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STUDIES ON THE METHOD – ETHNOBOTANY OF *CALOTROPIS GIGANTEA* AND *C.PROCERA*

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ABSTRACT: *The paper reviews the economic and traditional medicinal uses of the plants, Calotropis gigantean and C. procera from the published literature from various of India. The ethno-medicinal uses of the former species in Orissa are also incorporated. Their distribution in India, Botany, Physical and Chemical properties of the plant parts are provided. Uses of the traditional medicines and their authentication as evidence by the available clinical trials are discussed. Besides, uses and standardization of doses against various ailments are suggested.*

INTRODUCTION

The importance of traditional medicine which provides health service to 75 – 80% of world population was emphasized by Marini – Bettolo[1]. In India, references to medicinal uses of plants occur in *Rigveda, Charaka Samhita* and *Susruta Samhita*. However, such references with Sanskrit and other local names do no leave any chance to the botanical identification of the plants involved. Knowledge of the use of medicinal herbs that exists among primitive tribes in remote areas, is often in oral folklore only. So studies on ethno botany in India, after independence seems to have seized the intelligential, who are concerned to record all available knowledge before the tribal culture in India vanishes completely due to massive deforestation, industrialization and urbanization in the forest belts. As a result, a series of publications have to come out on Indian ethno botany over the last three decades. It has been estimated that out of about 2000 items recorded in Indian medical literature, less than 200 are of mineral and animal origin, the rest being derived from the vegetable sources[2].

Of large number of plant species reported on the ethno botanical interest, the two species of *Calotropis* R. Br. Viz., *C. gigantean* and *C. Procera* in India holds a pride of place largely because of its other uses and economic values. The fibre extracted from the bark of the stem is white, silky, strong, flexible and durable and is used to make rope for cots, gunny bags, fishing nets and bow strings. It is even considered superior to cotton and jute[3,4]. The wood is used as cheap fuel, the seed hair is used for stuffing mattresses and pillows4. Latex is used in tanning industries, a source of hydrocarbons and as a fish poison[5].

Although there were some attempts in the past to bring all available information on the medicinal uses of plants[2,6,7] yet, the published reports are fragmentary. Therefore, in this paper an attempt has been made to collect all the available information

on unani, ethno botanical, medico-religious and ayurvedic uses of *C.gigantea* and *C.procera* along with ethno-medicinal information collected from various parts of South Orissa. The collected herbarium specimens are deposited in the P.G. Department of Botany, Berhampur University (BOTB), Berhampur.

Botany

The genus *Calotropis* R. Br. (Asclepiadaceae) distributed in the tropical and sub-tropical regions of Asia and Africa[8] is represented in India by three species, viz., *C. acia, C.gigantea* and *C.Procera. C.gigantea* is distributed throughout India ascending to Himalayas; C.procera is more common in South – Western and Central India and Western Himalayas. *C. acia* Ham. Is restricted to north Bengal, Sikkim and Bihar. The former two species are economically very important and are known by many vernacular names such as *Arka, Akdo Arakha* and *Madar*.

In ancient ayurvedic literature the plant *C. gigantea* is known as '*Sveta arka'* and *C.procera* as *'Rakta arka'* often misled the ethnobilogist to identify one plant for the other. Both of them are often used as substitute of one another bearing a common name and are said to have similar effects. The species can be differentiated by the following floral characters:

1a. Erect herbs; Leaves petiole; corona scales two lobed ----------*C. acia*
1b. Medium shrub to a small tree, leaves sessile to sub-sessile; Corona scales unilobed----------2
2a. Corolla lobes spreading, uniformly coloured, pure lavender to white, coronal scales narrow truncate, shorter than the staminal column with pubescent back, apex entire ----------*C. gigantea.*
2b. Corolla lobes react white with pink or purple spotted on the lobes; Corona scales equal to or longer that the staminal column, glabrous on back, apex bifid, auricles wanting--------*C. Procera.*

Gupta et al9 suggested that variation of leaf characters, like leaf venation, anatomy, physical constants and fluorescence characteristics of leaf powders can also be used to differentiate them.

