

India has been famous for its many and varied spices for many centuries. The word "India" conjures up a vision, in the minds of foreigners, of land of spices, among other things. India is considered to be the "home of spices." Even before the Christian era, traders, and explorers from various parts of the world came to India to exchange their valuable merchandise for Indian spices. Even today, spices play a very important part in our national economy. The world trade in spices in 2004-05 was about 5,00,000 tonnes, worth 2 billion US dollars. India, during that year, exported 3,20,527 tonnes valued at 518 million dollars.

A diet composed of just the nutritive components may be quite insipid. To be palatable it should have flavour. In other words, man does not live by bread alone! The spice of his food life is concerned with what goes with his bread. The food is to be seasoned by the addition of flavouring agents, which include spices and condiments. According to the International Organization for Standardization, there is no clear-cut division between spices and condiments and so they are clubbed together. A spice is a dried seed, fruit, root, bark or vegetative substance used in nutritionally insignificant quantities as a food additive for flavouring. A condiment is a substance applied to food, usually in the form of a sauce, powder, or spread, to enhance or improve the flavour. Although at most forty different spice plants are of global importance (economically and culinarily), many more are used as condiments locally, in the region of their natural occurrence.

There are about 70 species of spices grown in different parts of the world. Many of them are grown in India. Spices can be classified in different ways, such as, according to their botanical families, economic importance, method of cultivation or which part of component of the plant, such as seeds, leaves, bark, etc. Each system has its own merits and demerits. A method of classification depending on the origin and active principle present in the spices is as follows:

1. Pungent spices: pepper, ginger, chillies, mustard.
2. Aromatic fruits: cardamom, nutmeg, mace, fenugreek, anise, fennel, caraway, dill, celery, cumin, coriander, etc.
3. Aromatic barks: cinnamon, cassia.
4. Phenolic spices containing eugenol: clove, allspice (pimento)
5. Coloured spices: paprika, saffron, turmeric

Spices are mostly used as flavouring agents in several foodstuffs, such as *curries*, bakery products, pickles, processed meats, beverages, liqueurs, etc. They enhance or vary the flavours of foods. Spices are also flavour disguisers; they help mask the off-flavour of foods that, if unspiced, have to be thrown away. Some spices possess anti-oxidant properties while others are used as preservatives in some foods like pickles and *chutneys*. Others, like cloves and mustard, possess strong anti-microbial

Table 20.1 Composition of Spices and Condiments, Dry (per 100 gms of edible portion)

