

## **SESAMUM INDICUM (SESAME OR TIL): SEEDS & OIL — AN HISTORICAL AND SCIENTIFIC EVALUATION FROM INDIAN PERSPECTIVE**

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*Sesamum indicum* (sesame or *til*) is an important food, oil, medicinal and religious crop in India. The article deals with the scientific study of the plant, origin, vernacular names, its use in *Atharava veda* and its popularity in the North Indian region, in Hindu festivals, and in the religious rites & ceremonies, its mythological history of origin and general uses. Other features are : its ethnobotany (its use by the tribals), its reference in proverbial literature, agriculture & commerce, Ayurvedic and other medicinal miscellaneous uses in India.

The main chemical constituents of the seed, oil & cake and their composition, the oil extraction techniques, purification, and its chemical tests to detect the purity of the oil are also described. It has been found to be a good protector of ultra violet light, sun, wind, and radiation, and therefore, it is used in various cosmetics, and in baby skin care. It is a safe and good cooking & culinary oil and used as a preservative to the dead bodies in India.

**Key words:** Ayurvedic medicine, Biological control, Body preservative, Ceremonies, Chemical composition, Cosmetics, Culinary oil, Festivals, Nutritional value, Oil-test, Preservative, Proverbial uses, Purity detection tests, Shelf-life, *Sesamum indicum*, *Til*, Ultra violetlight.

### **1. INTRODUCTION**

Now a days, Sesame or *Til* oil has been mostly used for cosmetics, medicinal industries in manufacturing proprietary branded oils and medicines

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and less used as a cooking and culinary oil in India. It is a good protector of ultra violet light, sun, wind, and radiation and therefore, it is used in various cosmetics, and also in baby & children skin care. Sesame (*Til*) seed and oil has been in use as a food and a healing oil for hundreds of years. It is a good source of protein 22% and fatty oil 54% (Bedigion, 2011). In early India, the seeds of *Sesamum indicum* was included in the list of cereals known as *sapta-dhānya* meaning seven cereals and not as a source of oil as it is used presently.

The medicated massage oils are mainly prepared from *til* oil. Apart from its medicinal use, the seed is used in the preparation of sweat-meat known as *rewari* & *gajak*. *Til* is regarded as sacred by the Hindus and used in *hāvan* (sacrificial-fire) and in *Śrāddha*, the annual last religious rites of the dead and similar such festivals.

Lancaster (1965) enumerated 190 sacred plants of Hindus and stated that the *Til* plant entered India in ancient times and provided the oil known as *mitha-tel* (sweet oil). White *Til* oil is eaten as an article of food and the black or other forms of seed oil are used for culinary purpose as well as in cosmeceutical and perfumery industry for extraction of perfumes, etc. The black *til* seed are the only one used in the sacrificial fire or '*hāvan*' and in other religious rites and ceremonies.

Chopra<sup>1</sup> *et al* described the plant under *Sesamum orientale*, L., a synonym of the *taxa*, but could not do justice to the medicinal values and other important uses of the seeds and oil; in the same way WHO (1999) also could not recognize the medicinal values of *Til* (Sesame). Dube (1995) also did not recognize the religious importance of the seeds as an important article of Hindus. The present article, however, tries to cover up all the left out details of the *Til* seeds and oil.

## 2. DESCRIPTION OF THE *TIL* PLANT

*Sesamum indicum* Linn., syn. *S. orientale* Linn. (*Pedaliaceae*), an erect, pubescent annual herb, height 2 to 3 feet more or less, foetid and branching from the base; leaves opposite or upper ones alternate, ovate, narrowly oblong or lanceolate, the lower ones often 3-lobed, feather-nerved; the middle one often toothed at the base of the peduncle with remarkable yellow glands; flowers solitary in the axils, 1-1½ inch resembling those of

the *Digitalis* (fox glove) in miniature form from dirty white to rose-coloured; capsule 1 inch velvety and pubescent, mucronate, at first 2-celled, afterwards 4-celled; seeds numerous, without wings, ovoid, flat, white, brown, or black (Fig.1).



Fig. 1. A white *Til* plant and its white seeds

## 2.1 Vernacular names

Sesame (*Til*) is known by different names, in different parts of the world and in different regions of India. Commonly it is known as Sesame, Gingelly and *Til*; *Konjele*, *Kunjit*, *Til* (Afghanistan); *Djyldiylan*, *Duban*, *Samusam*, *Simsim* (Arabian Countries); *Juljulyyn* (Africa); *Kumjad* (Persia); *Goma* (Japan); *Hu ma Zhi* or *Hei Zhi Ma* or *Hu-ma*, (China). In India, *Tilmi*, *Nuvvu*, *Nuvvulu*, *Polla-nuvullu* (Telgu); *Achelu*, *Ellu*, *Woellu*, *Yallu*, *Chitelu*, *Chitrallu*, *Ellu*, *Karellu*, *Scetel* (Malyalam); *Ellu*, *Hllu*, *Nuvvulu*, *Yellu-chedi* (Tamil); *Til* (Hindi & Beng.). In Sanskrit only one name, *Til* is available, however, its flower is known as *Bajrapuṣpam* and seeds without oil are known as *Tilpage* and *Tilpinja*<sup>2</sup>.

