

## Spices in India

M. ILYAS<sup>1</sup>

A spice may be defined as an aromatic vegetable substance used as a condiment and for seasoning food. It adds piquancy, aroma and sometimes colour. Spices owe their fragrance and pungency to some volatile oils that may occasionally be associated with an alkaloid. The volatile oils that give the spices the taste and flavour render their quality ephemeral. Spices are obtained from various parts of plants such as flowers, fruits, seeds, leaves, bark and rhizomes (Table I). Spices are not limited to plants of the tropics but are derived from plants in other geographic regions as well.

The use of spices in India and elsewhere is of great antiquity. In the pre-Christian era and in the Middle Ages, spices served to render the tainted and tasteless food palatable. They were found invaluable in preservation and seasoning of meat, especially when it was scarce. This practice continues even today. Chinese camphor and Indian cinnamon (and probably other spices also) were supplied to the Europeans by the Phoenicians, who kept their trade route east of Sinai as a great secret. The Arab merchants who later controlled the land route for trade from India and China to Europe were also good navigators in the Indian Ocean. They procured Indian, Sumatran, and African spices and other goods for their European customers. The graphic accounts of Marco Polo and his contemporary travellers established, among the European nations, the fame of the Malabar coast and East Indies as the main producers of spices.

<sup>1</sup> 1250, Ballimaran, Delhi-6, India.

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The Turkish expansion in the Levant interrupted the supply of spices and stimulated European nations to rediscover India, 'the Land of Spices,' through a sea-route. Vasco da Gama and his men exclaimed with joy, "Christos e espiciarias!" when in 1498 they landed on the Calicut coast of India. The travels of Vasco da Gama took him to Goa, Malacca, Mombasa and Mogadoxo. On his return, the inhabitants of Lisbon witnessed with awe large quantities of cinnamon, pepper, cloves and other Oriental goods brought home in the Portuguese galleons. The quest for spices by other spice-hungry European nations led to international rivalries, resulting in the loss of the Portuguese monopoly of the spice trade to the Dutch and then to the British. Vast tracts of spice-yielding territory in south Asia became annexed and the cheap native labour exploited to the maximum by the Dutch, French, Portuguese and British colonialists, India falling to the share of the British.

The major spices used in India are listed in Table I. Many of these spices are grown locally and a few are imported. Apart from these, India produces many other spices of minor importance. Spices of Indian origin are used in pickles, chutneys, sausages and in industries such as bakery, confectionery and beverages in India as well as abroad. Spices or their derivatives are also used in medicines, cosmetics and the tobacco industry. Apart from being appetisers, spices act as stimulants, carminatives and diuretics. The old belief that sharply spiced foods endanger health no longer holds, as recently it has been found out that hot spices such as mustard and chillies stimulate the production of saliva and gastric