	Moisture	Protein	Fat	Fiber	Carbohydrate	Energy	Energy	Calcium	Phosphorous	Iron	Thiamine	Riboflavin	Niacin	Vita-min B6	Biotin	Vita-min C
	g	g	g	g	g	K Joules	K Cal	mg	mg	mg	mg	mg	mg	mg	µg	mg
Asafoetida (<i>Ferula assa-foetida</i>)	9.42 ± 0.56	6.34 ± 0.53	1.26 ± 0.02	5.13 ± 0.33	71.95 ± 0.71	1387	332	266 ± 41.4	69.09 ± 15.60	15.68 ±4.51	0.82 ± 0.037	0.01 ± 0.006	0.43 ± 0.05	0.02 ± 0.003	2.27 ± 0.34	-
Cardamom, black (<i>Elettaria cardamomum</i>)	6.69 ± 0.47	6.69 ± 0.31	2.80 ± 0.24	23.46 ± 0.58	52.53 ± 1.51	1132	271	378	132	8	0.05 ± 0.015	0.13 ± 0.047	0.52 ± 0.11	0.20 ± 0.021	4.76 ± 0.88	-
Cardamom, green (<i>Elettaria cardamomum</i>)	11.24 ± 0.51	8.10 ± 0.41	2.60 ± 0.15	23.10 ± 0.14	47.76 ± 0.47	1067	255	312	117	8	0.12 ± 0.016	0.07 ± 0.013	1.13 ± 0.13	0.15 ± 0.007	4.94 ± 0.39	-
Chillies, red (<i>Capsicum annuum</i>)	14.57 ± 0.42	12.69 ± 0.22	6.40 ± 0.04	31.15 ± 0.04	29.46 ± 0.62	990	237	99.83 ± 6.61	280 ± 57.5	6.23 ± 0.79	0.46 ± 0.036	0.83 ± 0.009	6.94 ± 0.55	0.42 ± 0.009	0.92 ± 0.04	-
Cloves (<i>Syzygium aromaticum</i>)	26.49 ± 0.68	5.86 ± 0.21	8.41 ± 0.15	34.52 ± 0.48	18.73 ± 0.39	781	187	567 ± 70.8	83.10 ± 18.56	9.41 ± 2.10	0.53 ± 0.122	0.22 ± 0.022	1.15 ± 0.12	0.03 ± 0.003	2.41 ± 0.23	-
Coriander seeds (<i>Coriandrum sativum</i>)	8.72 ± 0.47	10.66 ± 0.33	17.47 ± 0.22	44.81 ± 2.36	12.98 ± 2.62	1125	269	718 ± 43.0	293 ± 54.4	17.64 ±6.74	0.19 ± 0.018	0.23 ± 0.022	1.20 ± 0.16	0.39 ± 0.010	1.20 ± 0.22	-
Cumin seeds (<i>Cuminum cyminum</i>)	10.59 ± 0.51	13.91 ± 0.50	16.64 ± 0.15	30.35 ± 0.71	22.62 ± 1.05	1274	305	878 ± 78.0	382 ± 6.4	20.58 ± 4.24	0.52 ± 0.055	0.13 ± 0.022	2.87 ± 0.38	0.13 ± 0.006	0.76 ± 0.14	-
Fenugreek seeds (<i>Trigonella foenum graecum</i>)	7.82 ± 0.37	25.41 ± 0.24	5.72 ± 0.02	47.55 ± 0.54	10.57 ± 0.57	983	235	135	435	8.47	0.28 ± 0.029	0.14 ± 0.026	1.19 ± 0.10	0.77 ± 0.128	1.54 ± 0.29	-
Mace (<i>Myristica fragrans</i>)	20.06 ± 0.70	6.24 ± 0.27	24.41 ± 0.20	20.31 ± 0.23	26.51 ± 0.81	1488	356	174 ± 3.5	110 ± 17.7	22.69 ± 6.87	0.13 ± 0.020	0.13 ± 0.033	0.92 ± 0.11	0.30 ± 0.041	1.80 ± 0.27	-
Nutmeg (<i>Myristica fragrans</i>)	15.55 ± 0.55	6.30 ± 0.24	36.52 ± 0.04	11.99 ± 0.18	27.64 ± 0.70	1940	464	148 ± 12.1	207 ± 37.2	2.33 ± 0.20	0.04 ± 0.015	0.05 ± 0.011	0.51 ± 0.06	0.10 ± 0.008	1.59 ± 0.27	-
Onium (<i>Trachyspermum ammi</i>)	9.71 ± 0.18	15.89 ± 0.61	21.11 ± 0.08	20.58 ± 0.04	24.53 ± 0.68	1495	357	1034 ± 144	329 ± 57.7	13.65 ± 2.29	0.30 ± 0.032	0.23 ± 0.024	1.23 ± 0.19	0.24 ± 0.006	1.78 ± 0.30	-
Pepper, black (<i>Piper nigrum</i>)	13.18 ± 0.40	10.12 ± 0.40	2.74 ± 0.02	33.16 ± 0.29	36.22 ± 0.45	910	218	405 ± 40.9	144 ± 14.8	11.91 ± 3.48	0.06 ± 0.012	0.09 ± 0.013	0.85 ± 0.02	0.27 ± 0.013	3.49 ± 0.38	-
Pippali (<i>Piper longum</i>)	10.95 ± 0.48	10.53 ± 0.45	2.27 ± 0.02	34.14 ± 0.60	35.70 ± 0.45	906	217	414 ± 66.2	181 ± 6.9	7.99 ± 2.11	0.06 ± 0.011	0.14 ± 0.030	1.06 ± 0.11	0.60 ± 0.051	2.34 ± 0.37	-
Turmeric powder (<i>Curcuma domestica</i>)	10.58 ± 0.49	7.66 ± 0.44	5.03 ± 0.07	21.38 ± 0.29	49.22 ± 0.55	1174	281	122 ± 20.9	276 ± 33.1	46.08 ± 1.83	0.06 ± 0.004	0.01 ± 0.000	1.55 ± 0.10	0.04 ± 0.002	1.46 ± 0.34	-

Source: IFCT, NIN, ICMR, Hyderabad, 2017

Table 20.2: Composition of Spices and Condiments, Fresh (per 100 gms of edible portion)