***C. gigantea* (Linn) R. Br. Ex W. T. Aiton.**

Large, bushy, stout tomentose shrubs, 2 – 4 m high. Leaves sessile, decussate, ovate, obovate, ovate – oblong to elliptic – ovate, base cordate, ofter amplexicaul, apex obtuse or shortly acuminate, subglabrous above, cottony beneath, 8 – 20 * 5 – 7 cm cymes umbellate or sub-raceme, penducle lateral, cottony. Corolla obese spreading, recurved, ovate – lanceolate, uniformly coloured, light purple to white 2 – 5 cm dia.; Corona scales 5 narrow, adnate to gynostegium, shorter that the staminal column, back pubescent; apex entire with two obtuse auricles below it, vesicle recurved at the base, the spur upcourved, involute. Stigma depressed, 5 – angular (-lobed). Follicles 6 – 10 cm long, recurved, boat shaped, obtuse, pubescent.

I11. : Wight, I11. Indian bot. t.155, 156A. 1831; Kritikar & Basu, Indian Med. Plants. P1. 621A. 1933.

Fls. : Dec. – July, Frs. : Feb – June.

Common in the dry waste places.

Throughout tropical Asia. In India it is found throughout the country ascending the Himalayas upto 1000 m high.

***C. procera* (W. Aiton) Dryland. Ex. W.T. Aiton**

Erect to suberect perennial shrubs, 1 – 1.5 m high, young parts floccosely white-tomentose. Leaves decussate, sub-sessile, thick, ovate, obovate-oblong, elliptic to broadly ovate, 6 – 18 * 3.5 – 12.5 cm, base cordate to amplexicaul, acute to submucronate, cottony beneath, glabrous with age. Cymes umbellate, penduncles stout, lateral or axillary, often paired, 2.5 – 6 cm long. Flowers scented, 1 – 25 cm dia. Coronoa lobes erect, white, pink or purple spotted; corona scales 5, fleshy, laterally compressed, equal to or larger than the staminal column, back glabrous, apex bifid without auricles, base upturned, white, acute. Follicles turgid, 5 – 10 * 3.5 – 6 cm recurved to sausage shaped.

I11. : Kritikar & Basu, Indian Med. Plants; p1. 621 B. 1933; Maheshwari, I11. F1. Delhi: 124. F. 124, 1966.

Fls. & Frs. : March – June (Probably throughout the year).

Common on waste open fields, banks of cultivated fields and road side ditches.

Reported from trop. Africa, Persia, Arabia, Syria, Egypt, Afghanistan and Pakistan. In India it is known from W. Himalayas, Gujarat, Delhi, Punjab, Madhya Pradesh, Bihar and Bombay.

Physio – Chemical properties :

Physico – Chemical properties of *C.gigantea* and *C.procera* based on the publications of the wealth of India[5], Chaudury[10], Gupta et al[9]., Tewari et al[11], Marimutu & Kothari[12] and Pant & Chaturvedi[13] are described below.

Calotropis gigantea

Plant parts contain 23.38% ash, acid insoluble ash 5.08%, water soluble extractive 33.38% and alcohol soluble extractive 6.66%.

Root bark : contains β-amyrin, 2-isomeric crystalline alcohols, gigantean (m.p.:223^0-24^0) and iso-giganteol (m.p.117^0-78^0). A colourless substance (m.p.:162^0) of Tetracyclic triterpene alcohol been obtained from unsaponifiable fraction of the fatty matter.

Leaf : contains an active principle – Mudarine and three glycosides calotropin uscharin, calotoxin along with phenol.

Latex: contains water and water solubles (86 – 95.5%) and caoutcohouc (.6 – 1.9%). The calcium consists of caoutchouch (5.5 – 18.6%), resin (73.6 – 87.8%) and insoluble matter (4.5 – 13.8%).

Two isomeric resinols : - calotropeol (m.p.:204^0 – 5^0) and β-calotropeol (m.p:216^0 – 17^0) with ester combinations of acetic and isovaleric acids and β-amyrin with small amounts of unidentified tetracyclic compounds and calcium oxalate.

Traces of glutathione and a proteoclastic enzyme similar to papain are also present.

Seeds : contains moisture (7.4%), protein (27%), ether extracts (26.8%), crude fibre and nitrogen free extract (32.4%) and ash (6.55%). Oil extracted from seeds is an olive green liquid, acid fraction of which contains palmitic (15%), oleic (52%), linoleic (32%) and linolenic acid (0.9%). The unsaponifiable fraction (31%) of seed wax yields phytosterol (m.p.:136^0), stigmasterol (m.p.:170^0), melissyl alcohol and laurane (0.6%).

