

Kodoth Prabhakaran Nair

Turmeric (*Curcuma longa* L.) and Ginger (*Zingiber officinale* Rosc.) - World's Invaluable Medicinal Spices

The Agronomy and Economy of Turmeric and Ginger

 Springer

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This book, written under very trying circumstances, is dedicated to my wife, Pankajam, a Nematologist trained in Europe but one who gave up her profession and, instead, chose to be a homemaker almost four decades ago, when we had our son and daughter. She is my all, and she sustains me in this difficult journey, that is, life.

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Chapter 1

Turmeric: Origin and History



Abstract The chapter discusses at length the origin and history of turmeric. Additionally, it covers details on area of turmeric production, nationally and globally.

Keywords History · Turmeric · Indian production · Global production

When one leafs through ancient scripture, primarily Indian, the most important plant that one comes across is turmeric. Turmeric, also known as “Indian saffron,” has been in use dating back to 4000 bc. It is mentioned in *Ayurveda*, the age-old Indian system of medicine, and one encounters its name and use recorded in Sanskrit, the ancient Indian language describing the ageless *Vedas* (ancient Indian scriptures), between 1700 and 800 bc during the period known as the *Vedic* age. In fact, the use of turmeric spans many purposes, as a dye, condiment, and medicine. In *Sanskrit*, it is referred to as *Haridra*, a word which has two parts: “Hari” and “Dara,” meaning Vishnu, also known as “Hari,” the omnipotent and omnipresent Hindu deity, and “Dara” meaning what one wears, obviously referring to the fact that Vishnu used it on his body. In India, it is put to several uses, as a coloring material, flavoring agent with digestive properties, and in fact, no Indian preparation (vegetarian or nonvegetarian) is complete without turmeric as an ingredient. The bright yellow color of the now famous Indian *curry* is due to turmeric. Turmeric is much revered by the Hindus and, interestingly, is given as *Prasad* (a benedictory material) in powdered form, in some temples. Obviously, whoever originated this idea had two purposes in mind—to bless the recipient and to give him or her material that has great medicinal value. *Charaka* and *Sushruta*, the great ancient Indian physicians who systematized the *Ayurvedic* system of medicine, have cataloged the various uses of turmeric (Anon 1950; Nadkarni 1976). Also the Greek physician Dioscorides, in the Roman Army (ad 40–90), makes a mention of turmeric. In Malaysia, a paste of turmeric is spread on the mother’s abdomen and on the umbilical cord after childbirth in the belief that it would ward off evil spirits and also would provide some medicinal value, primarily antiseptic. Both the East and the West have held turmeric in high esteem for its medicinal properties. The Indus Valley Civilization dating back to 3300 bc in Western India was involved in the spice trade, of which turmeric

was an important constituent. The Greco-Roman, Egyptian, and Middle East regions were all familiar with turmeric (Raghavan 2007). The crushed and powdered rhizome of turmeric was used extensively in Asian cookery, medicines, cosmetics, and fabric dyeing for more than 20,000 years (Ammon and Wahl 1991). Early European explorers to the Asian continent introduced turmeric to the Western world in the fourteenth century (Aggarwal et al. 2007). About 40 species of the genus *Curcuma* are indigenous to India, which point to its Indian origin (Velayudhan et al. 1999). Apart from *Curcuma longa*, several species of economic importance are available, such as *Curcuma aromatica* Salisb., *Curcuma amada* Roxb., *Curcuma caesia* Roxb., *Curcuma aeruginosa* Roxb., and *Curcuma xanthorrhiza* Roxb. About 70–110 species of the genus have been reported throughout tropical Asia. The species in India, Myanmar, and Thailand show the greatest diversity. Some species are seen as far away as China, Australia, and the South Pacific, while some other popular species are cultivated all over the tropics.

Turmeric, originating from India, reached the coast of China in ad 700 and reached East Africa 100 years later and West Africa 500 years later. Arab traders were instrumental in spreading the plant to the European continent in the thirteenth century. There is a parallel here between black pepper and turmeric. The first explorers who went out in search of both spices were Arabs, and in fact the sea route was a secret until the Europeans came on to the scene, as exemplified by the landing of Vasco da Gama in coastal Malabar in Kappad, in Kozhikode district in Kerala State, India. The exact location in India where turmeric originated is still in dispute, but all the available details point to its origin in western and southern India. Turmeric has been in use in India for more than 5000 years now. Marco Polo described it in ad 1280 in his travel memoirs about China. During his several legendary voyages to India via the “Silk Route,” Marco Polo was so impressed by turmeric that he had mentioned it as a vegetable which possesses properties akin to saffron but is not actually saffron (Parry 1969). Probably that is also the reason why it was then known as “Indian saffron.”

