles and taken daily along with food.

5.	Curcuma longa Zingiberaceae Turmeric	Rhizome powder	Tea spoon ful	Turmeric and pepper powders are mixed in hot milk and consumed daily.
6	Piper nigrum Piperaceae Miriyalu	Seed powder	Half tea spoon	Turmeric and pepper powders are mixed in hot milk and consumed daily.
7	Capparis sepiaria Capparidaceae Nallavuppi	Stem bark	5 grams	Decoction is prepared and given every day, orally to relieve from pains of fluorosis arthritis.
8	Azadarachta indica Meliaceae Vepa	Stem bark	5 grams	Decoction is prepared and given orally every day to relieve from pains of fluorosis arthritis.
9	Holoptelea integrifolia Ulmaceae. Nemalinaara	Stem bark	5 grams	Decoction is prepared and given orally every day to relieve from pains of fluorosis arthritis
10	Vitex negundo Verbenaceae Vaavili	leaves	5 grams	Decoction is prepared using tender leaves 1 gram of pepper powder, 1 gram of turmeric powder, in 60 ml of water and given internally for pain relief.
11	Leucas aspera Lamiaceae Tummi	Leaves		Leaves are cooked/ fried in oil and made into curry and eaten with Ragisangati.
12	Ricinus communis Euphorbiaceae Caster	Seed oil	10 ml	Taken orally mixed with warm water to drain away the fluorides from the body through intestines.
13	Boehaevia diffusa Nyctaginaceae Punarnave	Whole plant powder	2 grams	Leaves are cooked/ fried in oil and made into curry and eaten with Ragisangati.
14	Abutilon indicum Malvaceae Tutturubenda	Root powder	2 grams	The indicated powders these 3 Species mentioned against the sl. nos. 13, 14 and 15 are mixed in 100 ml of water, decoction is prepared and taken orally every day for 10 days for draining out all the deposited fluorides from the body through the urinary system.
15	Aerva lanata Amaranthaceae Konda pindi	Root powder	2 grams	Taken orally mixed with warm water to drain away the fluorides from the body through intestines.

Table -2: Plants used for external applications for pain relief

1	Ricinus communis Euphorbiaceae Castor, Aamudam	Pure seed oil + Root extract	1 kg. 1 lit.	As explained in this document under Arthritis, castor oil + root extract is to be boiled to get 1 lit. of concentrate, and applied every day on the painful joints.
2	Vitex negundo	Leaves		1 kg. of vitexnegundo leaves are to be pounded,

	Verbinaceae Vaavili			mixed in 4 lits. of water in a earthen vessel. Boiled till 4 lits. of water become to 1 lit and filtered. This solution is to be mixed in 1 lit. of gingelly oil in another vessel and boiled to get finally one lit of the concentrated oil. 10 to 15 grams of pepper powder is added to this. This is applied every day on painful joints of Arthritis.
3	Dodonea viscosa Sapindaceae	Leaves		1 kg. of Dodonea leaves are to be pounded, mixed in 4 lit.of water in an earthen vessel. Boiled till 4 lits. of water become to 1 lit. and filtered. This solution is to be mixed in 1 lit. of gingelly oil in another vessel and boiled to get finally one lit.of the concentrated oil. This is applied every day on painful joints of Arthritis. Dodonea leaves can also be pounded and tied around painful joints with a thin cloth.
4	Celastrus paniculata Celastraceae Jyothishmathi/ Malkangani	Seed		Oil extracted from the seed is applied on painful joints of arthritis.
5	Litsia glutinosa Linaceae Naramamidi	Seed		Oil extracted from the seed is applied on painful joints of arthritis
6	Simarouba glauca Simaroubaceae	Seed		Oil extracted from the seed is applied on painful joints of arthritis
7	Barlaria montana Acanthaceae Mulugorinta	Leaves juice		Leaves juice is applied gently on painful joints of arthritis.
8	Calophyllum inophyllum Clusiaceae Ponnachettu	Seed		Oil extracted from seed is applied gently on painful joints of Arthritis
9	Allium sativum liliaceae Garlic/ vellulli	Bulbs		400 gm. Of garlic bulbs paste is mixed in 1 lit of boiling gingili oil stirred thoroughly on the fire for 5 minutes put off fire, allowed to be cooled and applied daily on painful joints of arthritis.
10	Rutac halepensis Rutaceae Sadapaku	Whole plant		Oil extracted from whole plant is applied on the painful joints.
11	Pinussps Pinaceae	Resin		Resin obtained from stem bark is applied on the painful joints.
12	Brassica napus Brassicaceae Canola/ Aavalu	Seed		A.250 grams of canola oil is taken in a glass bottle keep it aside. B) In a separate glass bottle keep 100 grams of pure