Cardiments and Spice Dry	Moisture g	Protein g	Fat g	Fiber g	Carbo- hydrate g	Energy		Cal- cium mg	Phos- phorous mg	Iron mg	Thia- mine (B1) mg	Ribo- flavin (B2) mg	Niacin mg	Vita- min B6 mg	Biotin µg	Vita- min C mg
						K Joules	K Cal									
Chillies, green-all varieties (<i>Capiscum annum</i>)	85.39 ± 0.68	2.36 ± 0.34	0.72 ± 0.05	4.77 ± 0.61	5.86 ± 0.77	177	42.50	18.45	59.91	1.2	0.09 ± 0.033	0.11 ± 0.038	0.89 ± 0.15	0.28 ± 0.100	0.63 ± 0.16	94.07 ± 11.67
Coriander leaves (<i>Coriandrum sativum</i>)	86.99 ± 0.41	3.52 ± 0.26	0.70 ± 0.06	4.66 ± 0.24	1.93 ± 0.27	130	31.00	146 ± 13.0	64.69 ± 13.00	5.30 ± 1.55	0.09 ± 0.005	0.05 ± 0.004	0.73 ± 0.03	0.19 ± 0.025	4.17 ± 0.89	23.87 ± 7.33
Curry leaves (<i>Murraya koenigii</i>)	65.33 ± 1.57	7.41 ± 0.26	1.06 ± 0.04	16.83 ± 0.78	4.51 ± 1.79	266	64.00	659 ± 77.4	83.29 ± 14.06	8.67 ± 0.42	0.07 ± 0.016	0.13 ± 0.008	0.85 ± 0.10	0.57 ± 0.096	1.77 ± 0.22	6.04 ± 1.36
Garlic, big clove (<i>Allium sativum</i>)	64.38 ± 0.56	6.92 ± 0.20	0.16 ± 0.02	5.22 ± 0.41	21.93 ± 0.82	518	124.00	20.08 ± 5.73	119 ± 10.9	1.05 ± 0.15	0.20 ± 0.029	0.25 ± 0.026	0.38 ± 0.05	0.56 ± 0.039	2.55 ± 0.34	12.62 ± 1.15
Garlic, small clove (<i>Allium sativum</i>)	64.42 ± 0.30	6.75 ± 0.24	0.14 ± 0.01	5.47 ± 0.07	21.84 ± 0.74	514	123.00	17.63 ± 2.77	116 ± 27.9	0.88 ± 0.21	0.20 ± 0.023	0.23 ± 0.015	0.36 ± 0.04	0.77 ± 0.112	2.54 ± 0.21	13.57 ± 0.70
Garlic, single clove, Kashmir (<i>Allium sativum</i>)	64.49	6.12	0.16	4.01	23.46	523	125.00	19	128	1.01	0.25	0.22	0.42	0.97	2.85	15.38
Ginger, fresh (<i>Zinziber officinale</i>)	81.27 ± 0.22	2.22 ± 0.16	0.85 ± 0.03	5.36 ± 0.40	8.97 ± 0.28	230	55.00	18.88 ± 2.87	44.36 ± 2.16	1.90 ± 0.55	0.04 ± 0.005	0.04 ± 0.003	0.42 ± 0.05	0.20 ± 0.025	1.07 ± 0.15	5.43 ± 1.22
Mango ginger (<i>Curcuma amada</i>)	84.55 ± 0.16	1.45 ± 0.37	0.70 ± 0.03	4.74 ± 0.50	6.98 ± 0.15	177	42.50	13.74 ± 2.59	68.33 ± 20.13	2.31 ± 1.27	0.02 ± 0.001	0.07 ± 0.015	0.45 ± 0.01	0.18 ± 0.010	1.49 ± 0.49	1.62 ± 0.30
Mint leaves (<i>Mentha spicata</i>)	84.24 ± 0.71	4.66 ± 0.15	0.65 ± 0.05	5.89 ± 0.49	2.39 ± 0.36	155	37.00	205 ± 31.8	65.25 ± 16.18	8.56 ± 3.21	0.02 ± 0.005	0.19 ± 0.029	0.74 ± 0.23	0.17 ± 0.028	2.21 ± 0.43	17.16 ± 6.75
Onion, big (<i>Allium cepa</i>)	85.76 ± 0.43	1.50 ± 0.10	0.24 ± 0.03	2.45 ± 0.21	9.56 ± 0.44	201	48.00	21.03 ± 6.68	32.34 ± 7.63	0.43 ± 0.11	0.04 ± 0.005	0.01 ± 0.001	0.34 ± 0.10	0.10 ± 0.014	2.61 ± 0.19	6.69 ± 0.63
Onion, small (<i>Allium cepa</i>)	84.67 ± 0.12	1.82 ± 0.20	0.16 ± 0.01	1.16 ± 0.19	11.58 ± 0.37	237	56.50	19.92 ± 4.48	39.65 ± 9.90	0.53 ± 0.37	0.07 ± 0.012	0.02 ± 0.004	0.21 ± 0.01	0.12 ± 0.009	2.69 ± 0.63	10.96 ± 2.00

Source: IFCT, NIN, ICMR, Hyderabad, 2017

properties and, as such, prevent food spoilage. Spices were used to preserve meat for long periods when there was no refrigeration. Many spices also possess important physiological and medicinal properties.

Phytotherapy (*phyto*—Greek word for plants) is becoming popular. It is a science of using plant substances to treat or prevent illness. These plants, including their leaves, flowers, stems, rhizomes and roots are called botanicals, but the terms “herbs” and “botanicals” are often used interchangeably. Botanicals are bulk herb extracts, tinctures and capsules used for therapeutic purposes.

20.1 Composition

Spices are obtained from a large number of different plants. They are parts of plants, such as roots, buds, flowers, fruits, barks or seeds. Thus, little can be said in a general way about their composition. Most spices owe their flavouring properties to volatile oils and, in some cases, to fixed oils and small amounts of resins, which are known as oleoresins. In many cases, no single compound is responsible for flavours; a blend of different components, such as alcohols, phenols, esters, terpenes, organic acids, resins, alkaloids and sulphur-containing compounds, contribute to the flavour. In addition to flavour-contributing components, all spices contain the usual components of plant products, such as proteins, carbohydrates, fibre, minerals and tannins or polyphenols.

