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Role of White Sandal in Times of COVID-19- A Hypothesis

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Abstract White sandal (*Santalum album* L.) grows in sandy alluvial or laterite soil having adequate edaphic as well as environmental factors. There are references of Sandalwood in Indian mythology, folklore and ancient scripts. 'Chandana' the Sanskrit name ascribed to *Santalum album* L. was known and used in India from the earliest historic times and is frequently mentioned in the ancient Sanskrit writings, some of which dated before Christian era. Kautilya's Arthashastra (320 B.C.) considered Sandal as one of the important forest products to increase royal revenue. Charaka Sanhitha, the major textbook of internal medicine in Ayurveda (300 B.C.) quotes uses of Sandal over 160 time in the entire text. In treatment of major diseases like fever, piles, hemorrhagic conditions, diabetes, dropsy, mental disorders, management of poisons & skin disorders widespread uses of sandal is seen. Susrutha Samhita (150 B.C.) a great text on Indian wisdom on surgical procedures, equally preferred sandal for the management of wounds. Sandal fumigation is indicated in warding off evils and organisms, which contaminate the wounds. Such fumigations hasten the wound healing & surgical wards remain aseptic. Dusting of wounds with sandal for early healing is common. In the Amarkosha (Lexicon 3rd or 4th Century A.D.) sandal is mentioned and it is said that 'Vina-malayam anyathra chandanam vivarditha' [Majumdar, 1941]. While observe the COVID-19 disease, there is o specific common symptom except a few viz. headache, fever, hemorrhagic conditions in artery and vein. Other variable symptoms are blood pressure fluctuation, fluctuation of blood sugar, mental disorders, skin disorders etc. The primary medicines are used Brufen, Ibuprofen. Maximum use of saline dips to patients by venal injection methods. No specific medicine has been shorted out of the COVID-19 patient. Though it varies country-wise and its vigourity. Each and medical team (homeopathy, allopathy, ayurvedic, unani,) are trying to their best knowledge and effort. If we compare with chemical compound of those medicine and santalol, we will be able reach a mental solace. On the contrary, we must combat this pandemic situation COVID-19. The aims and objects of the study were to ensure the role of santalol to fight against COVID-19 and to achieve adequate immunity against COVID-19 by which we will be able delegate a delectable gift to human beings in the globe.

Keywords Sandy alluvial, Laterite soil, Edaphic factors, Influence of, Treatment of major diseases

1. Introduction

Quality of sandalwood depends on the oil and alcohol (santalol) content of the heartwood. The oil content of sandalwood was estimated collecting wood samples from the old stand/stock of Hirbandh Block in the district of Bankura, West Bengal. The wood samples were analized in the Institute of Wood Science and Technology (IWST), Bangalore. The result shows that the heartwood contains α-santalol-59.40% and β-santalol-30.25%. Hence, total santalol content is 89.65% which is excellent in nature. The oil content of the heartwood is also estimated, and it is recorded as 4.0%.

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During 1918, Shastri a renowned chemist who studied intricacies of soap manufacturing at Landon, started experimenting natural sandal oil use in soap industry. In these experiments, sandal oil maintained its original fragrance & properties intact. The protecting, smoothening, moisturizing, hydrating and skin anti-wrinkling properties of sandal oil are praiseworthy even in the form of soap. Sandalwood is the blend of economic and traditional culture from time immemorial. It not only finds its place in the modern era but has a history of 3000 years in the medicinal system of Ayurveda by Susrutha and Charaka Samhita. Essential oil of Sandal is formed by the plant cells and reservoir of solar healing power. It is described as lifeblood of the plant. Marcel Lavabre, a French Aroma Therapist, went one step ahead and rightly said "essential oils are the ultimate manifestation of a plant's enjoyment of life''. When one smells the fragrance, it is the tiny droplets of air borne essential oil of sandal, which triggers a response in a olfactory epithelium or smell sensors in roof of the nose.

From here it is just one nerve synapse to the limbic system of the brain, which regulates motor activities, primary drives, emotions and memories. Impulses are then transmitted to the hypothalamus, which regulates bodily functions like temperature, thirst, hunger, blood sugar level, growth, sleep and wake patterns, sexual arousal and the emotion. Ultimately, the pituitary is stimulated next, which activates the endocrine system which in turn controls digestion, emotional and sexual behavior, responses to stress and all metabolic process. Bhat and Prajapathi (2007) described medicinal and cosmetic uses of sandal in the context of ancient literature. Madhu *et al* (2014) opined that the oil present in the heartwood of the tree makes it a unique and valuable asset of the plant kingdom. Sandalwood is used to make artifacts and intrinsic carvings and its oil is used in manufacturing perfumes, incense sticks and in medicines.