These vernacular names denote some meaning or facts or characteristics, for example *Hu-ma* in Chinese means, “hemp introduced from the West.” Clearly indicating that the plant was introduced from West. Recently, *Hu-ma* was tentatively identified as Flax (investigation continued) (Qui *et al.* 2012). However, De Candolle (1886) stated the importance of

vernacular names of the cultivated plants as one of the tools in ascertaining the origin of the plant.

### 3. ORIGIN

About 34 species of *Sesame* are found in the world mainly in tropical South Africa and Asia. Out of those 18 are found in S. Africa, Nigeria, Sudan, Congo and 8 are found in the Indian region. However, Watt (1889-1893) was of opinion that its origin is from more than one place, and must have been cultivated in Euphrates valley and in Bokhara of Afghanistan. Recently, the African origin has also been well established (Bedigion, 2011).

De Candolle (1886) was of opinion that India might have received Sesame from Malayan & Indonesian region in pre-Aryan period, possibly, by the South-Indian navigators. Esquinas-Alcazar (2004) has shown its origin in the Central Asian Region (Afghanistan & Iran). The secondary centers are: Abyssinia, Afghanistan, Uzbekistan, India, Bangladesh, Myanmar (Burma), Central Asia, and China. According to Fluckiger & Hanbury (1879), in the days of Pliny Sesame oil was an export item from Sind to Europe by way of the Red Sea. In the Middle Ages, the plant was known as 'Suseman' or 'Sempsen', a corruption of the Arabic 'Simsin' or 'Samsim'.

#### 3.1 *Til* in *Atharava veda* and in the North Indian region

*Til* is very well known in northern India. The origin of its use has been lost with the time. But evidence of the plant's cultivation goes far back when it was cultivated by the Harappan people about 3,500 years BC. When the Aryans came to India, they not only evaluated the crops grown or used by the Harappan people but also adapted and mentioned in their holy scriptures like *Atharvaveda* (I.26.15). Then, it was used as a food rather than an oil or medicine. Its sale was forbidden perhaps by Brāhman and was eaten in certain ceremonies. It is to be used in *śrāddha*, *Atharvaveda* (II.2.13) for expiating certain sins, and it is only eaten during the *śukla-pakṣa* (full moon days) as a penance<sup>3</sup>. *Til* seeds mixed with rice grain is regarded auspicious (*Atharvaveda* 18.4.26, 13.3.69 and 11.4.43. Not only this there are references in which *Til* was used in proverbial language 2-8-3. 'Danto' bird is advised to leave flesh-meat and to eat rice, *masa* or *urada* (*Phaseolus mungo*). It was a holy tradition to broadcast it in the field mixed with paddy and barley

seeds, and when they grew they gave power to the local king (*Atharvaveda*<sup>4</sup> 6.140.2 and 18.3.69 and 18.4.32-34).

#### 4. USE OF *TIL* IN HINDU FESTIVALS & CEREMONIES

Possibly, knowing the fact of its nutritional importance, it was linked with the tradition and culture in North India so much so that certain *Til* it is known as festivals and ceremonies are celebrated under different names in different regions. In Panjab, *Lohri*, or *Bhugga*, or *Pugga* in the plains of U.P. and in western Uttar Pradesh and in other parts it is celebrated under the name of *Sakat* in which, *Til* preparations are made in homes, mainly of black *Til* and its *laddoos* with *gur* are prepared and offered to Gaṇeśa, who, is supposed to be fond of *laddoos*. These are also sold in Bazar only for a week or so. It is believed to be auspicious to eat *til laddoos* or its other preparations.

##### 4.1 Uses in last religious rites and in ‘*Śrāddha*’

In Hindus, during the funeral ceremony in honour of the dead, as a last religious rites, *Til* seeds are placed in three vessels containing *Kuśa* grass (*Desmostachys bipinnata*) and water. The holy water is sprinkled with the following prayer : “*O Tila, sacred to Soma, created by the gods during the Gosava (the cow-sacrifice, not in practice now), make the dead and us happy. !*” (Dymock *et al.* 1893).

In *śrāddha* ceremony, (death anniversary of the dead) every Hindu, uses the *Til* seeds with rice and honey in preparing *piṇḍas* (the funereal cakes) and performs *piṇḍa-dān* at the death of the last ceremony of the deceased, and on the death anniversary of the close relatives and during the *Śrāddha* ceremony of mostly mother and father or nearest ones.

It is to be noted that *Til* oil is extracted from the *Til* seeds available in the market, with the solvents, however, the shape, size and colour of the seeds remains the same as usual.

In South India the festivals are the same as in Hindu religion. These are mostly used in paying tribute to dead relatives through a ‘*hāvan*’ known as ‘*Tilhāvanam*’, in which mainly *Til* seeds are used.