				camphor lump, an extract of cinnamomumcamphora (karpuram) + Menthol crystals of Mentha species(pudinapuvvu) + Vaamupuvvu, crystals of the extract of Trachyspermumammi, together. A chemical reaction takes place and Within 10 minutes these three solids will become a liquid. Add A+B = To get an excellent oil, and application of same externally gives relief for all the rheumatic pains. OR A and B may be used separately.
13	Cissus pallida Vitaceae Adavigummadi	Roots	50 grams	Bruised roots are applied on swellings of arthritic joints
14	Cleome viscosa Cleomaceae Vaaminta	Leaves and fruits	25 grams	Leaves along with fruits are to be made into paste and applied on the painful joints
15	Cleome gynandra Cleomaceae Tellavaaminta	Leaves and fruits	25 grams	Leaves along with fruits are to be made into paste and applied on the painful joints
16	Cuscutareflexa Cconvulvaceae Bangaaruteega, chetlameedapaachi	Whole plant	50 grams	Whole plant's paste is applied and bandaged on painful joint
17	Vanda cristata Orchidaceae Badanika, kodikallachettu	Whole plant	50 grams	Whole plant's paste is applied and bandaged on painful joint
18	Argyreia nervosa Convolvulaceae Samudrapaala	Leaves	100 grams	Leaves are made into paste and bandaged on the painful joints.
19	Merrima tridanta Convolvulaceae Seethammavaarijada	Whole plant	100 grams	Whole plant is made into paste and applied on painful joints
20	Achyranthus aspera Amaranthaceae Vuttareni	Whole plant	100 grams	Whole plant is made into paste and applied on painful joints
21	Cardiospermumhelicac abum Sapindaceaevekkudute ega	Whole plant	100 grams	Whole plant is made into paste and applied on painful joints
22	Delonixalata Caesalpinaceae Sunkesula	Leaves	100 grams	Leaves paste is applied on the painful joints.
23	Crateva roxburghii Capparidaceae	Leaves	100 grams	Leaves paste is applied on the painful joints.

	Isukaraasi			
24	Euphorbia tirucalli Euphorbiaceae mudu, sannajemudu	Latex		Latex of this plant is applied externally
25	Abutilon indicum Malvaceae Tutturubenda	Leaves	100 grams	Leaves paste is applied externally
26	Coldenia procumbens Boraginaceae Chepputattaku	Leaves	100 grams	Leaves paste is applied externally
27	Commifera mukul Burseraceae Guggulu	Resin	5 grams	Gum resin mixed with zingiber officinalis rhizome paste is applied externally on the painful joints.
28	Pergularia daemia Asclepiadiaceae Dustapaaku	Whole plant paste	25 grams	Whole plant's paste is mixed with turmeric powder and applied externally on painful joints of arthritis
29	Nerium oleander Apocynaceae Tellaganneru	Leaves		Leaves paste is applied externally on painful joints.
30	Plumbo zeylanicum Plumbaginaceae Tellachitramulam	Leaves		This plant is a Vesicant and applied in acute conditions.
31	Plumbago rosea Plumbaginaceae Yerrachitramulam	Leaves		This plant is a Vesicant and applied in severe/acute conditions.
32	Holoptelia integrifolia Ulmaceae Nemalinaara	Leaves		Leaves are vesicant. Leaf is dipped in water for a while and placed on knee/ painful joint and bandaged in severe and acute condition.
33	Sansevieria roxburghii Agavaceae	Leaves juice		Leaves are gently heated on fire and squeezed to get juice and applied on painful joints.
34	Calotropis gigantea Asclepiadaceae Jilledu	Leaves	200 Grams	500 ml of raw Gingelly seed oil is poured in earthen / stainless steel vessel or kadai, heated well on fire, pounded calotropis leaves are added in the heated oil. Heating is to be continued for few minutes till the leaves turn grey in colour. Fire is put off, oil is allowed to cool, screened and the oil is applied externally on the painful joints and muscles.
34	Pueraria tuberosa Fabaceae Nelagummudu	Fabaceae	50 grams	The plant parts shown against sl. nos 34 and 35 are made into a paste and applied externally on painful joints of Arthritis.
35	Brassica juncea Brassicaceae Mustard	Seed	5 grams	

36	Capparis zeylanica Are donda	Leaves	15 grams	Leaves paste is mixed with egg white yolk, poultice is prepared and applied on painful joints of Arthritis
37	Phyla nodiflora Verbinaceae Jalapippali/ Neetippali	Whole plant	50 grams	Whole plants paste is applied on painful joints of Arthritis.