Turmeric derives its name from the Latin word *terra merita*, meaning meritorious earth, which refers to the color of ground turmeric, resembling a mineral pigment. The botanical name is *Curcuma domestica* Val. syn. *Curcuma longa* L. belongs to the family Zingiberaceae. The Latin name for turmeric is *Curcuma longa*, which has its origin in the Arabic name *Kurkum*, for this plant (Williamson 2002). In Sanskrit, it is called *Haridra* (“The Yellow One”), *Gauri* (“The One Whose Face Is Light and Shining”), *Kanchani* (“Golden Goddess”), and *Aushadi* (“Herb”). *Haridra* also comes from the *Mundas*, a pre-Aryan population, who lived through much of their life in northern India (Frawley and Lad 1993). The ancient Indian *Vedas* also refer to a set of people called *Nishadas*, literally translated as “Turmeric Eaters.” Turmeric has also been used as a dye for mustards, canned chicken broth, and pickles. It has been coded as food additive “E 100” in canned beverages, baked products, dairy, ice cream, yogurts, yellow cakes, biscuits, popcorn, sweets, cake icing, cereal, sauces, gelatin, and also direct compression tablets.

Because of its unique color and history, turmeric has a special place in both Hindu and Buddhist religious ceremonies. Initially, it was cultivated as a dye because of its

brilliant yellow color. With the passage of time, ancient populations came to know of its varied uses, and they began introducing it into cosmetics. The plant's roots are used in one of the most popular Indian *Ayurvedic* preparations called *Dashmularishta*, a concoction prepared from ten different types of roots, which relieve fatigue, and have been in use since thousands of years. The plant's flowers are used as an antidote against worms in the stomach of humans and can also cure jaundice and venereal diseases and have been known to have specific properties to combat mental disorders. Human breast tumors can be treated with turmeric leaf extracts.

1.1 Area and Production

About 80% of world turmeric production is from India. India is the largest producer, consumer, and exporter. The plant grows extensively in the country, but the southern states of Tamil Nadu and Andhra Pradesh, Maharashtra in central, and West Bengal in East India, respectively, grow it extensively (Spices Board 2007). Overseas producers are Thailand, China, Taiwan, South America, and the Pacific islands. Major importers are Japan, the United States, the United Kingdom, Sri Lanka, North African countries and Ethiopia in East Africa, and Middle Eastern countries. Iran is the largest importer. China produces about 8%, followed by Myanmar (4%), while Nigeria and Bangladesh combined contribute 6% of world production. Recent statistical estimates indicate Indian production at 856,464 metric tons from a total acreage of 183,917 hectares (Spices Board). In 2006–2007, India exported 51,500 metric tons valued at US\$35.77 million. In 2007–2008, world export totaled 49,250 metric tons valued at US\$33.87 million, and in the following year, the corresponding figures were 52,500 metric tons valued at US\$35.77 million. From India's total export, 65% is exported to the United Arab Emirates (UAE), the United States, Japan, Sri Lanka, the United Kingdom, and Malaysia. The institutional sector in the West buys ground turmeric and oleoresins, while dry turmeric is preferred by the industrial sector. Table 1.1 gives the details about the turmeric scenario in India.

In India, turmeric is produced in 230 districts in 22 states (Table 1.1). Andhra Pradesh, Tamil Nadu, Odisha, Karnataka, and West Bengal are the major turmeric-producing states which contribute 90% of the production in the country. Turmeric is available in two seasons in India (February–May and August–October). The different varieties of turmeric traded in India are Alleppey Finger, from the State of Kerala; Erode Turmeric and Salem Turmeric, both from the State of Tamil Nadu; Rajapore Turmeric and Sangli Turmeric from the State of Maharashtra; and Nizamabad Bulb from the State of Andhra Pradesh. The major turmeric trading centers in India are Nizamabad and Duggirala in Andhra Pradesh; Sangli in Maharashtra; and Salem, Erode, Dharmapuri, and Coimbatore in Tamil Nadu.