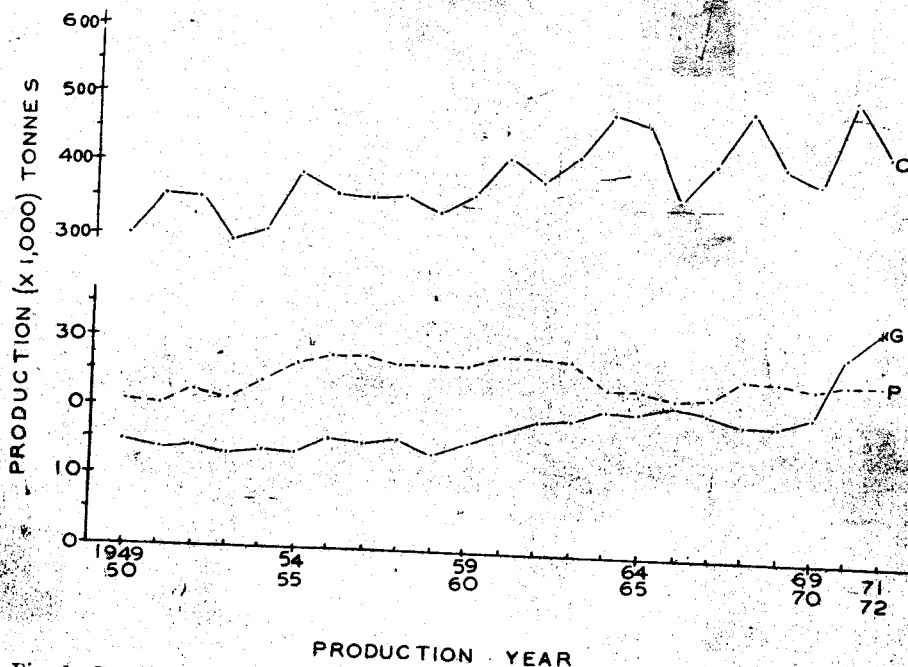


Fig. 1. Graph showing the production trends in India of three major spices for the past 23 years. [Based on information from: 1) The Director, Directorate of Areca nut and Spices, Calicut. 2) Estimates of Principal crops. Agricultural Situation in India 27(4): 283 (1972). 3) Commercial Crops Statistics. 1971. Directorate of Economics and Statistics, Ministry of Agriculture, Govt. of India, N. Delhi. 4) Estimates of Area and Production of Principal Crops in India. 1970. Directorate of Economics, Min. Food, Agr., Commun. Development, and Co-operation., Govt. of India, N. Delhi.] C = Chillies; G = Ginger; and P = Pepper (black). Year extending from April to March.

juices and accelerate digestion. Chewing of garlic has been reported to restore energy after prolonged physical exertion.

The spices that India exports to other countries are her messengers of good will and friendship and provide variety and pleasure in life. The Indian export of spices during 1971-72 amounted to Rupees<sup>2</sup> 387,290,546 and the imports to Rs 12,097,441 (excluding oil of spices). Table II indicates India's foreign trade of spices during 1971-72. This part, first in the series, deals with the Botany, cultivation, production and processing of peppers. Fig. 1 gives an idea of the production trends of 3 major spices during the past 23 years.

#### Black Pepper

King of Spices, the black pepper of commerce consists of dried unripe fruits of *Piper nigrum* L., a climbing vine belong-

<sup>2</sup> Rupees (Rs) 7.50 = 1 U.S. Dollar (1971-72)

ing to the family Piperaceae. It is indigenous to the forests of the southwest coast of India, and its cultivation is confined to the warm moist areas in Kerala, Karnataka and Tamil-Nadu states. In India there are about 120,000 hectares, yielding about 26-30 thousand tons, 95% of which comes from Kerala only.

Black pepper is one of the most ancient Indian spices. In southwest India the plant is capable of growing from sea-level to an altitude of about 1,500 m (the optimum growth being at 500 m), in a temperature range of 10 to 40°C and rainfall extending from 125-250 cm annually. In Kerala it is grown in home gardens and also as an intercrop in coffee, tea, areca nut and coconut plantations, whereas raising it as a pure plantation crop is practiced to a small extent. Pepper plants are raised either by seeds or by cuttings. Fresh ripened fruits are freed of the pulpy pericarp after

soaking in water for 2 or 3 days; the decorticated seeds dried in the sun are sown in well-manured nursery beds; the seedlings are transferred to the field when they bear 4 or 5 leaves. In general, seedlings take longer to come to bearing, although the ensuing plants have a longer life-span than those raised from cuttings. Plants raised from seeds have the disadvantage of being not always true to the maternal type, and hence propagation by vegetative means is preferred.

The stem is tender and green when young, but becomes grey and woody when old. It branches laterally and sends out sucker shoots at the base. The nodes are slightly swollen and give rise to the leaves and attaching roots. The vines in the forest reach a length of 10 m or more, but in cultivation the length is maintained by pruning. The large (up to 25 cm long and half as broad), ovate leaves are ex-stipulate, petiolate and dark green in colour and have 5 to 9 convergent veins.

Cuttings with 4 or 5 nodes, either from the terminal or basal shoots, are layered in October in well-manured soil contained in bamboo baskets. These are watered regularly and kept in shade. The cuttings strike roots within 4-6 weeks. At the onset of rains in May-June two of these rooted cuttings are transplanted 5 cm apart in pits prepared near the base of supports consisting of poles, concrete pillars or stems of trees like areca nut, coconut and *Erythrina* (called standards). Pepper thrives in loamy soil having high humus content. Water-logged soils are detrimental to growth. The pits situated 15 cm away from the support and occurring at a distance of 2.5 to 3.5 m measure 0.5 m and are filled with friable, loamy soil, mixed with leaf manure or compost. Sometimes 3 to 7 unrooted cuttings are put directly in such pits and later 1 or 2 of the rooted cuttings are retained. Generally 750-1,000 vines are grown per hectare. In the initial stages these plants are shaded and supported on standards. The vine attains a height of 1.0 to 1.5 m in a year and after 3-4 years it becomes firmly established on supports by means of adventitious roots arising from the nodes.