Floss : contains moisture (7.2%), soluble matter (4.7 – 9.7%), lignin (15.5%), wax (6.4%), saccharose (0.4%) and ash (3.64%). They also contain yellowish brown colouring matter, chlorophyll, resin and crystalline unsaturated substance along with few toxic substance.

C. procera

Plant parts contain 20.2% ash, acid insoluble ash 3.14% water soluble extractive 35.27% and alcohol soluble extractive 8.16%.

Root : contains flavonoids, glycosides, saponins and sterols.

Leaf and stalk: contains calotropin ($C_{29}H_{40}O_9$) which decomposes on 221^0C and calotropagenin ($C_{23}H_{32}O_6$) with melting point of 2400C is present. Traces of orthodihydroxy phenol (ODP) also present.

Latex : Chemical composition of the latex depends on season, environment, soil and the maturity of the lactifier. Latex contains water and water soluble 88.4 to 93% and coagulate 0.8 to 2.5%. The coagulam contains resins 52.8 to 85.5% and caoutchouc 11.4 to 22.9%.

So far 16 active principles are derived from the latex of the plant. They are calactin, calotropagenin, calotropin, calotropin, calotoxin, L-lactucerol, rpoceroid, syriogenin, tetraxasterol, uscharin, uscharidin, uzarigenin, voruscharin, β-amyrin – calotropeol, 3-epimoretenol and lupeol.

Besides above active principles it also contains trypson, active labenzyme, a heart poison traces of orthohydroxy phenol.

Flower: contains traces of orthohydroxy phenol.

Medicinal uses:

The herbal medicines are used by the tribal mainly through the traditional healers with a strong spiritual belief. These magico-spiritual and religious beliefs may not have any scientific basis, but they cannot be ignored[14]. In the Indian folk songs, the plant is considered as the reincarnation of certain God or Goddesses[15] and the leaves are offered to lord '*Hanuman'* and the flowers to *'Shiva',* which may have a psychotherapeutiv value. Thus *calotropis gigantea* used by *Kolas* of Uttar Pradesh (leaves are put on the head of pregnant woman) for easy delivery[16] and by North Bengal tribals (use a talisman with a root piece on the pelvic region of the woman at the time of copulation) for antifertility[17] may not be explained by the clinical trials.

Table 1 depicts the uses of the plants (plant parts) against 62 different ailments, described in ayurvedic and unani system of medicine (often translated from various scripts and traditional units of measurements are converted to matric units). From the table it is well evidence that *C.gigantea* is more often used as medication that *C. procera*. In the table, where the specific names are available are indicated. But in most of the cases, the two species are used alternatively or the species available in the area. The local name of the species are generally referred in the articles.

Table 2 enumerates the ethno medicinal uses of the plants by the tribals of different parts of India, our own collections from South Orissa are also incorporated.

DISCUSSION

Herbal medicines are developed by our ancient sages through hit and trial methods[18], so it is worth to test such medicinal uses through modern scientific means[19,20]. Some of the traditional uses either approve or disapproves, their uses are discussed below.

Leaf, latex and root of the plant *C.gigantea*[21-25], are used as a remedy for snake bite or scorpion sting, but all parts are quite useless in the antidotal and symptomatic treatment of either snake bite or scorpion sting[6]. Use of *C.procera* as tooth brush enhances the analyze activity[26], also in support of the use of the root as digestive agent[6,27]. Jain et al[28] prescribed capsulated root bark powder to the patients of *Diarrhoea* and *Dysentery,* found significant results and considered that the drug is an excellent substitute for ipecacuanha. But patients of blood dysentery after similar treatment, showed increase of blood in their stool. The said therapy also relieves mucus and tenesmus. Traditionally, leaf and root (bark) are used to cure cholera[21], extracting guinoworms[7] and indigestion[6]. The drug is well known to enhance bile secretion and has a sedative effect on the intestinal muscles[28]. Ethanol extract of *C.gigantea* applied to cancer ulcers shows 60% growth regression[29] seems to be its use against wounds, ulcers and old sores[5-7]. Although tender leaves of *C.procera* cures migraine[30], application of the latex directly to the blood stream[21] seems quite unnatural. Calotropin isolated from the roots of *C.procera* inhibit spermatogenesis in male and induced abortion in female gerbils and rabbits[31]. A similar use of the leaf[5,24,32] may also be due to the novel compound calotropin. Contact of *C. procera* cause intense localize allergy, dermatitis with marked erythema, oedema, ulcertation and oozing in scrotal area[33]. These findings go against their uses to eliminate black scars of face[21], boils, cold cough and asthma[21], earache[22], eczema and skin eruption[22,27,34], inflammatory swellings, pains of the body parts and rheumatism[7], syphilis, leprosy, oedema[27,34], and vertigo[34]. However, often they are prescribed along with seasame oil, turmeric paste or a mixture of both.