Table 1.1 Turmeric area, production, and productivity in Indian states

State	Area (ha)	Production (t)	Productivity (t/ha)
<i>Southern states</i>			
Andhra Pradesh	64,500	400,920	6.22
Tamil Nadu	30,530	175,390	5.74
Karnataka	12,720	82,470	6.48
Kerala	3920	9980	2.54
<i>Central states</i>			
Maharashtra	6798	8508	1.25
Gujarat	1297	16,909	13.03
Rajasthan	140	620	4.43
<i>Northern states</i>			
Himachal Pradesh	187	99	0.53
Madhya Pradesh	670	585	0.87
Jammu and Kashmir	0	0	0
Chhattisgarh	879	743	0.85
<i>Eastern states</i>			
Odisha	24,730	59,360	2.40
West Bengal	13,660	30,070	2.20
Assam	11,740	8540	0.72
Bihar	3038	2981	0.98
Tripura	1150	3380	2.94
Uttar Pradesh	2000	6000	3.00
Meghalaya	1910	14,350	10.59
Nagaland	18	62	3.40
Sikkim	580	1920	3.31
Uttarakhand	630	6068	9.63
Arunachal Pradesh	600	2300	3.83
Manipur	400	280	0.70
Mizoram	1740	24,460	14.17
<i>Union territory</i>			
Andaman and Nicobar	80	469	5.86
Total	183,917	856,464	4.66

Source: Spices Board, Kerala State, India

1.2 Global Turmeric Scenario

The global turmeric production is around 1,100,000 tons per annum. India's position in global turmeric trade is formidable, with a total of 48% in volume and 44% in value. Table 1.2 gives a country-wise breakdown.

India is the global leader in turmeric export and its value-added products. The UAE is the major importer of turmeric from India, and it accounts for about 18% of the total export volume. The UAE is followed by the United States with 8%. The other leading importers are Bangladesh, Pakistan, Sri Lanka, Japan, Egypt, the

Table 1.2 Export of turmeric from India around the world in US\$ (million)

Destination	2006–2007		2007–2008	
	Quantity	Value	Quantity	Value
UAE	7823.8	4.818	5150.6	3.121
Japan	2631.9	2.572	2797.1	2.676
USA	2460.6	2.983	2648.6	2.609
Iran	6094.7	3.151	3708.7	2.032
Malaysia	2263.5	1.647	2895.4	1.969
UK	2896.1	2.313	2460.6	1.852
Egypt (ARE)	2057.0	1.259	2438.8	1.529
Bangladesh	4039.2	2.245	2879.5	1.503
Pakistan	47.6	0.024	2756.2	1.480
Sri Lanka	3725.0	1.496	3453.0	1.382
South Africa	2195.2	1.563	1842.8	1.364
The Netherlands	1816.7	1.528	1700.3	1.325
Morocco	736.3	0.439	1772.0	1.105
Germany	1155.8	1.052	1255.2	1.009
Saudi Arabia	1406.1	1.070	1239.0	0.988
France	627.5	0.497	761.3	0.626
Canada	347.4	0.416	600.3	0.485
Singapore	622.5	0.471	868.1	0.588
Kuwait	320.1	0.281	519.4	0.417
Russia	567.3	0.378	635.3	0.409
Israel	632.7	0.363	621.7	0.367
Others	7033.1	5.483	6246.3	5.120
Total	51500.0	35.74	49250.1	33.96

Source: Spices, Kerala State, India

United Kingdom, Malaysia, South Africa, the Netherlands, and Saudi Arabia. These countries together account for 75% of the total import volume. Asian countries are the main suppliers of turmeric with India leading the pack. The remaining 25% of the total global import volume is met by Europe, North America, and Central and Latin American countries. The United States imports 97% of its turmeric requirement from India and the remaining 3% from the islands of the Pacific and Thailand. Of the total global production, the UAE accounts for 18% of the imports, followed by the United States (11%), Japan (9%), and Sri Lanka, the United Kingdom and Malaysia put together (17%).

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Chapter 2

The Botany of Turmeric



Abstract The chapter discusses the botany of turmeric and would cover areas, such as origin and distribution, taxonomy, use of isozymes, molecular marking, morphology, and cytology of turmeric including turmeric crop improvement.