Plants raised from cuttings start flowering

in the third year, but a substantial yield is obtained only after the sixth year. The yield increases with age and gradually declines after the 25th year if plants are not cared for. Wild pepper vines are dioecious, whereas the cultivated types are selections of monoecious plants with higher percentage of fruit set. The inflorescence is a yellowish-green catkin-like spike borne at the nodes opposite the leaf. Fleshy bracts are present subtending the minute perianth-less flowers, which number 50 to 100. The flowers open during the rainy season (May to August) and consist of an ovate, sessile ovary, surmounted by a stellate, white stigma. The flowers are protogynous and the 2 or 3 lateral stamens appear after the ovary has fully matured. Pollination is brought about by wind, rain and insects.

The stigma turns black after fertilization and the unilocular ovary containing a single ovule develops into a fleshy drupe. With the development of the fruits the inflorescence stalk elongates up to 10-16 cm depending on the variety. The fruits are slow growing, attaining maturity in 6-8 months. They are ovoid or globose and bright red when ripe and each contains a globose seed rich in starch. A three-year-old vine produces on an average 0.5 Kg dried pepper. Pepper, being an exhausting crop, is given nitrogenous fertilizers in July or August every year. Pruning of the main stem is done to promote branching and yield. Cultural practices such as weeding and hoeing are done at regular intervals.

In the plains, harvesting commences in November-December and continues until March; in the hills it is delayed by about a month. Fig. 2B shows a fruiting black pepper vine. Spikes bearing fully developed unripe fruits are hand-picked and spread on mats in the sun for 3 or 4 days. The fruits are then separated from the stalk either by hand or by beating with sticks or by treading on them. The separated fruits are dried for 7 or 8 days in the sun or dried artificially by heat. The skin of the dried fruit is black and wrinkled (Fig. 2E). One hundred Kg of fresh/green fruits yield about 33 Kg of dried pepper. The dried product, which is generally a mixture of different varieties, is winnowed and graded



Fig. 2. A. A fruiting chillies plant; B. A fruiting Black Pepper vine; C. Dried Chillies; D. Dried Indian Long Pepper, and E. Black Pepper of Commerce (Peppercorns). f = fruit; fs = fruiting spike

into whole fruits, light, broken and underdeveloped fruits (pinheads). Ungarbled pepper contains 3 to 7% of impurities, whereas garbled pepper contains less than 3% of impurities. 'Malabar' and 'Telli-cherry' are the trade types and the grades are extra-bold, bold, light and pinheads.

White pepper, which has the flavour of

black pepper but is less pungent, is obtained from fruits (either ripe or unripe) deprived of the pericarp. The pericarp is removed after softening in running water for 4 to 8 days or by boiling for 15 minutes and then rubbing and washing the pulp to obtain the white seed.

Presence of 4-10% of a brownish-green

oleo-resin consisting of piperine, chavicine and piperidine in the fruit makes it pungent. The chief constituent of the oleo-resin is piperine, the amount increasing and later declining with maturity of the fruit. Chavicine—a liquid isomer of piperine, present in small quantity, is more pungent than piperine. The cells of the pericarp and those of the inner core of the fruit contain 1.0–2.6% of a volatile oil—the oil of pepper. The oil distilled from the fruits is colourless or slightly green but not pungent in taste. It is a complex mixture of piperonal, citronellol, dihydrocarveol,  $\alpha$ - and  $\beta$ -pinene, limonene, caryophyllene, etc. The oil of pepper and the extracted oleo-resin are now being added to food instead of the spice. Pepper is carminative, stimulating and causes increased flow of gastric juices.

Some of the varieties of black pepper grown in India are Karimunda, Kaniakadan, Kailuvalli, Kottanadan, Cherikodi, Balamkotta, Chumali, Travancore, Tattisara, Uthirankotta and Malligasara. These varieties differ in their maturation period, length of spikes, size of fruits, etc. Panniyur I—a hybrid of Uthirankotta and Cheriakaniakadan is a fast growing and early bearing type with long spikes, having large closely set fruits. The yield per vine being 1.7 to 3.5 Kg dried berries per vine, this hybrid has a great promise if properly exploited.