## 4.2. Use in religious acts & ceremonies and in festivals

### 4.2.1 Religious acts

On six religious festivals *Til* ceremony were performed with seeds by which the Hindus hope to obtain recluse from sin & poverty and other evils and secure a place in *svarga* (Heaven, or the abode of Indra). Dymock *et al* (1893) has described the six acts, namely bathing in water containing the Sesame – seeds known as *holdvartu*; and anointing the body with the pounded seeds *filasfia*; offering of the seeds by burning in homa *tila-homi*; offering of the seeds to the dead *tila-fadā*; eating of the seeds and lastly *tila-bhuj*, throwing out the seeds *tila-vapi*. These religious acts are seldom seen, now.

### 4.2.2 *Ṣaṭ-tila Ekādaśī*

Mostly, in northern India, a festival known as *Ṣaṭ-tila Ekādaśī* meaning six sesame seeds on eleventh day, is performed by the Hindu ladies on 11<sup>th</sup> day of the *Māgha* month of Hindu calendar, which falls usually in January in each year. For this occasion, six types of seeds are selected and taken after the fast and given to Brāhmans to eat. It is said that by doing so, one reaches to *Vaikuṇṭha* (The abode of Viṣṇu). In earlier days, this was the way of conserving and recognizing and knowing the available genetic material of the Sesame seeds within the country. However, six *testā* (seed coat) colour types of *Til* have also been agriculturally recognized, e.g., white, dull-white, black, light brown and dark brown (red) by Raghavan (1961). In China a range from white to black testa colour seeds are recognized gray, brown, yellow, red, tan and ivory (Qui *et al.* 2012). But now only 101 healthy black seeds are selected with 101 *dūrbā* grass, (*Cynodon dactylon*) aerial shoots for the *pūjā*. Possibly, the collection of six types or variety of *Til* seeds is lost with the time. Further, there is a mythological story described in detail of the act due to which ‘*Ṣaṭ-tila Ekādaśī*, is celebrated<sup>5</sup>.

### 4.2.3 *Lohri or Bhugga or Pugga*

In Panjab and in North India within the Panjabi community, or wherever they reside, an important festival known as *Lohri* or less known as *Bhugga* or *Pugga* is celebrated, a day before *Makar Sankrānti* on 13<sup>th</sup> of

January, each year with gaiety and enthusiasm. In this festival all family members, relatives and friends meet around an open bon-fire and *til*-seeds along with other cereals like, parched- rice in form of *layaa*, peanut, corn-seed, even dry fruits and roasted cereals with *til*, *rewri*, *gajak*, etc. are offered to the bon-fire and recite, a number of songs including, '*til chaṭke, jad saṭke*' meaning 'as *Til* cracks (burst), the winter recedes'. Then, *rewri*, *gajak*, etc. or any other home made *til* preparations are distributed among the participants.

#### 4.2.4 *Makar Sankrānti*

When the sun moves to North, mostly, on 14<sup>th</sup> January each year *Makar Sankrānti* is celebrated and the Sun is worshipped. Then, *Til* and rice grains is distributed among the Brāhmins and the poor. Now a days, rice with other pulses mainly *urada (māśa)* or *Phaseolus mungo* known as 'Khichari' is distributed. It is said that doing such act one gets '*Mokṣa*'. In North India, during this occasion *Til laddoos*, are also sold in the sweet-meat shops and people buy and eat.

#### 4.2.5 *Sankaṭ*

In Kumaon, each year, on *Gaṇeśa caturdaśī*, of winters usually in, January and in rainy season, in *Bhādo* (in August), two ceremonies are celebrated known as "*Sankaṭ-har caturthi pūjā*" or more commonly as '*Sankaṭ*'. This puja is conducted to appease Lord Gaṇeśa to take away all the worldly troubles. On this day, black *Til* seeds are toasted and ground with *gur* and a paste is formed, which is given a shape of '*laddoos*' and also a shape of a goat. Then, after the *pūjā* the youngest male child of the house cuts the '*til goat*'. Then, the '*laddoos*' and the '*til goat*' parts are distributed as an offering of God to all the family members, commonly known as '*Prasād*' and eaten.

#### 4.2.6 *Til-pātra dān*

In Kumaon during marriage ceremony in a small copper/bronze cup is filled with *til* seeds with a piece of gold or money. Then, the brides' father and mother worship Lord Gaṇeśa and with the holy water they themselves purify along with the cup filled with *Til* and a piece of gold and offers it



**Fig. 2.** Black *til* seed are toasted and ground with 'gur' on 'Gañeśa caturdaśī' in Kumaon (Uttarakhand), and 'til laddoos' are made and a 'Sesame-goat' is made, which is then cut by a youngest male child of the family.

to the priest who had conducted the marriage. While offering 'Til pātra' a *mantra* is chanted which means, "Til is pious, holy and fulfills all the desires."

Mythologically, black & white *Til* have originated from the body of Lord Viṣṇu. In case, if the performer has ever committed a top sin like killing a Brahmin (*Brāhma hatyā*), the performer is expiated or freed from the said sin, (Joshi, n.d.)