Special diet being prescribed by the local village vidyas for Strong & Healthy Bones, Development of Synovial fluid and cartilage in the Bone joints

- *Setariaitalica*/ Fox millets. Family. Poacea, Local name: Korraluand
- *Triticumdicocum*/ wheat. Family. Poaceae , Local name : Godhumalu, , seeds of Godhumalu andkorralu are made in to Rawa(broken in to small pieces) , cooked and eaten daily .
- *Eleusinecoracana*/ Finger millet. Family: Poaceae, Local name: Ragi. Ragi seeds powder is cookedwith water to make Jawa/ soup, to be consumed with curds/jaggery made from ie., *Saccharumofficinarum*/sugar cane juice and to be taken orallydaily.
- *Sorghum bicolour*/Great millet, Family: Poaceae. Local name: Jonna. Jonna seeds powder is usedto prepare Rotis and eaten along with palak/Bhendi currydaily.
- *Vigna mungo*/Black gram, Family: Fabaceae. Local name: Minumulu. Seeds are soaked in water, grinded into paste roasted in gingely oil- olive oil and vadas are prepared and consumed daily.or, seeds are tofried in ghee, powdered, mixed with cow ghee and jaggery powder made into round balls called Sunni vundalu (each weighing about 20 grams) and eaten daily.
- *Sesamumindicum*/Gingelly seed, Family: Pedaliaceae, Local name: Nuvvulu. Nuvvulu seeds are tobe powdered and to be mixed with pure jaggery and eatendaily.
Egg white yolk 2 nos. are to be consumed / swallowed in raw along with jaggery daily followed by intake of one glass of cow milk mixed with one to two grams of GomuthraShilajith .
- *Abelmoschusesculanthus*/ Ladies finger. Family: Malvaceae, Local name :Bhendi is to be consumeddaily.
- Piper betle / Betel leaves, Family: Piperaceae. Local name: Tamalapaku: Betel leaves 3 to 4 nos are to be chewed alongoptimum quantity of shell lime powder daily and to begulped without spitting.
- *Annona sqamosa*/Custard apple, Family: Anonaceae. Local name: Seethaphal. Fruits are to be takenbefore meal
- *Annona reticulate* / Family: Anonaceae. Local name: Ramaphal. Fruits are to be taken beforemeal
- *Psidiumguajava*/ Guava, Family: Myrtaceae. Fruits are to be taken beforemeal
- *Musa paradisiaca* / Banana, Family: Musaceae. Fruits are to be taken beforemeal
- *Phonixdactylifera* / Date palm, Family:Arecaceae, Local name; khajoor fruits are eatendaily.
- *Citrus sinensis*/ Batevia, Family: Rutaceae, Local name: Bathhaii, Fruit juice is to beconsumed.
- *Citrus lanatus*/Indian squash melon. Family: Cucurbitaceae,Puchhakaya, Juice of fruit pulp along with seeds is to consumeddaily.
- ❖ *Spinacia oleracea*/ spinach, Family: Chenopodiaceae. Leaves are made into curry and taken.
- ❖ *Basella alba* / Basellarubra, Bachhali, Family: Basellaceae, Leaves are made in to curry and eaten daily for cartilage development.
- ❖ *Lycopersiconesculentum*/Tometo, Family: solanaceae. local name:Tometo.
- ❖ *Daucas carota*/carrot, Family: Apiaceae
- ❖ *Beeta vulgaris* /Beet root, Family:Chenopodiaceae

- ❖ *The above 3 items each weighing 100 grams each are to be made into juice by adding adequate water and to be taken orally everyday*
- *Moringa oleifera/ drumstick leaves, Family:Moringaceae*
- *Cajanuscajan / Red gram seed, Family:Fabaceae*
The Above two items are to be cooked and consumed along with Jowarroti . Intake of Rice and other curries are to be avoided completely. Optimum quantities of the above mentioned qualitative food is to be taken.
- *Amaranthus viridis/ Thotakura / Family: Amaranthaceae* is to be made into curry and to be consumed with jowar roti

5. Conclusion

Local people in this region, men and women having used these medicinal plants for cure disease, these plants are easily available and no side effect. Further research is mandatory to focus on bioefficacy and safety aspects of these phytochemical agents for finding novel natural drugs.

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