The extraction and disposal of sandal came under the Forest Department in 1864 in Mysore state [Adkoli, 1977]. In Karnataka (formerly Mysore) the forest working plan for sandal extraction were prepared for Hunsur Talik in 1910, Heggadadevanakote in 1920 and Narasimharajapura in 1926. In 1871, the parasitic nature of sandal was reported by John Scott. Watt (1893) described the technique of raising sandal seedlings in tile pots in the nurseries and planting in the field. McCarthy (1899) first noticed the spike disease of sandal in Coorg. Brandis (1903) suggested that though sandal is a root parasite, it may derive part of its nutrition from the soil as well. Barber (1905) noted that haustoria formation occurred only on **certain roots of sandal** and not on all of them.

Ecologically sandal has adapted various agro - climatic and soil conditions for *in situ* regeneration with an exception of waterlogged areas and very cold places. In India, 8 Sandal growing areas have been identified as potential provenances of Sandal on the basis of population density, phenotypic characteristics, latitude, longitude and eco-climate (Jain *et al*., 1998). The provenances vary in climate and edaphic preference since they are located in different localities of South and Central India. The state of West Bengal is cited in the map of occurrence and distribution of *Santalum album* in India (Srinivasan *et al*., 1992).

Distribution of *Santalum album* is also found outside India, e.g. in Sri Lanka and South East Asia (Timor, Indonesia, Malaysia, Cambodia, Vietnam, Myanmar, Thailand and China), the Pacific (Papua New Guinea, Fiji, New Caledonia and Hawaii) and to some extent northwest of Western Australia (Kanunurra). Recently the Govt. of Australia had undertaken the venture of commercial cultivation of Sandalwood specially they considered the Indian Sandalwood species (*Santalum album*) is the best due to its higher oil (β-Santalol) content. In Sri Lanka natural stands of sandalwood are present in the districts of Kandy, Nuwara Eliya, Ratnapura and Badulla belonging to the wet and intermediate climatic zones (Panabokke, 1996; Mapa et al., 1999). It is believed that *S. album* is an exotic in India, having been taken there from East Indonesia by traders of the fragrant wood and holding a pre-eminent position in the Indonesian island (Malay Archipelago), Timor(Ajaubaki, Siso, Buat, Niki –Niki, Kokoi and Netpala districts) (Effendi, 1994) and to a small extent in Alor, Roti, Sumba and Flores islands. There are two types of *S. album* found across Timor, a small-leaf variety & a large-leaf variety (Harisetijono and Suriamihardja, 1993). In Australia, a small naturalized area in the northwest of Western Australia which is believed to have been established through the activities of Mallacan traders. *S. album* was believed to be first grown experimentally in the Ord River Irrigation Area, Kununurra Western Australia in 1983. The first private sector commercial plantations of *S. album* were established in Kununurra in 1999 (Clarke, 2006). But, in middle-east countries did not take any massive venture on its agronomical nurture.

2. Materials and Methods

2.1. Materials

Sandalwood (*Santalum album* L.) was collected from Hirbundh mouza of Hirbundh Range under Bankura (South) Forest Division, West Bengal during the month of November-December and May-June of 2011 and 2012 for experimentation. An adequate quantity was sent to Institute of Wood Science Technology (IWST), Bangalore, India for analyzing its Santalol quality.

2.2. Chemistry and Utilization

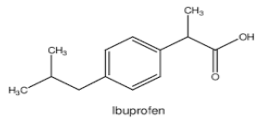
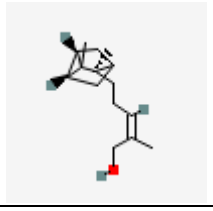
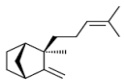
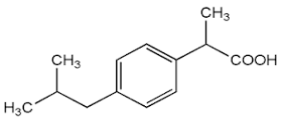
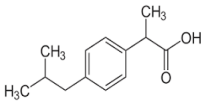
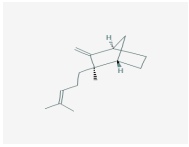
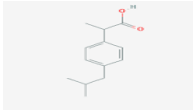
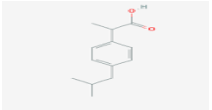
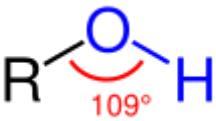
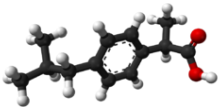
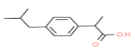
Sandal bark is one of the raw materials which has not been put to any use so far. Benzene extract of powdered bark on repeated chromatography over alumina gave a new triterpene solid ester (yield 0.3%) which has been identified as urs–12–en–3–beta–yl–palmitate (Shankaranarayana et al., 1980a). The compound is a chemosterilant and an insect growth inhibitor too (Shankaranarayana et al., 1979a). Sandal bark also contains small amounts of betasitosterol, fatty acids and 14% tannins (Shankaranarayana et al., 1980b). Seeds contain 50 to 60% of a drying oil composed of 80% santalbic, 2.5% stearolic and 10% oleic acids. The seed oil is a polyunsaturated fatty oil comprising of acetylenic glycerides – santalbic and stearolic. Seeds of all members of santalaceae possess santalbic acid which is a characteristic feature of the family (Hatt and Schoemfeld, 1956). Sandal oil has been studied by many works for its physico – chemical properties, chemical compositions and structure of constituent molecules. (Iyer, 1935; Sreenivasaya and Narayanna,1936; Madhurnath and Manjunath, 1938; Manjunath and Siddappa, 1943; Gunstone and McGee, 1954; Gunstone and Russell, 1955; Hatt *et al*., 1959; Morris and Marshall, 1966 and Hopkins *et al*., 1969).