Though there are negative results about the reported uses of medicinal plants, the efficacy of the herb(s) may depend on the total effect of the plant contents rather than on the one of the few chemical fractions (active principles) separated from the herbs[35] or the age of the plant part(s) (mostly of the root or bark) extracted[36]. This may be a reason that effective herbal medicines were discounted due to lack of explanatory mechanisms to account their mode of action[37]. There is a long controversy regarding use and disuse of ayurvedic drugs. Therefore, the validity of medicines should be assessed at two levels: the emic (i.e based on the prevailing folk etiological belief) and the ectic (i.e based on the objective "scientific' criteria)[38].

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Table - 1

Ayurvedic, Unani and folk uses of *Calotropis gigantea* (a) and *C.procera* (b) to cure various ailments

(Note : when species are not indicated both are used for the purpose)

Disease(s) 1	Part(s) used 2	Mode of administration 3	Source(s) 4
Amoebic dysentery	Root or root bark	Paste with/without opium orally administered	Misra[21], Jain *et al*[28], Garg[24]
Anemia	Fruit	Ground with equal amount of red chilli, mineral salt and taken along with milk	Garg[24]
Antifertility	Leaf(a)	Juice of extracts of petroleum ether or alcohol taken orally	Wealth of India[5], Garg[24], Choudhury *et al*[32]
Antipoison (for the seeds of *Thevetia peruviana* (Pers.) K. Schum).	Stem bark	Diluted powder orally taken	Misra[21]
Ascites	Root (a) Leaf Batex	Powder along with black pepper and cow milk taken orally Fresh juice orally taken Applied externally	Kirtikar & Basu[6], Garg[24] Pathak[22] Kirtikar & Basu[6]
Black scar on the face Boils	Latex Latex	Along with turmeric paste applied Externally applied	Misra[21] Misra[21], Garg[24]
Calculus, liver and spleen disorder	Plant Leaf Flower Latex	Paste orally taken Powder orally taken Paste along with milk or powder taken Taken after dilution	Garg[24] Tripathy[27] Garg[24] Kirtikar & Basu[6]
Cholera	Root bark Root Root(a)	Paste with black pepper (size of pea seed) and ginger juice orally taken Powder orally taken Powder smoken or taken orally	Misra[21] Kirtikar & Basu[6] Kirtikar & Basu[6] Wealth of India[5]

Cold, cough, asthma and bronchitis	Leaf	1. Warmed along with ghee and bandaged on the chest of infants	Misra[21]
		2. Boiled in ghee and the Ghee taken	Misra[21]
		3. Fresh juice orally taken	Pathak[22]
		4. Powder smoken	Dastur[7] Garg[24]
	Latex	Powder of imbibed wheat grain with honey orally taken	Misra[21]
	Flower bud	Along with long pepper and black salt orally taken	Sharma[34]
	Flower	1. Powder orally taken	Kirtikar & Basu[6] Wealth of India[5] Garg[24]
		2. Along with jaggery taken	Bhatnagar *et al*[39]
		3. Fruit powder orally taken	Garg[24]
Dysentery	Root or root bark	Powder orally taken	Kirtikar & Basu[6]
Ear ache or ear troubles	Leaf	Juice along with fermented boiled rice water used as ear drops	Pathak[22]
Eczema and skin eruptions	Leaf with or without latex	Fresh juice added to turmeric paste and seasame oil applied externally	Pathak[22], Tripathy[27], Sharma[34]
Elephantiasis and hydrocele	Root	Paste with fermented rice (boiled) water applied on the effected area	Tripathy[27], Wealth of India[5], Pathak[22]
Enlargement of abdominal viscera and spleen; dropsy	Leaf	Powder orally taken	Tripathy[27] Dastur[7]
Epilpesy	Root	Ground with goat milk and used as nasal drops	Garg[24]
	Flower	Paste with black pepper orally taken	Garg[24]
Expectorant	Leaf	Ash along with black salt and butter milk taken	Dastur[7]