20.2 Flavouring Extracts

Spices, being agricultural commodities, are prone to spoilage by insect or microbial attack. Hence, the spice oils or oleoresins, which contain all the active principles of spices, are extracted and marketed. Spice oils are obtained by the steam distillation of ground spices. Oleoresins are obtained by the solvent extraction of ground spices or, more advantageously, the steam distilled spice. The spice oils contain only the aromatic principles, while the oleoresins contain both the aromatic and pungent principles. Various solvents like acetone, isopropanol, methanol, hexane, etc., are used as solvents. According to ISI standards, oleoresins obtained from solvent extraction should not contain more than a specified amount of solvent. The processed products of spices have several advantages—they are convenient to use, free from contamination, have better storage life, and are easy to transport. Technology has developed in India to prepare ready-to-use oleoresins from spices. In 2003–04, the country exported 3,300 tonnes of oleoresins and other spice oils worth 56.21 million US dollars.

20.3 Adulteration

Among food items, spices, due to their inherent nature, great demand and high price, become easy substances for gross adulteration. According to the Prevention of Food Adulteration Act, 1976 (of India), adulteration means any article of food whose quality or purity falls below the prescribed standards. Spices are generally adulterated with less expensive materials, e.g., cassia or cinnamon is mixed with a variety of different materials, such as ground hulls from various fruits, sawdust, ground fruit seeds and nut shells, and other readily available waste materials. Ground spices, such as *curry powder*, *garam masala*, chilli powder and turmeric powder are others that are easily adulterated. Therefore, ISI specifies and lays down general standards for all spices to be fit to be marketed or exported (see also Chapter 28).

20.4 Major Spices of India

Nine spices, namely, pepper, ginger, cloves, cinnamon, cassia, mace, nutmeg, pimento and cardamom, alone contribute to more than 90 per cent of the total world trade in spices. The major spices of India are

pepper, cardamom, ginger, turmeric and chillies. Large quantities of these spices are exported; pepper ranks first (with 41 per cent), followed, by cardamom (22.7 per cent), turmeric (8 per cent), ginger (7.6 per cent) and chillies (5.3 per cent), of our total export of spices. The remaining 15.4 per cent is contributed by other minor spices. The important minor spices grown in India are ajowan, aniseed, caraway, coriander, cummin, dill seeds, fennel, fenugreek, garlic, onion, saffron and vanilla.

1.4.1 Pepper, Black Pepper (*Piper nigrum*)

Black pepper or *kali mirch* is the dried, mature but unripe fruit or berry of a perennial climbing vine cultivated as a plantation crop. It is considered to be the "king of spices" because it is the largest used spice in the domestic and industrial sectors. Presently, its world consumption is of the order of 3,00,000 tonnes. It is one of the agricultural commodities of the country with a pronounced export bias. Nearly 90 per cent of our pepper output is exported.

The world production is 39,18,159 tonnes and India is 13,89,000 tonnes, 2016. In the year 2016-17, India produced 72 million tonnes of pepper.

Different varieties (24 types) of black pepper are grown in the country. It is grown only in South India, Kerala contributing 95 per cent of India's total production and Karnataka 3.5 per cent. Pepper is obtained by harvesting the spikes when the fruits are fully mature and start yellowing or become yellowish. The berries are removed from the spikes by rubbing, threshing or trampling, and sun-dried for a few days. When completely dry, the outer skin of the berries becomes dark brown to black and gets shrivelled. Before drying, if the berries are kept in boiling water for about 2 min., a glossy uniform black product is obtained on drying. Heat treatment arrests enzyme activity and the dried product has better keeping quality and a fresher aroma.

Composition: The Indian black pepper gives the following ranges of values: moisture, 8.7–14.0; total nitrogen, 1.55–2.60; ether extract (volatile and non-volatile), 4.2–15.7; carbohydrates (starch), 28.0–49.0; crude fibre, 8.7–14.0; and ash, 3.5–5.7 per cent. A considerable portion of the nitrogen in pepper is non-protein nitrogen and is due to alkaloids. The spice value of pepper is mainly due to the presence of 5 per cent of a group of alkaloids, piperine and related compounds (chavicine, piperidine and piperettine). Apart from the pungent constituents, pepper contains about 2.5 per cent volatile oil (pepper oil) having about 95 per cent terpene hydrocarbons and about 4 per cent oxygenated terpenes, which are responsible for the characteristic odour of the oil.

White pepper: White pepper also is obtained from the berries of *P. nigrum* by harvesting them when they have become ripe, i.e., the berries are yellowish red or red in colour. White pepper is prepared by removing the outer coating of the seeds either before or after drying. White pepper has less flavour and less pungency than black pepper, for the reason that the outer skin which also contains some of these ingredients is removed. India does not produce and export white pepper on a large scale. It is prepared by any one of the following methods.

The old indigenous method consists of steeping the ripe pepper in water for several days which results in the softening of the skin, which is then rubbed and washed off. The cores are then dried to get white pepper. Microbial action during steeping gives a bad smell to the product.

A better method involves the boiling of fully ripe pepper for a few minutes in water (just long enough to soften the skins), cooling and then rubbing off the skin manually or mechanically. On drying, this gives a very pleasant-smelling product. In the alternative, the pepper is heated in water till the blackening enzymes are inactivated is treated with sulphur dioxide and the berries are then dried. This gives a buff-

coloured pepper with the skin intact. On grinding, a powder similar to traditional white pepper powder is obtained and the aroma is superior. White pepper is also prepared by the decortication of dry black pepper mechanically.