## 5. MYTHOLOGICAL HISTORY OF ORIGIN

According to Gupta (1971, p. 97-98) *Til* seeds sprang from the limbs of Rishi Kāśyapa as stated in *Mahābhārata, Anuśāsana Parva* vol XI p.79. She further states, whatsoever, objects should be offered to *pitras* (dead relative souls) along with *Til* seeds which also includes rice, barley and *mās* (*urada*) which satisfies their souls only for a month; with fishes only for two months; mutton for three months, flesh of hare for four months, and the time increases with the flesh of goat, bacon, flesh of birds with vension (flesh of deer), and buffalo for full year with beef (cow meat) and with *vadrinara* possibly the bull flesh it last for twelve years. This was in practice with the Aryans, who had arrived in India and had just settled. Later on, animal killing was prohibited in religious rites and ceremonies and in 'hāvan' and, and vegetable commodities were offered and possibly, *Til* was the first.

Further, *pūjā* practice and ritual was created and performed. ‘*Pū*’ is a Dravidian word meaning flower and ‘*jā*’ means to do or perform. It is a flower ritual or ‘*puṣpa-karma*’ (Shah, 1994). Later, the sacrifice of the animals was abandoned in ‘*Homa*’ and only the vegetable material like ‘*til*’ and the cereals like barley was used. Not only this ‘*Piṇḍadān*’ in Gaya satisfies the *pītras* (the dead souls) for ever and annual *śrāddhas* are no more required to be performed.

In Hindu mythology *Til* (Sesame) seed is symbolic of immortality. According to the *Brahma-purāṇa*, *Tila* was created by Yama, the “king of death”, after prolonged penance. Gandhi Maneka (1989) tells an interesting mythological story that once Viṣṇu punished her wife Laximi to live for three years in a house of a poor farmer from whose field, she had plucked the flowers of *Til* without his prior permission.

## 6. *TIL* FROM TRIBAL REGIONS OF INDIA AND ITS ETHNOBOTANY

Only eight uses of *Til* have been recorded from the tribal regions of India, mainly North East region and Santhal Pargana (Jain 1991). The uses are almost the same which we generally come across.

### 6.1 Uses as an aphrodisiac

Dymock *et al* (1893) state during 19<sup>th</sup> century the hawkers (street vendors) of Delhi used to sell an aphrodisiac preparation with a street-cry as under :

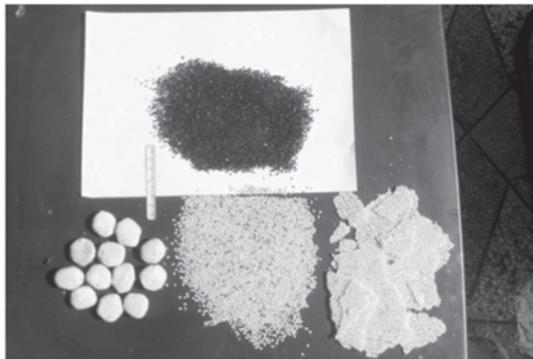
“*til, tikhur, alsi, dāna,*  
*ghī, śakkar men sāna,*  
*khāye buḍḍhe, hoe javāna*”

Meaning,

*Til* (*Sesamum indicum*), *tikhur* (*Curcuma angustifolia*), and *alsi*, linseed (Flax, *Linum usitatissimum*), *dāna* or Poppy seeds (*Papaver somniferum*), *ghee* (clarified-butter), and sugar, are mixed and ground and whosoever, old fellow eats, he speedily becomes young.

### 6.2 Sweet-meat prepared from *Til*

Usually, in Rajasthan, *papri*, in Lucknow and other cities, *rewri* and *gajak* and other sweet-meat prepared from white *til* are sold in the bazaar (Fig. 3).



**Fig. 3.** Shows white and black *til* seeds in the centre, sweat meat of Rajasthan, *papri* and *rewri* of Lucknow manufactured from 'white *til*' in the corners.

### 6.3 Used in proverbial literature as a symbolic

'*Jartila*', a useless & worthless person is compared to wild Sesame (*Jartila*), which contains no oil. "*In tilon mein tel nahin*" meaning there is no good in him. "*Til-bhar*" means an area or a space equal to '*til*-grain'. "*Tilbhar bhi jagah nahi*' means no space left even to the size of a *til*. It is said, "*Til cor so bajjar cor*" meaning, a thief, who can steal a grain of *til* would steal a sack. "*Til-til kā hisāb*" meaning the exact and the final calculation.

It is also stated that the word '*Taila*' in Sanskrit, which stands for oil, is derived from *Til*. It seems that *Til* oil is one of the first oil extracted from the seeds by the ancient Hindus.

*Tilāñjali*- also indicate meaning to leave or abandon a thing for ever. The moles of the human body are also called *Til* in Hindi and Sanskrit.

## 7. CULTIVATION

It is cultivated throughout the tropical and subtropical regions in India and most part of the world, viz., in S. Africa, East Indies, West Indies and also in southern United States, Mexico, Venezuela. In Asia, Sudan, Afghanistan, Pakistan, Bangla Desh, and in far East countries like; China, Korea and Japan (Fig. 4). In Afghanistan, it is known as *konjet* or *konjele* and cultivated in seven provinces out of ten to be used in medicine (Younus Chafique *et al* 1987).