#### Indian Long Pepper

The Indian long pepper consists of dried unripe fruits (botanically an infructescence developing from several flowers in a female spike) of *Piper longum* L., another member of the family Piperaceae. The plant is a perennial climber, having jointed stem and cordate leaves like those of black pepper. It is native of the evergreen forests of the hot parts of India, occurring in the southwest coast and eastern Himalayan range. Long pepper is propagated by layering the mature branches or by basal suckers put in the soil at the beginning of the rains. The rooted cuttings grow and the vines properly manured start bearing 3 or 4 years later. The spikes are unisexual, cylindrical and pedunculate. The female inflorescence mea-

sures up to 6 cm long and 0.6 cm in diameter (Fig. 2D), and is economically important, while the male inflorescence is not useful. The fleshy spike consists of yellowish orange, ovoid fruits set compactly together. In January when the spikes are nearly mature, i.e., still green and unripe, they are hand-picked and dried in the sun with constant turning over till they turn grey. The yield in the beginning is 560 Kg/ha and increases to about 1680 Kg/ha, but productivity gradually decreases when neglected. The usual cultural practices such as manuring, weeding, hoeing and pruning are done at regular intervals where it is cultivated.

Long pepper has a black pepper-like pungent taste and causes salivation and numbness in the mouth. It contains 4–5% of piperine. The essential oil (0.7%) has a spicy odour and contains about 7% of zingiberene. The Indian product is obtained from plants growing wild in Assam, Bengal, Uttar Pradesh, Kerala, Andhra Pradesh and Nepal. It is cultivated on a small scale in Tamil-Nadu and Assam. The imports into India consist of dried spikes of *Piper retrofractum*, and exports of *P. longum*. The samples in the Indian markets are mixtures of both.

#### Pimento: Allspice

Allspice is the name given to the dried unripe fruits of *Pimenta dioica* (Linn.) Merrill. The plant is indigenous to the West Indies and the American tropics. It is an evergreen tree belonging to Myrtaceae and grows 6–9 m tall. It is grown to a very small scale in home gardens in India. Most of the requirements of India are met with by imports from Malaysia and Singapore.

It is raised from seeds. Fresh ripe fruits are sown in nursery beds or in pots kept in shade and watered regularly. Seedlings are transferred to larger pots when they have 2–4 leaves. On reaching a height of 25–40 cm the plants are transplanted in the field.

A tree starts flowering when 7 years old and continues to do so till the 20th year. The white flowers are borne in axillary, trichotomously, paniculate cymes. A mature fruit is a purple or black globose berry,

7-10 mm in diameter and contains two reniform, brown seeds. Nearly mature but green fruits are picked and rapidly dried in the sun for 4-10 days, otherwise they lose flavour. The dried fruits are globose (4-7 mm diameter), reddish brown and have wrinkled skin. A tree yields 35-45 Kg fruits.

The aroma and flavour of allspice resembles that of a mixture of cinnamon, nutmeg and cloves, and hence the name Allspice. The pericarp contains 3.3-4.5% of an essential oil which has a large proportion of eugenol (65-80%). It also contains phellandrene, cineole and caryophyllene. The pericarp also contains about 8% of quercitannic acid, which is responsible for the astringency, and a resin accounting for the burning sensation in the mouth. The essential oil obtained by the distillation of the fruits is called Pimenta Berry Oil. It is yellow in colour and turns dark with age. The berries whole or ground, are used as a condiment, and as a flavouring ingredient in food and wines.

#### Red Pepper: Chillies

The dried fruits of *Capsicum annuum* and *C. frutescens*, both annual, solanaceous herbs, are known as chillies. The chilli plant, a native of America, was introduced into India in the 17th Century by the Portuguese, and now its fruits have become an indispensable ingredient of food. It is now cultivated in all the states of India on about 760,000 hectares and the production is about 486,000 tons. The major chilli producing states are Andhra Pradesh, Maharashtra, Karnataka and Tamil-Nadu. It is grown in northern India as a winter crop. In southern India it is sown either as winter, summer or mid-season crop in the months of September-October, February-March and April-May, respectively. Harvesting is usually done in May-June for the winter crop, October-November for the summer and December-January for the mid-season crop. The crop is grown rain-fed, but in areas where rainfall is below 75 cm irrigation becomes necessary. It thrives on well-drained, loamy soils having high organic content, and can grow from sea-level to an altitude of 1,500 m above the

sea-level. Very low temperatures and water-logged soils are detrimental to growth of the plant.