Green pepper: In recent years there has been a growing demand for canned and bottled green pepper in Western countries for garnishing meat dishes. India is producing and exporting green pepper. Immature pepper is harvested and is canned in brine or vinegar. Dehydrated green pepper is also being produced in the country for export purposes.

Pepper oil and oleoresins: The characteristic odour of pepper is due to the volatile oil present in the pericarp of pepper. This oil is obtained by steam distillation using ground black pepper or light pepper obtained during the grading of pepper. Some pepper oil of commerce is a by-product of the oleoresin industry. The quality and composition of the pepper oil vary considerably. This is generally due to variation in the variety, grade, storage condition, and processing of pepper.

Pepper oleoresin is obtained by the solvent extraction of ground pepper and subsequent removal of solvent. It contains the oil responsible for the aroma and the resinous portion containing the pungent factors. Pepper oleoresin has the largest sales among all spice oleoresins. India in 2006 exported pepper oleoresin at 11.50 US dollars per kg.

Long pepper (*Piper longum*): Long pepper is cultivated in India only to a limited extent. It is derived mostly from wild plants grown in the Northern and North-Eastern parts of the country. Long pepper contains alkaloids having a pungent pepper-like taste and produces marked salivation and numbness of the mouth. It contains an essential oil with a spicy odour resembling that of pepper and ginger oils. Long pepper is used as a spice and also in pickles and preserves.

Uses: Pepper is used for a variety of purposes. It is used for relieving various types of bodily ailments. For centuries it has been used as an essential preservative for meat and other perishable foods. It is largely used in meat packing and canning, pickling, baking, confectionery and preparation of beverages. Its principal use is as a seasoning agent. Black pepper is an important component of culinary seasoning and an essential ingredient of many commercial foods.

White pepper has been in use for a long time and currently, large quantities (over 20,000 tonnes) are being produced. There is scope for the increased use of white pepper in food processing. It is chiefly used in white sauces, mayonnaise and salad dressings, where black particles are undesirable, it is also a favourite with users who prefer its mild flavour to the strong one of black pepper.

Canned and dehydrated green pepper is relished as a flavouring agent for eating with meat. Since the product has a very fresh smell of harvested green pepper and higher oil content, it has found new uses besides the garnishing of meat.

Pepper oil is used in the flavouring of foods in conjunction with other spice oils. It is used in oleoresins to bring about a balance between aroma and pungency. To a limited extent, it is used in perfumery. Pepper oleoresins are chiefly used in the processed food industries in advanced countries, and these are expanding.

20.4.2 Cardamom (*Elettaria cardamomum*)

Cardamoms or *chhota elaichi* are the dried ripe fruits of *E. cardamomum*. Two distinct varieties of cardamom based on the size of fruits are recognized. They are *E. cardamomum* var *major*, comprising the wild indigenous cardamom of Sri Lanka and cultivated to some extent in the eastern Himalayan region and *E. cardamomum* var *minor* which is indigenous to India cultivated in the Southern States.

Kerala, Karnataka and Tamil Nadu. *Var major* is the more primitive variety from which the cultivated *var minor* is derived. The minor consists of a large number of races differing in the size of the plant, leaf surface, flower and fruit.

The minor variety constitutes the second most important spice of India and is known as the "queen of spices," coming next to pepper. India is the major cardamom producing country in the world, the other important countries being Guatemala, Sri Lanka, Tanzania and Taiwan. Till recently, India was the biggest exporter of cardamom accounting for about 90–95 per cent of the world's export but of late Guatemala and other countries are competing with India and our exports have come down to about 70 per cent of world trade.

India produced 28 million tonnes in 2016-17.

Processing: The cardamom fruits (capsules) are ovoid, pale green to yellow in colour, and contain 15–20 hard brownish-black, angled and wrinkled seeds, covered by a thin mucilaginous membrane. The fruits are harvested when they are just short of full ripeness. This is necessary to prevent the capsules from splitting during drying. The fruits are dried either in the sun or in a drying chamber. A certain amount of bleaching takes place during drying and the capsule attains a straw colour. The capsules are sometimes bleached by exposure to sulphur dioxide or by steeping in a dilute solution of sulphurous acid. Bleaching improves the appearance of the pericarp and keeping the qualities of cardamom. On the other hand, it reduces the percentage of volatile oil in the seeds. ISI has prescribed standards for different types of cardamom grown in the country.

Composition: Analysis of the Indian cardamom seeds gives the following range of values: moisture 7.0–10.0; ether extracts, 7.5–15.0; protein 7.0–14.0; carbohydrates, 39.0–49.0; and ash 3.8–6.9 per cent. The calcium and phosphorus contents are 0.3 and 0.4 per cent, respectively. The vitamins present (mg per 100 g) are thiamine, 1.8; riboflavin, 0.23; niacin, 2.3; and vitamin A, 175 IU.

The spice value of cardamom depends on the volatile oils (2–10 per cent) present in the seeds. Seeds stored after dehusking suffer a loss of volatile oils (about 30 per cent in 8 months), while husk-protected seeds show practically no loss. Cardamom oil of commerce is obtained by the distillation of seeds or whole fruits. It is a colourless to pale yellow liquid with a penetrating, somewhat camphoraceous odour, and a strong persistent pungent taste. The oil loses its flavour on storage. The principal constituents of the oil are the terpenes—cineole, terpineol, terpinene, limonene, sabinene and terpinyl acetate. The quality of cardamom oil is related to the terpinyl acetate content.