Fig. 4. A *Til* crop in the field

### 7.1 Agriculture & Commerce

As stated earlier Sesame is commercially cultivated in many countries. In China, it is intercropped by soyabean, peanut and cotton. Though, in India six colour types have been stated (Raghavan 1961) but commonly, only two types of *Til* are recognized commercially, normally black red and white seed; the former being generally known as '*Til*' and the latter as '*Tili*'. The duration of crop ranges from 85 to 140 days and it can be planted almost throughout the year in the southern part of the country (Anonymous 1948).

It is cultivated as a 'Kharif' crop under rain-fed areas like; U.P., Rajasthan, Maharastra & Punjab, and also as 'Rabi' crop in irrigated areas like Andhra Pradesh, Tamil Nadu, Madhya Pradesh, Maharashtra, and in Orissa as a summer crop in irrigated lands. The yield of 'Kharif' crop was estimated 200-400 lb (90.8-181.6 kg) and in 'Rabi' crop the yield is 100-300 lb (45.4- 135.2 kg.). However, in irrigated summer season it yields 300-600 lb.(135.2- 272.4 kg) (Raghavan 1961). Presently, average yield 377 kg/ha. has been reported, which is less than a half of the best yield 980 kg/ha in Mexico and 950 kg/ha in China (Anonymous 2009).

'*Til*'(*black*)ripens rather late than '*Tili*'(*white*), and is more commonly grown, mixed with other crops, such as *Sorghum vulgare* (barley), while '*Tili*' does best when mixed with cotton. Usually, the seeds contain about 50 to 60% of a fatty oil. However, the Bombay variety-85 was reported yielding

59 % of oil, which was earlier cultivated in Nasik, Ahmadnagar, East Khan Desh (Raghavan 1961, p. 204-206). The total production during 1994-95 the country produced 8000 thousand tones (8 crore tones). It is exported from India to about 62 countries and mostly to the middle east countries like Turkey, Saudi Arabia, etc. (Anonymous 2009).

## 8. AYURVEDIC & OTHER MEDICINAL USES

### 8.1 Sesame plant used for medicinal purpose

According to Trivedi<sup>6</sup> all the parts of the plant are used for medicinal purpose. It is stated that 54 medicinal uses of different parts of the plant such as: seeds, oil, oil-cake, flowers, leaves, root, whole plant, are used, which includes boils, carbuncle, menstrual irregularities, blood dysentery, poly-urea, stomach- trouble, migraine, serious burns skin diseases, eye trouble (flowers), alopecia (leaves & root), and used as a tonic, etc. Morton<sup>7</sup> (quoting Dastur 1952) informs that the leaves are mucilaginous and are poulticed on wounds. The mucilage is collected by boiling in water or steeped in cold water and is used as a remedy of chronic diarrhea and other intestinal and urinary disorders. It is also applied in ophthalmic and skin complaints.

### 8.2 Best suited oil in Ayurvedic medicine

The *Bhāvaprakāśa Nighaṅṭu* describes only three types of *Til* seeds, viz., black, white and red (Chunekar & Pandey)<sup>8</sup>. The black is regarded as the best suited for medicinal use and it yields also the highest quantity of oil. While the white-*til* is of intermediate quality. *Til* of red or other colours is said to be inferior and unfit for medicinal use. Suśruta considered the oil from the black *til* as the most superior among the oils (Trivedi 1965).

### 8.3 Medicated Oil

Sesame oil forms the basis of most of the fragrant or scented massage oils, and hair oils used in India. It is used before taking a bath, and also as a medicated oils prepared along with various vegetable drugs or animal drugs like, scorpion, lizard, etc. It is used in different kinds of body pains, in neuralgia and in old age disease, paralysis, gout, rheumatism used as massage oil and also as a hair-oil, and are sold in the market.

*Seeds as medicines:* Sesame seeds are considered emollient, nourishing, tonic, diuretic, and lactagogue. They are said to be especially serviceable in piles, by regulating the bowels and removing constipation. A poultice made of the seeds is applied to ulcers. Both the seeds and the oil are used as demulcents in dysentery and urinary diseases in combination with other drug plants<sup>9, 10</sup>.

*Proprietary medicines:* In the market a number of the proprietary Ayurvedic preparations in the forms of oils and drugs are sold prepared either from seed or oil. These are: *tilādi-guṭikā*, *tilādi-lep*, *tila-tak*, *laghu-vis-garva-taila*<sup>11</sup> and *til-saptakcūrṇa*<sup>12</sup>, *mahāmaś-taila*, *mahānārayaṇ-taila*, 'mahārājprasāriṇī-taila'<sup>13</sup>.



Fig. 5. *Til* crop being dried on the roof of the houses in Rajasthan

#### 8.4 Miscellaneous uses

*As a preservative:* It is stated that it was used to preserve the dead bodies in India in ancient days<sup>14</sup>.

*Pest control:* It is further stated that the pest infested on *Til* plant are collected from the field in a blanket and brought in the room, where there are many bed-bugs (*khaṭmal*) as pests and left for some time. It is stated that pests of the *Til* plant eat away the bugs, without harming humans<sup>15</sup>. Could it be used as a biological control for bed-bugs ?