Deoiled seed meal prepared from decoated of sandal contains 52.5% protein (rich in essential amino acid) and 5% mineral matter (rich in N, P, K, Ca, Mg). The status of protein, amino acids and minerals in comparison with that of common feed material (cotton seed, guinea grass, oat hay, sorghum hay, wheat hay) indicates its potential use as a feed for farm animals (Shankaranarayana, 1985a).

Seeds from young trees show their potential use as rich proteinous and nutritive source even at the young stage of the sandal plant (Shankaranarayana *et al*., 1990). Further, it has been found that nonviable sandal seeds contain slightly larger amounts of fatty oil but less amounts of protein compared to viable seeds (Ananthapadmanabha et al., 1989b).

Sandal oil is nearly colourless to golden yellow, viscous liquid, ref. ind. 1.449 – 1.506, sp. gr. 0.962 – 0.985, solubility in 70% alcohol – 1:5 volumes, optical rotation -19° to 20°, acid value 1.9 – 2.2, ester value 13 -16, ester value after acetilation 210 -215, ester content 1.6 – 5.4%, alcohol content (Santalols) > 90%. Sandal oil has been extensively studied for chemical constituents, their isolation, synthesis and quantitative evaluation (Guha and Bhattacharya, 1944; Balakrishnan *et al.*, 1956; Dasgupta *et al*., 1956; Ghatgey and Bhattacharya, 1956; Karawya and Wahba, 1962; Kishore, 1962; Nigam and Devi, 1962; Kamat *et al*., 1967; Walker, 1968; Bhati, 1970; Kumar and Kartha, 1974; Chaurasia *et al*., 1975; Demole *et al*., 1976; Brunke, 1981a; Yadav and Bisarya, 1982).

Table (1). Comparison of Chemical Structure of COVID-19 Medicine Used and α-Santalol and β-Santalol

Ibuprofen	Brufen	α-Santalol	β-Santalol
			
			 2D
			 3D
			
(R)-(-)-Ibuprofen | C13H18O2 | CID 114864 - structure, chemical names, physical and chemical properties, classification, patents, literature, biological activities, ... Molecular Formula: $C_{13}H_{18}O_2$ Molecular Weight: 206.28 g/mol PubChem CID: 114864		$C_{15}H_{24}O$ ALPHA-SANTALOL (Z)-alpha-Santalol Santalol A 220.35 g/mol	$C_{15}H_{24}$ BETA-SANTALENE (-)-beta-Santalene 511-59-1 (1S-exo)-2-methyl-3-methylene-2-(4-methyl-3-pentenyl)bicyclo[2.2.1]heptane (1S,2R,4R)-2-methyl-3-methylidene-2-(4-methylpent-3-en-1-yl)bicyclo[2.2.1]heptane More... 204.356 g/mol
Use for Kidney diseases Liver diseases Asthma Allergy Allergic to aspirin High Blood Pressure Presence of nasal polyps Heart disease Stomach or intestinal problems Ulcers	**Use for** Headache Dental pain Menstrual cramps Muscle pain Arthritis Common cold and flu (works as a pain-reliever) In short provides relief from any kind of pain.	**Use for** Fever, piles, hemorrhagic conditions, diabetes, dropsy, mental disorders, management of poisons & skin disorders, antitumour and cancer preventive	**Use for** Potent antimicrobial, anti-oxidant, antispamidic, an-inflammatory, antiseptic and astringent(Burdock and Bommarreaddy et al, 2017)

Gairola et al (2007) stated that the current harvest of sandal wood and international demand for its oil exceeds supply, and prices continue to rise. Currently, sandal wood oil is sold in the international market at the rate of Rs. 70,000/- to 1,00,000/- per kg.