Uses: Cardamom seeds have a pleasant aroma, and a characteristic pungent taste. They are used as a spice and in medicine. They are the common ingredients of *curry powder*, cakes and other bakery products and sweet breads. They are also used for flavouring liquors. In West Asia, cardamom is used for flavouring coffee. About 85 per cent of India's cardamom export is to the Arab nations. It also finds use in the preparation of flavoured tea. The chewing of cardamom masks bad breath and prevents dental decay. Different systems of medicines—Ayurvedic, Allopathic and Unani—employ cardamom for the cure of many human disorders. Cardamom oil also is used in medicine and in flavouring beverages.

20.4.3 Ginger (*Zingiber officinale*)

Ginger is native to South East Asia, but the wild forms are found in India and several species are grown in Malaysia.

Ginger or *adrak* is the dried underground stem or rhizome of the zingiberaceae herbaceous plant. The rhizomes are irregular and are formed at a shallow depth in the soil. Ginger has been under cultivation

in India from time immemorial and is being exported from very early times. Indian ginger is considered only second to the Jamaican variety in quality. Apart from India which is the major producer of ginger today, Taiwan, Jamaica, Nigeria and Malaysia produce and export ginger.

The world production is 32,70,762 tonnes and India is 11,09,000 tonnes, 2016. In the year 2016-17, India produced 1070 million tonnes.

Processing: The crop is dug up for ginger in stages, depending upon the type of ginger required. The tender rhizome, sold as green ginger for the preparation of preserves or pickling, is harvested from the fifth month after sowing. The crop for dry ginger is harvested after about the eighth month. The rhizomes are marketed as such or after peeling or scraping of the epidermal layer. In the latter case, the peeled ginger is washed and then sun-dried. When white, polished rhizomes free from specks or spots are required, the peeled ginger is soaked in a solution of lime and then dried. In some cases, the lime-treated rhizomes are further treated with sulphur dioxide.

Composition: The composition (average value) of Indian dry ginger is: moisture, 6.9; protein, 8.6; fat, 6.4; fibre, 5.9; carbohydrate, 66.5; and ash, 5.7 per cent. The vitamins present are thiamine, 0.05; riboflavin, 0.13; niacin, 1.9; ascorbic acid, 12.0 mg per cent; and vitamin A, 125 IU/100g.

Ginger contains 1–3 per cent essential oil (oil of ginger) with a characteristic pleasant and aromatic odour. The oil is separated by the steam distillation of rhizomes. Since the oil is more in the epidermal tissue, unscrapped ginger is used for steam distillation. The oil is greenish to yellow in colour, becomes viscous on storage, and does not have the pungent flavour of the spice. The important constituents of the oil are monoterpenes (4 per cent), sesquiterpenes (65 per cent), and oxygenated terpenes (17 per cent).

The pungent principles of ginger are non-volatile. They are extracted from the coarsely ground, dried spice by percolation with organic solvents. On removal of the solvent, a viscous and dark brown oil (ginger oleoresin) is obtained, which retains all the pungency of the spice. The oleoresin is known by the trade name "Gingerin" and it contains besides the pungent principle, essential oils and non-pungent matter. The non-pungent substances include carbohydrates and palmitic and other fatty acids. The pungent principles are oxymethyl phenols, such as gingerol, shogaol, and related, compounds.

Uses: Ginger is one of the most important and oldest spices. It is used in dried, preserved and green forms. Because of its pleasant aroma and pungency, it is widely used as a flavouring agent in the preparation of a great variety of food products like ginger bread, confectioneries, *curry* powders, *curried* meats, pickles, soft drinks like ginger cocktail or gingerella, and carbonated drinks like ginger beer. It is also used for the preparation of oleoresin and essential oils.

Substantial quantities of green ginger are used in the country as a spice in culinary preparations. Some quantity is also used for the preparation of pickles and canned ginger. Preserved ginger is made from young fleshy rhizomes boiled in sugar and packed in syrup. The preserved ginger is used in confectionery. The production of ginger *muraba* is a traditional industry in India. Ginger is also used in the preparation of some alcoholic beverages (ginger brandy and ginger wine) and in medicine. Ginger oil finds limited use in perfumery.

20.4.4 Chillies (*Capsicum annuum*)

Chillies or *lal mirch* are the fruits of some species of the genus *Capsicum*. They are also called capsicum or red pepper. Chillies are an indispensable and common ingredient of Indian food, and especially of South Indian food. Notwithstanding such a general use at the present time, the chilli crop is not indigenous

to India. It was introduced to India from its native home Brazil and the South American continent, by the Portuguese only about 400–500 years ago. Prior to its introduction, black pepper was being used to provide the necessary pungency to food. In the year 2016-17, India produced 2096 million tonnes.