*Extraction of oil (new type):* In Maharashtra, the seeds are wrapped in *Palās* (*Butea monosperma*) leaf and cooked in steam. Then, the seeds are transferred to a clean white cloth, when it is still hot and the oil is squeezed from the cloth and collected. This oil is used for various medicinal purposes such as for curing abscess, bleeding- piles and in abdominal-pain (D' Souza 1993).

### 8.5 Uses in other countries

*In Africa:* Sesame is an ancient cultigens and presently, it is mostly grown in several parts of the world as a source of oil. In Africa, its leaves are consumed raw during food scarcity (Qui, *et al* 2012 quoting Latham 1979). However, in Africa the other species found are: *S. alatum*, *S. angustifolium*, *S. radiatum* and used as food plant (Nayar & Mehra 1970). The Egyptians are said to have produced flour from its ground seeds. The Roman soldiers are said to mix the seeds with honey for an energy snack.

*Uses in Middle East countries:* The toasted seeds are ground into a grayish-brown oily paste called *Tahini*. *Tahini* paste has a smooth texture and a nutty flavor and used in a similar way to peanut butter. And, because it is a good source of calcium, protein and energy, it is particularly given to growing young children.

*Uses in Arabian Countries:* The oil is called in Arabic '*Duhn-el-hal*', and used for the same purpose as olive oil. In Europe sesame is considered fattening, emollient, and laxative. The decoction of seeds is said to be emmenagogue; the left out seeds are made into a preparation sweetened with sugar and is prescribed in cough; a decoction with linseed is used as an aphrodisiac; a plaster made of the ground seeds is applied to bums, scalds, & cuts; a lotion made from the leaves is used as a hair- wash, and is supposed to promote the growth of the hair and make it black; a decoction of the root is said to have the same properties like leaves; a powder made from the roasted and decorticated seed is called '*Rahishi*' in Arabic<sup>16</sup>.

*In South-East Asian countries:* It is used as Shampoo<sup>17</sup> (quoting Burkil 1935).

*Uses in China:* Recently, in China a cache of sesame seeds, discovered in the Thousand Buddha Grottoes at Boziklik, in China (c. 700 BC), is an evidence of its use in China since that time. It is further established that it

was a valued commodity that could provision the monks and enrich the diet of ancient inhabitants as an oil source (Qui *et al*, 2012)

In China it is known as *Hu-ma* the seeds are used for invigorating liver & kidney functions, replenishing essence and blood and moistening the intestine for smooth flow of food under digestion. It is used as a longeval tonic due to its property reducing blood cholesterol, which is due to linoleic acid and acts as a prophylactic in arteriosclerosis. It is regarded as invigorating liver& kidney, replenishing essence and blood and moistening intestines (Anonymous 2007). However, Bedigion (2011) reports that it is widely utilized in China, and 2/3<sup>rd</sup> is used as food oil and rest in perfumery, cosmetics, pharmaceuticals, soap, paint and as synergist in insecticide. Leaf are used as edible fresh vegetable / canned. However, China has assembled more than 5200 germ plasm accession of Sesame. Ethiopia still exports sesame to China and China buys about 60 percent of Ethiopia's sesame produce (<http://www.ethiomedias.com/assert/4868.html>)

*Use in Japan:* In Japan it is known as *goma* and the yield of oil is 45-55 % with light & yellow colour with a pleasant aroma used for cooking purpose and for making Japanese cuisine Tenpura, The oil is produced from the toasted, white-yellow seeds. It is mainly used to increase two fold insecticidal activity of natural insecticide of pyrethrum by adding 10% of sesame oil, which is due to sesamin, and lately artificial synergists of insecticide have been synthesized on the basis of the chemical structure of sesamin (Takeda, 1971).

## 9. THE MAIN CHEMICAL CONSTITUENTS OF THE SEED, OIL & CAKE AND THEIR COMPOSITION

### 9.1 The Seeds

Basically, all seeds contain some kind of stored energy used as a fuel by the young plant in the first phase of its life. This energy is commonly stored in form of proteins, carbohydrates, or fat. It also contains protein 18.3 (Nx6.23), fat 43.3, minerals, 5.2g, fibre 2.9 g, carbohydrate 25.0 g, energy 563 K.Cal., Ca 1450 mg, phosphorus 570 mg and iron 9.3 mg per 100 gm of edible protein<sup>18</sup>. The essential amino acids are: arginine 750, histidine 170, lysine 170, tryptophan 080, phenylalanine 370, tyrosine 230, methionine

180, cystine 120, threonine 230, leucine 500, isoleucine 250 and valine 290 mg per gm N<sup>19</sup>. The seeds contains the following minerals and trace elements; copper 2.29, manganese 1.32, molybdenum 0.204, zinc 12.20, chromium 0.087 per 100 gm of edible protein<sup>20</sup>. And, oxalic acid 1700 mg/per 100 mg<sup>21</sup>.

The sesame seed contains about 50 to 60% of a fatty oil, which is characterized by a two lignans, sesamin and sesamol (approximately 300 ppm in the oil), whence, during raffination two phenolic antioxidants, sesamol (3, 4-methylenedioxyphenol) and sesaminol, are formed. However, the seeds contains: carotene 60µg; thiamine 1.01 mg; riboflavine 0.34 mg; niacin 4.4 mg, folic acid (free) 51 µg and (total) 134 µg, as Gingelly seeds<sup>22</sup>.