Extracting guino-worms	Leaf	Decoction used for washing and taken orally	Dastur[7]
Eye diseases	Whole plant	Decanted ash water applied on eye lids	Misra[21]
Gonorrhoea	Leaf	Decoction used for washing and taken orally	Dastur[7]
Hysteria	Flower (white)	Powder with black pepper taken in empty stomach	Misra[21]
Indigestion, promotes gastric secretions	Root	1. Powder orally taken 2. Decoction with cow milk taken	Kirtikar & Basu[6] Tripathy[27]
Inflammatory swellings	Leaf	Convered after warming on the affected part	Dastur[7]
Jaundice	Root Root bark	Ground with rice and taken Paste with black pepper and sodium carbonate orally taken	Dastur[7] Garg[24]
Joint pain	Leaf	Powder taken	Kirtikar & Basu[6]
Leprosy	Latex	Applied on the affected area	Kirtikar & Basu[6] Garg[24]
Malaria and intermittent fever	Leaf	Fresh juice orally taken	Wealth of India[5] Dastur[7] Garg[24]
Migraine	Latex	Applied on the affected side vein of forehead	Misra[21]
Neurites	Root	Powder with cow butter taken orally	Garg[24]
Pain of the body parts	Leaf	Affected parts covered after warming	Dastur[7]
Pain of feet (Battakantaka)	Flower	Decoction used for fomentation	Garg[24]

Piles (haemorrhoides)	Latex	Externally applied and dried to make tablets and taken	Misra[21]
Puragative	Young twigs	Juice taken	Hajra & baishya[40]
	Leaf	Dermal powder collected by wheal pulp to make tablets of black pepper size. Two tablets (in morning and evening) for 14 days are	Misra[21]
		taken along with sugar and ghee	Misra[21]
Rabis dog / Jackal bite	Flower (White)	On the seventh day of biting seven tepals chewed with fine rice	Misra[21]
	Latex	and continued for seven days reducing one tepal each day.	
		1. Applied on wound	Misra[21]
		2. 20 – 21 drops (adults) and 14 – 15 drops (infants) are swallowed keeping inside banana before sunrise to induce vomiting or dysentery	Misra[21]
		3. Taken with the same amount of jaggery and sesame oil.	Tripathy[27]
		4. With paste or red chillies oil and jaggery applied on wounds.	Pathak[22]
Rat bite	Flower	Powder taken orally	Kirtikar & Basu[6] Wealth of India[5]
Rheumatic pain and hyperacidity	Whole plant	Paste taken orally	Misra[21]
Rheumatism	Root	Powder with sugar and milk taken	Tripathy[27]
	Leaf	Covered after warming	Dastur[7]
Ring worm	Latex	Applied externally	Dastur[7] Garg[24]
Scabis	Latex	Externally applied	Garg[24]
Sciatica and paralysis	Leaf	Decoction with sesame oil massaged	Kirtikar & Basu[6] Tripathy[27]
Snake bite	Root	1. Powder orally taken	Kirtikar & Basu[6]
		2. Paste applied on wounds	Jain *et al*[23]
		3. Paste applied on wounds and internally taken with ghee	Murthy *et al*[25]