Arti Rani *et al* (2014) studied on molecular approaches to understand/decode oil production in sandalwood and found that the principle chemical constituents are sesquiterpenoid compounds mainly α – santalol (40-55%) and β – santalol (12-27%) which constitute > 90% of the distilled oil. Nesari (2014) explained that anti-hyperglycemic and anti-oxidant potentials of α – santalol & sandalwood oil, anti-microbial & anti-oxidant properties possibly attributed to sesquiterpenoids, shikimic acid, etc. Gupta (2014) studied on vibrational spectroscopy of Indian Sandalwood oil and explained that almost 90% of the total alcohols are santalol, around 2-4% of santalol are present as esters.

2.3. Evidence

From the above table, it is clearly evident the following side effects of each medicine and plant extract:

Side Etfect of Ibuprofen: Stomach pain, heartburn, nausea, vomiting, gas, constipation, diarrhea etc.

Side Effect of Brufen: Vomiting, stomach pain, nausea, indigestion, heartburn etc.

Side Effect of α-Santalol: No side effect.

Side effect of β-Santalol: No side effect.

3. Discussion

From the above results, it clearly indicates that the side of medicines are dominating over the good effect of medicine (Carabin, 2008; Sharma et al.; Bommardy et al., 2017). Actually, no is no other alternative in doctor's hand. It would better if we properly utilized to apply the organic medicine therapy having the organic compound like **α- santalol** or **β-santalol** as it was used early days. The effect, power and potency have been cited below:

This sandalwood is known commercially as 'East Indian Sandalwood' and essential oil from it as 'East Indian Sandalwood Oil' are among the oldest known perfumery materials. Both wood and oil are used in incense, perfumes and in medicine and are of great commercial importance. Sandalwood being closely grained and amenable to carrying, is some of the finest woods for the purpose. It is used for making idols, boxes and other curios of exquisite beauty (Srinivasan *et al*, 1992). Power of heartwood upon steam distillation yields the East Indian Sandalwood oil which is rated very high for its sweet fragrant, persistent, spicy, warm, woody note, non-varying composition and fixative property. Apart from it importance as a supremely satisfying source of fragrance, it finds use in medicine as an antiseptic, antipyretic, anti-scabietic, diuretic, expectorant, stimulant and for treatment of bronchitis, dysuris, gonorrhea and urinary infections [Handa *et al*., 1951; Okasaki and Oshima, 1953; Winter, 1958; Dastur, 1962; Jain, 1968]. However, its use as a base of fragrance has far outweighed its use in medicine. Indian Sandalwood is highly valued for its fragrant heartwood, which consists of the highest oil (upto 6%) as well as santalol (α & β 90%) contents in oil as compared to other species of the genus Santalum (Srinivasan *et al*, 1992). Sandalwood oil is used in world – class perfumes due to its excellent fixative properties & attars in Indian perfumes (Anonymous, 1972).

Jahan and Rahman (2014) explained that sandal dissolves inflammation and tumors and stabilizes palpitation. Sandalwood is used as a disinfectant in bronchial and genitourinary tract infection. A paste of the wood is applied in burns, fever and headache. It relieves thirst. It is also used in acne, biliousness, blood impurities, bronchitis, cough, depression, diarrhea, leucorrhoea, menorrhagia and sore throat. It is one of the potential anti-ulcer drug used in Unani system of medicine. Various uses mentioned in Ayurveda system about sandalwood are in treatment of various other ailments like diarrhoea with bleeding, intrinsic hemorrhage, bleeding piles, vomiting, poisoning, hiccoughs, initial phase of pox, urticaria, eye infections and inflammation of umbilicus (Benencia and Courreges, 1999; Desai et al, 1991). α- santalol, an active principle of Sandalwood oil, has been studied for its skin cancer preventive efficacy in murine models of skin carcinogenesis, employing human epidermoid carcinoma cells. It was assessed whether α-santalol at concentrations of 25-75 µml resulted in a concentrations and a time dependent decrease in a cell number, which was largely due to cell death. Dwivedi *et al* (2014) enumerated that both the sandalwood powder and its essential oil have been used in Ayurveda for curing genito-urinary disorders, gastric irritability, dysentery, excessive sweating, high blood pressure, heart pain, inducing sleeping, cleaning wounds, respiratory disorders, fever and different skin diseases.

4. Hypothesis & Conclusions

Based on the above evidence and discussions, the author see that there is a good chance for conducting proper experimentation of **α- santalol** or **β- santalol** over human body against COVID-19. From the chemical structure and formula it is assumed that there are ample scope to insert certain necessary molecular derivatives to make it proper organic drug against COVID-19. We are not properly utilizing the gift of our mother earth, probably.

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