## 9.2 Composition of the pressed oil (untoasted) and its shelf-life

Oil obtained by pressing such seeds, contains besides true fats (lipids) several more constituents: the aroma compounds, which make up for the culinary character of the oil, vitamins, trace elements, etc. Sesame oil is mostly composed of triglycerides of the singly unsaturated oleic acid (40%) and the doubly unsaturated linoleic acid (45%), besides approximately 10% saturated fats (iodine index 110). Sesame oil has an excellent shelf-life because sesamol is converted into sesamol and sesaminol, this fact has been recently found to contribute to the oil strong resistance to rancidity (Anonymous 2009 and Bedigion 2011). Sesame oil is rich in the essential amino acids methionine. It also contain P, Mg, Ca, and vitamin E, as well as trace amounts of elements Mo, Zn, Fe, Co, and Iodine (Qui *et al*, 2012 quoting Bedigian, 2010 c and Zhao 2010).

The oil present in seed is about 51% and the fatty acid, include mainly oleic, linoleic and lesser amount of palmitic & stearic acid. And composition of the different crop is given by Nayar & Mehra (1970) for comparison as under:

	Palmitic	Stearic	Oleic	Linoleic	Linolenic
Corn	11%	4%	30%	54%	1%
Safflower	6%	3%	16%	75%	—
Sesame	9%	5%	38%	48%	—

However, Handa & Kapoor (1988) reported the following Fatty acids; Palmitic 90%, Stearic 4%, Oleic 23% and Linoleic 20%.

### 9.3 The composition of oil extracted from toasted seeds for flavouring purpose

In Eastern countries like Japan, China, Korea, the sesame oil owes its characteristic flavour to a huge number of compounds, which form only during the toasting procedure. It is revealed that there are 41 odour (aromatic) –active constituents and out of which 18 show very high flavor dilution factor. Most prominent are 2-furfurylthiol, which also plays an important part in the flavour of coffee and roasted meat. The other ones are: 2-methoxyphenol (guajacol), 2-phenylethanylthiol (furanol), 4-hydroxy-2, 5-dimethyl-3(2H) (furanone); furthermore, 2-pentylpyridine (vinylguacol), and there many other compounds reported in toasted sesame oil. It is also reported that pyrazines are the key aroma compounds of toasted sesame seeds. It was found out that pyrazines dominate the flavour for mild toasting conditions (160 °C), while roasting at higher temperature (200 °C) leads to increased formation of furanes<sup>23</sup>.

*The composition of meal-cake or oil-cake:* Meal-cake is a byproduct of the *til*-oil milling industries and high esteemed as live stock and poultry feed. The oil-cake has the following composition; about 8-12 % oil, moisture 8-25; crude protein, crude fat 8%, crude fibre 7.0%, total ash 13.0%<sup>24</sup>. Meal-cake is also an item of export to many countries in 1991-1992, 1992-1993 and 1993-94, 20658 t., 32849 t. and 11313 t., respectively were exported to different countries<sup>25</sup>.

*Extraction and purification of til-oil in India:* *Til* oil is one of the most valuable of Indian vegetable oils; it can be kept for a long time without becoming rancid. It is produced in large quantities in almost every part of the country. The following method of extraction of oil is earlier reported by Fluckiger & Hanbury (1879);

“The method sometimes adopted is that of throwing the fresh seeds, without any cleansing process, into the common mill, and expressing in the usual way. The oil thus becomes mixed with a large portion of the colouring matter of the epidermis (*testā*) of the seed, and is neither so pleasant to the eye nor it is tasty as obtained by first repeatedly washing the seeds in cold water, or by boiling them for a short time, until the whole of the reddish-brown colouring matter is removed and the seeds

have become perfectly white. They are then dried in the sun, and the oil expressed as usual. The process yields from 40 to 44 per cent, of a very pale straw-coloured sweet-smelling oil, an excellent substitute for olive oil.”

Nayar & Mehra (1970) described three steps for expression of oil; first expression with cold water- yielding a high grade oil; second expression with hot water, it has a colour and is further refined and used for food purpose and third expression again with hot water it is an inferior quality of oil. In Calcutta, where the seeds are only pressed twice, the average yield is; 1st pressing of fine oil 36%; 2<sup>nd</sup> pressing ordinary oil 11%.

Handa & Kapoor<sup>26</sup> stated that it has the same saponification value (188-195) that of olive oil and the iodine value is 103-116, slightly higher than the olive oil and also described the refining of the crude oil by the use of caustic alkali for bleaching and as an agent for deodorizing.

Now a days, electric-mills are in use, in the urban parts of the country and in the villages the bull- mills are still used for extraction of the oil (Fig 6).



**Fig. 6.** In a big village of Rajasthan (Kharwa) Electric oil crusher machines are generally seen, which usually crush oil from the seeds brought by the farmers

**9.4 Chemical test to detect the purity of the oil:** The tests were given by Fluckiger & Hanbury (1879), however, these tests require re-testing and confirmation.