Keywords Turmeric · Taxonomy · Molecular marking · Morphology · Cytology · Crop improvement

Curcuma longa L. belongs to the family Zingiberaceae which falls under the order Zingiberales of monocots and is an important genus in the family. The family is composed of 47 genera and 1400 species of perennial tropical herbs, found usually in the ground flora of lowland forests. It is a very popular family which includes other important spices, such as cardamom (*Elettaria cardamomum* Maton.), large cardamom (*Amomum subulatum*), and ginger (*Zingiber officinale*).

2.1 Origin and Distribution

The exact geographic origin of turmeric is unknown, but it is a safe bet that it could be in Southeast Asia (Velayudhan et al. 1999). Watt (1972) reported that there is no conclusive evidence to show that *C. longa* is a native of India, though several species of *Curcuma* are found in India. The greatest diversity of turmeric species is found in India, Myanmar, and Thailand. Table 2.1 gives a geographic distribution worldwide.

2.2 Turmeric Taxonomy

Despite systematic investigation by taxonomists, starting from Linnaeus, Hooker, Rendle, Watt, Valeton, and Hutchinson (Hooker 1894; Hutchinson 1934; Valeton 1918), the classification and nomenclature of *Curcuma* remained quite confusing.

Table 2.1 *Curcuma* distribution worldwide

Country	Approximate number of species
Bangladesh	16–20
China	20–25
India	40–45
Cambodia, Vietnam, and Laos	20–25
Malaysia	20–30
Nepal	10–15
The Philippines	12–15
Thailand	30–40
Total	100–110

Source: Ravindran et al. (2007)

Hooker (1894) described *Curcuma* under the natural order Scitamineae and tribe Zingibereae. However, Rendle (1904) introduced the subfamily Zingiberoideae under Zingiberaceae and described *Curcuma* under the tribe Hedychieae, which was corroborated by Hutchinson (1934). Holtum's (1950) classification of the Zingiberaceae family is presumed to be the most authoritative to date, wherein he divided the family into two subfamilies, namely, Zingiberoideae and Costoideae, and *Curcuma* was included in Zingiberoideae, under the tribe Hedychieae. The description of the *Curcuma* genus (Holtum 1950), as referred by Ravindran et al. (2007), is presented below.

A fleshy complex rhizome, the base of each aerial stem consisting of an erect, ovoid, or ellipsoid structure (primary tuber), ringed with the bases of old-scale leaves, bearing several horizontal or curved rhizomes, when mature, which are again branched. Fleshy roots, many of them bearing ellipsoid tubers. Leafy shoots bearing a group of leaves surrounded by bladeless sheaths, the leaf sheaths forming a pseudostem; total height of leafy shoots ranging from 1 to 2 m. Leaf blades usually more or less erect, often with a purple-flushed strip on either side of the midrib; size and proportional width varying from the outermost to the innermost (uppermost) leaf. Petioles of outermost leaf short or none, of inner leaves fairly long, channeled. Ligule forms a narrow upgrowth across the base of the petiole; its ends join to form thin edges of the sheath, the ends in most species simply decurrent, rarely raised as prominent auricles. Inflorescence either terminal on the leafy shoot, the scape covered by rather large bladeless sheaths. Bracts are large, very broad, each joined to those adjacent to it for about half of its length, the basal parts thus forming enclosed pockets, the free ends more or less spreading, the whole forming a cylindrical spike; uppermost bracts usually larger than the rest and differently colored; a few of them sterile (the group is called coma). Flowers in cincinni of two to seven, each cincinnus in the axil of a bract. Bracteoles thin, elliptic with the sides inflexed, each one at right angles to the last, quite enclosing the flower buds but not tubular at the base. Calyx short, unequally toothed, and split nearly halfway down one side. Corolla tube and stamina tube tubular at the base, the upper portion half cupped, the corolla lobes inserted on the edges of the cup, and the lip, staminodes, and stamen just above them. Corolla lobes thin, translucent white or pink to purplish, the dorsal one hooded and ending in a hollow hairy point. Staminodes elliptic-oblong, their inner edges folded under the hood of the dorsal petal. Labellum obovate, consisting of a thickened yellow middle band which points straight toward or somewhat reflexed, its tip slightly cleft, and thinner pale (white or pale yellow) side-lobes upcurved and overlapping the staminodes. Filament of stamen short and broad, constricted at the top, anther versatile, the filament joined to its back, the pollen