The genus *Capsicum*, with a wide range of varieties and many intermediate and hybrid forms, has been classified in different ways and many different common names have been applied to them. The generally accepted two main species are *Capsicum annuum* and *Capsicum frutescens*. The former is an annual and the flowers grow singly in the leaf axils, while the latter is a perennial, with flower clusters in the leaf axils. Most of the chillies grown in India belong to the species *C. annuum*. There are many varieties differing mainly in the size, shape and pungency of fruits. Unripe fruits are generally green but forms differing in colour are known. The ripe fruits are generally red, but in some forms, they are yellow or orange. The long and thin to round or oblong varieties having thin and comparatively smooth pericarp are highly pungent and used as spices in the preparation of hot foods. The larger bell-shaped fruits with thick pericarps are less pungent or non-pungent and used in the green condition as a vegetable, in salads and in pickles. Paprika belongs to this group.

Bird chilli (*C. frutescens*) is a perennial plant. It grows wild in the tropics. It bears small, conical fruits which are extremely pungent. Its capsaicin (the pungent principle) content is high (0.3 per cent), and occasionally it may be as high as 1.8 per cent. Its vitamin C content is less than in *C. annuum*. Cayenne pepper is made from finely ground dried bird chilli mixed with salt (25 per cent).

Processing: The dry chilli of commerce is obtained by picking ripe and nearly ripe fruits, curing them by heaping them indoors for 2–3 days and then sun drying. Partially ripe fruits, if dried without the curing treatment, develop white patches which reduce their market value. When the fruits are partially dried they are trampled upon or rolled over to flatten them. This enables a greater quantity of the dried product to be packed in a unit volume. The yield of dried material is about 25–30 per cent of fresh weight. Chillies are sometimes smeared with suitable oil to impart glossiness.

Composition: The chemical composition of Indian red chillies is as follows: moisture, 10.0; protein, 15.0; fats, 6.2; fibre, 30.2; carbohydrate, 31.6; total ash, 6.1; calcium, 0.16; phosphorus, 0.37; and iron, 0.23 percent. Chilli powder, on solvent extraction, gives a fatty oil (9–13 per cent), which is viscous, red in colour, and has a sharp taste. On steam distillation, 0.16–0.39 per cent of a volatile oil is obtained. Chilli seeds contain 26.1 per cent oil. The protein content of fat and moisture-free seeds is 28.9 per cent. In this respect, chilli seeds resemble other oil seeds.

The pungent principle in chillies is an alkaloid called capsaicin. Capsaicin retains its pungency in a dilution of one in a million parts of water. Its content varies from zero to 1.8 per cent in bird and other hot chillies. Commercial chilli samples contain about 0.1 per cent. The colouring matter of the ripe fruits is due to carotenoid pigments.

Chillies are high in vitamin C content. The vitamin content depends on the variety, locality and stage of maturity of the fruits. Hungarian paprika contains 280 mg and Indian varieties up to 170 mg per 100 g. The green chillies contain 111 mg and dry chillies 50 mg of the vitamin per 100 g. The vitamin content of green and dry chillies are, respectively, 454 and 576 IU per 100 g.

Uses: Dry chilli is extensively used as a spice in all types of *curried* dishes. It is the major constituent of *curry powder* made by grinding roasted dry chilli with other spices, such as coriander, cumin, turmeric, etc. Bird chilli is used in making hot sauces, such as tabasco sauce.

Chilli helps digestion. It stimulates the taste buds which results in an increased flow of saliva amylase helping the digestion of starchy foods. Paprika and green chilli are good sources of vitamins and C. Paprika is also used to colour and flavour dishes. Chillies find several medicinal uses.

20.4.5 Turmeric (*Curcuma longa*)

The species *Curcuma longa* is probably native to India, and is a triploid with 42 chromosomes which have originated from *C. aromatica*, a species found all over India.

Turmeric or *haldi* belongs to the ginger family and, as with ginger, it is the rhizome that finds use as a spice and for other purposes. There are about 70 species of turmeric of which 30 species occur in India. Of these, several are wild species and *C. longa* is the most important cultivated variety.

In the year 2016-17, India produced 1056 million tonnes.

Curcuma aromatica occurs wild throughout India and accounts for 4 per cent of the area under turmeric cultivation. This variety is called *Kasturi* turmeric. The cured turmeric has a sweet fragrance and is used largely for the production of bathing powder, perfumed bathing oils and other toiletry preparations.

Processing: The turmeric rhizomes are to be cured for the development of colour and aroma. The curing consists of cooking the rhizomes in water until they become soft. Earlier, some cow dung was added during cooking to intensify the colour of the product. Addition of cow dung made the boiling water alkaline. According to the new technique, the rhizomes are boiled in lime water or soda bicarbonate solution. The well-cooked rhizomes are spread out in the open for sun drying. They are then cleaned and polished mechanically in a rotary drum. Cured and finished turmeric is brittle and has a striking yellow colour.

Composition: Analysis of Indian turmeric gives the following values: moisture, 5.8; protein, 8.6; fat, 8.9; carbohydrate, 63.0; fibre, 6.9; ash, 6.8; calcium, 0.2; phosphorus, 0.26; and iron, 0.05 per cent. The vitamin content is thiamine, 0.09; riboflavin, 0.19; niacin, 4.8 mg per cent; and vitamin A, 175 IU per 100 g.