**9.4.1** The oil itself being gently shaken with sulphuric and nitric acids takes a fine green hue, no other oil exhibits this reaction. It takes place even with the bleached and perfectly colourless oil. Sesame oil added to other oils, if to a larger extent than 10 per cent may be recognised by this test. The reaction ought to be observed with small quantities, say 1 gram, of the oil and 1 gram, of the acid mixture previously cooled.

**9.4.2** The use of hydrochloric acid with a little pyrogallol for detecting the presence of sesame oil in this 14 parts of the acid and 1 part of pyrogallol are to be placed with an equal proportion of the oil to be tested in a test tube, which is corked and well shaken. The tube is then to be allowed to stand for five minutes, when, the upper layer of oil having been removed by a pipette, the acid solution is boiled for five minutes. If sesame oil is present, it will show a purple colour, when viewed by transmitted light, and a blue colour by reflect-red light; the latter colour is best observed when the fluid is poured into a porcelain capsule.

Olive oil tested with this re-agent afforded a faint yellowish colour, and also almond, groundnut and rape oils no colour, and cotton-seed oil a very pale red. An admixture of 1 to 2 per cent, of sesame oil with olive oil may thus be detected by this method.

**9.4.3** The substance obtained on shaking sesame oil with acetic acid has also been tested and found it to be best obtained by using 7 volumes of acetic acid to 10 volumes of oil. After removal of the acid, a brown transparent gelatinous residue was left, which, upon agitation with weak potash solution and kept for twelve hours, afforded a deposit, which; after being well washed with distilled water, was boiled with hydrochloric acid, collected on a filter, thoroughly washed to free it from acid, and dried over a water bath. It was then soluble in alcohol and crystallized on cooling from its alcoholic solution in long needles melting at 117-118° C. The needles were soluble in benzene, oil of turpentine, carbon bisulphide, chloroform, and glacial acetic acid, but insoluble in water, alkaline solutions, and hydrochloric acid. They were neutral to test (litmus) paper, and gave no colour reaction with the hydrochloric acid and pyrogallol solution, showing that this reaction is due

to another principle in the oil which has not yet been isolated. (*Pharm. Journ.*, Jan. 24th, 1891 quoted by Fluckiger & Hanbury, 1879).

**9.4.4 Villavecchia test:** In place of sugar furfural is used and it is said to be the widely used test for the detection of the sesame oil, when present even in small amount in other oils and fats. The presence of sesamolin or free sesamol is responsible for this test (Anonymous 1948).

Handa & Kapoor (1988) describes Bedouin's test as follows, when two ml. of sesame oil is shaken with 1 ml. of 1% solution of sucrose in hydrochloric acid, a pink to red colour is obtained due to presence of a phenolic component sesamol (Fig. 7).



**Fig. 7.** A Freshly crushed *Til* oil

## 10. DISCUSSION & CONCLUSION

There are many questions which require explanations. No doubt the origin (native place) of *Til* has been stated to be Africa but its introduction in India has been lost with the time. It is stated that it was cultivated during Harappan period and further stated by Pliny that it was an item of export from Sind to Europe. There are many theories, one is that it was introduced

either from Euphrates valley or Bokhara from Afghanistan. Likely, the crop was introduced from Ethiopia, by the navigators who were in trade before the Arabians came to India for trade. As we see the Ethiopian merchants were well in contact with India and Ceylon from 100 AD to 400 AD (Tolmacheva, 2008). Ethiopia still exports sesame presently to China.

The chemical composition of the seeds and oil show that *Til* is a very nutritive crop and it is certain that in the remote past in India, *Til* was an very important crop and only due to its high nutritive properties, it was adopted in the Hindu religion and culture.

Over and above, the festivals like *Ṣattila Ekādāśi* are celebrated to conserve the germ-plasm (genetical material) available within the country. Further, *Sankat-har Caturthī Pūja* (*Gaṇeś Caturdaśi*), *Makar Sankrānti*, *Lohri* or *Bhugga*, or *Pugga* festivals are the remnant signs to show the importance of *Til* as an important crop of the past. It is to be noted that *Til* was included as a cereal under '*Saptadhānya*', e., g., rice, wheat, barley, black-gram or *urad* (*Phaseolus mungo*), green-gram *moong* (*P. aureus*) Bengal-gram, *cānā* (*Cicer arietinum*) and *Til*. These are still used in certain *pūja* and ceremonies like marriage as a '*sapta dhānya*'. Dymock (1893) has referred six religious acts viz., *Holdvartu*, *Filasfiats*, *Tila-homi*, *Tila-fadā*, *Tila-bhuj*, and *Tila-vapi*. Among these only *Til-homi* has been identified from south India in which only *Til* is used in *homa*, while in north India barley is mixed with *Til*. It is required to identify the five remaining acts, which are being observed in some parts of the country.

The plant is known by different vernacular names in India and abroad. Vernacular names are the part of the native language and it has some meaning pertaining to its use, its properties and character and some time, it bears the name of the native place from where it was introduced or brought. It is required to work out on all vernacular names of sesame. It is certain that we may get some useful information, about which we do not know yet.

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