Seeds from selected pods are used for propagation. About 1 Kg of the seeds are sown in raised nursery beds by broadcasting. After covering them with soil, the beds are regularly watered. The seedlings emerge in a week and are sufficient to be transplanted on 2 hectares. Sometimes 20-35 days old seedlings are topped to promote branching, and after another 10 days these are transplanted to the field. The field is ploughed, manured and drawn into ridges and furrows. Groups of 3 or 4 seedlings (30-45 days old) are put together on the ridges at a distance of 45-60 cm either way. The field is watered daily till the plants establish, whence they are watered once a week. The plant is grown at some places by direct drilling of the seed in the field. This procedure hastens the maturity of the crop and it is ready for harvest in 3 months after planting. Three to four Kg seeds are required for an acre and are sown in rows 30 cm apart. The seedlings are later thinned to a spacing of 12-15 cm. The plant may grow up to 1 m in height and bears oblong, pointed leaves which are about 10 cm long along with the petiole (Fig. 2A).

Flowering starts in 75-100 day old plants and continues for about 3 months. The flowers of *Capsicum annuum* occur singly in the leaf axil, depending on the variety, in either erect or pendulous position, as a result of which the fruit also stands erect or hangs down. On the other hand, in *C. frutescens* the flowers are borne in clusters of two or more in the leaf axil. A flower has a 1.5 cm long pedicel. The sympetalous, rotate corolla is white or purplish-white and is about 1 cm long. A cup-shaped calyx often with five minute teeth measuring 0.3 cm is present and persists in the fruit. There are 5 epipetalous stamens and the bilocular ovary has numerous ovules on an axile placentation. The ovary initially measuring 0.15 cm may elongate up to 16 cm in length or grow 6-7 cm in diameter after fertilization.

A first picking of unripe fruits is done to stimulate flowering. Later, ripe and nearly

ripe fruits along with the stalks are picked by hand at intervals of 5, 10 or 20 days and heaped for 2-3 days in shade when all fruits become uniformly coloured (ranging from orange to deep red). The fruits are then spread out in sun on concrete floors for drying. They are regularly turned over for 2 days, and when flaccid they are flattened by trampling or rolling over. This facilitates a larger quantity of the dried produce to be accommodated while packing. Usually 100-110 Kg chillies are packed in gunny bags. Currently a wooden compression kit is also being employed to press the dried fruits, and it has been found that fruits having 10% of moisture content press well without breaking. Depending on the weather, it takes 3-15 days to dry the chillies. One hundred Kg of fresh red chillies yield 25-30 Kg of dried chillies. The yield from rain-fed crop is 250 Kg per hectare, i.e., 5-6 times less than that of irrigated crop, and the picking period too is also much reduced. In Tamil-Nadu the production per hectare is maximum, i.e., 1,330 Kg.

Dried chillies possess a firm stalk and are slender or conical, long or short (Fig. 2C). Their pericarp is thin, yellow, orange or bright red and encloses a few to many seeds. The fruits have a glossy appearance and their pungency varies according to the variety. Cayenne pepper is orange to bright, deep red coloured and highly pungent, while red pepper is deeper in colour but not as pungent. Chillies obtained from pods over 6 cm long are extremely pungent. The bell pepper, which consists of large bell-shaped fruits 5-10 cm in diameter, is obtained from *C. annuum* var. *grossum*. Recently a few exotic lines of *C. annuum* var. *longum* have been introduced in India for the production of Paprika pepper. These types yield bright red coloured, mildly pungent fruits which on drying appear wrinkled and are conical or cylindrical. The yield of Paprika is found to be 3,000 Kg dried fruits per hectare.

Fresh green or red chillies are pickled, used in chutneys and sauces. Dried red chillies are added entire or in powdered form in food or curry powder to give a biting sensation. Chillies have a stimulating effect on

the alimentary canal and are carminative. The Paprika powder gives a bright-red colour to food and makes it look attractive. It can be added to food without restraint, whereas caution has to be taken while adding chilli powder. Teni, Patti, Lanka or Warangal, Patna and Golaprulu (yellow chillies) are some local types. For increased production and export purposes the following types are being grown: Sannam, Guntur, G2, G3, K1, Mundu, Rari and Gaspurea.

Pungency of chillies is due to capsaicin. This substance is present in the pericarp and accounts for about 0.1% of the weight, manifesting its pungency at a concentration as low as 1 ppm in aqueous solution. The pericarp of the ripe fruits contains (about 4.0 to 5.5 gm per Kg fruits) a complex mixture of pigments. The pigments found are capsanthin, capsorubin, zeaxanthin, lutein, cryptoxanthin,  $\alpha$ - and  $\beta$ -carotenes and xanthophylls. Dried chillies contain 9-13% of a red fatty oil which has a biting taste. They also contain 0.16 to 0.39% of a volatile oil.

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