	Leaf	1. Epidermal powder with latex made to tablets (size of Bengal gram); 2 tablets taken to induce vomiting	Misra[21]
		2. Fresh juice orally taken	Pathak[22]
	Latex	1. Applied wounds/orally taken (20-30 drops for adults and 15-20 drops for infants)	Misra[21] Garg[24]
		2. Five drops with 50 drops of distilled water injected hypodermally	Misra[21]
Spider and insect bite	Root	Ground with vinegar and orally taken	Garg[24]
Style	Latex	Applied on the nail of opposite foot thumb	Misra[21] Kirtikar & Basu[6] Wealth of India[5]
Syphilis	Root	Bark smoken or taken orally	Garg[24]
Syphilis, Leprosy and Odema	Latex	With sesame oil externally applied	Tripathy[27] Sharma[34]
General health tonic	1. Plant	Powder orally taken along with cow milk	Tripathy[27]Kiritiakr& Basu[6]
	2. Flower	Powder orally taken	Kirtikar & Basu[6]
Tooth ache and caries	Latex	Applied on affected tooth	Tripathy[27] Pathak[22]
Vertiga (Leucoderma)	Latex	Applied on the affected parts	Sharma[34]
Whooping cough	Flower	Burnt with honey and mineral salt in a closed chamber, the resultant ash with honey is orally taken	Misra[21]
Wild poison	Stem	Diluted paste applied on the affected area	Garg[24]
Wounds, ulcers and old sores	Leaf	Powder externally applied or orally taken	Kirtikar & Basu[6] Wealth of India[5] Dastu[7]

TABLE - 2

Ethno-medicinal uses of *Calotropis gigantean(a)* and *C.procera (b)* among various tribes / regions of India.

Disease(s) 1	Part(s) used 2	Mode of administration 3	Source (s) 4
MEGHALAYA (K & J Hills)	Root (a)	As on oral contraceptive	Joseph & Khotkongor[41]
ASSAM (Miris)	Root (a)	Bark paste taken to cure dysentery Juice applied on burn injuries and swellings	Hajra & Baishya[40] Hajra & Baishya[40]
EASTERN INDIA	Leaf (a)	Wormed and bandaged on swellings of cattle	Pal[42]
GUJARAT (Dangas)	Leaf (b)	Boiled with groundout oil and the oil is used as an ear drop to cure ear ache	Joshe *et al*[43]
MADHYA PRADESH (Gwalior, ghatigaonforest)	Flower (b)	Powder with jaggery is taken to cure cough	Bhatnage *et al*[39]
BIHAR (Singhum)	Stem (b)	Infusion of the powder used to cure fever and abdominal pains; diluted powder is taken to cure diahorea	Chandra & Pandey[44]
BIHAR (Dumka – Santals of Pragana district)	Leaf (b)	Tied over injured area after worming for remedy	Chandra & Pandey[45]
NORTH BENGAL (Tribals)	Plant Leaf Flower & Seeds	Ash is taken to cure dyspepsia Juice is used to cure ear troubles Used to cure sexual diseases	
ANDHRA PRADESH	Root (b)	Bark used to cure dysentery and elephantiasis	Venkateswarulu *et al*[46]
ORISSA (Santals)	Root (a)	Decoction is used to cure infertile convulsions and delirium during fever.	Hainess[47]
ORISSA (kols)	Root (a)	Bark and juices are alternative purgative,	Hainess[47]

		diaphoretic, tonic used in fever, in large doses emetic	
ORISSA (Mahunts)	Leaf (a)	Warm fomentations is given in treating abscesses on elephants	Haines[47]
ORISSA (Mayurbhanj)	Leaf (a)	1. Applied for poulticing sores 2. Used as fomentation in chest diseases	Haines[47]
	Latex (a)	Applied on wounds and tooth troubles	Bal[48]
	Root (a)	Paste applied on snake bite and scorpion stings	Jain *et al*[23]
	Root (a)	Pounded an applied with country liquor on the wounds of leprosy patients as well as internally taken	Ray Choudhury *et al*[49]
	Root (a)	Bark paste applied on wounds and along with ghee taken to cure snake bite	Murthy *et al*[25]
ORISSA (Koraput)	Leaf (a)	Along with leaves of *Pergularia daemia, Datura sp.,* and *Bambusa bamboos* fomented to cure sciatica	This study
(Koraput)	Latex (a)	2 – 3 drops with warm water taken to cure chronic fever.	This study
(Koraput)	Root (a)	A piece of root is given to cattle with grass or straw to cure cleft on the pallet	This study
(Ganjam)	Floral buds (a)	In 3 – 5 number is given in the above said disease	This study
	Leaf (a)	Turmeric paste is baked in the folders and applied to babies to induce bright body colour and to avoid common cold	This study

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