Turmeric on steam distillation gives 1.5 per cent essential oil, which consists of 56 per cent of sesquiterpene ketones (turmerones) and 9 per cent tertiary alcohol. On solvent extraction, followed by removal of the solvent, an oleoresin containing all the aroma and flavour of turmeric is obtained. This is in great demand in food and pharmaceutical industries. The colouring matter of turmeric is due to the curcumin pigment.

Uses: Turmeric powder is used as a flavouring material and colourant in many foods to give an agreeable flavour and colour. It is a constituent of *curry* powders and prepared mustards. It is used for dyeing wool, silk and cotton. Turmeric is an anti-oxidant due to its phenolic character. Turmeric is an auspicious article in all religious observances of Hindu households. It is also used as a cosmetic and for the preparation of *kumkum* which is used by Hindu women. Like other spices, it finds many uses in the indigenous systems of medicine.

20.5 Minor Spices of India

20.5.1 Ajowan, Coriander and Cumin

Among the minor spices of India, ajowan or bishop's weed or *omum* (*Trachyspermum ammi*), aniseed or *valaiti saunf* (*Pimpinella anisum*), caraway or *shia jira* (*Carum carvi*), celery or *shalari* (*Apium graveolens*), coriander or *dhania* (*Coriandrum sativum*), cumin or *jira* (*Cuminum cuminum*), dill or *sowa*

(*Anethum graveolens*), and fennel or *saunf* (*Foeniculum vulgare*) belong to the same family (*Umbelliferae*). All these seeds are used as spices for culinary purposes. They all contain essential oils which find use as flavouring material, in medicine and in toilet preparations. In some cases, the leaves and stems are also used; celery leaves and stalks are used as salads, in soups, and as pre-dinner appetizers. The stem, leaves and fruits of coriander have a pleasant aromatic odour. The entire plant, when young, is used in preparing chutneys and sauces, and the leaves are used for flavouring curries and soups. The seeds are extensively employed as a spice in the preparation of *curry* powder, pickling spices, sausages and seasonings. Young leaves of dill also are used for flavouring soups and sauces.

Cumin: This seed is derived from the herb *Cuminum cyminum* native to Mediterranean region, whose Sanskrit names are *ajaji*, *Karachi*, and *kunchika*. It appears rather late in literary usage with Kautilya, Charaka and Sushruta around 300 BC.

In the year 2016–17, India produced 27 million tonnes ajowan; 883 million tonnes of coriander; 493 million tonnes cumin.

20.5.2 Cinnamon (*Cinnamomum zeylanicum*)

Cinnamon or *dalchini* is the inner bark of the young shoots of the cinnamon tree. The tree is an important spice tree in India and it is grown on the West Coast and Western Ghats. The quality of cinnamon depends upon the length, breadth and thickness of the bark. The bark contains 0.5 to 1.0 per cent volatile oil. The bark is extensively used as a spice in the form of small pieces or powder. It is aromatic, astringent and stimulatory. It is also used for flavouring confectionery, liquors, pharmaceuticals, soaps and dental preparations. The bark oil is also used extensively as a flavouring material.

The world production is 2,23,574 tonnes in 2016 and India in 2016–17 produced 5 million tonnes cinnamon and tejpatta.

20.5.3 Fenugreek (*Trigonella foenum-graecum*)

Fenugreek or *methi* is the dried ripe fruit of an annual herb, native to South-Eastern Europe and West Asia and now cultivated in India. India is one of the major producers and exporters of fenugreek. About 40,000 hectares are under this crop, producing about 20,000 tonnes of the seeds.

Fresh tender leaves and shoots of fenugreek are rich in minerals (Ca, P, Fe) and vitamins A and C, and are eaten as vegetables. The seeds are small, hard, smooth and oblong, and yellowish-brown in colour. They contain many substances like proteins, starch, sugars, mucilage, mineral matter, volatile oil, fixed oil, vitamins and enzymes. As a spice, fenugreek adds not only to the flavour but also to the nutritive value of foods. It forms a constituent of *curry* powder. Sometimes fenugreek is used in place of black gram in the preparation of idlies. The seeds possess medicinal properties and are thus articles of medicinal value, especially for diabetic patients, as there is a significant hypoglycemic effect.

In the year 2016–17, India produced 297 million tonnes.

20.5.4 Garlic (*Allium sativum*)

Garlic or *lassan* is a bulb made up of several cloves enclosed within the white or pink skin of the parent bulb. It is cultivated all over India. Garlic is used practically all over the world for flavouring various dishes. In India, it is used in several food preparations, notably in chutneys, pickles, *curry* powders, *curried* vegetables, meat preparations, etc. However, its flavour is less appreciated by some people. Garlic has a strong flavour due to the sulphur-containing allicin (see Chapter 9). It has also anti-bacterial and anti-insecticide activities. Garlic is a remedy for several ailments and

physiological disorders. It is said that it decreases the cholesterol content of the serum and reduces hypertension.

Garlic powder is dehydrated garlic. By proper technique, garlic powder with better colour, flavour, pharmaceutical or anti-bacterial property than garlic, can be obtained. In some countries, garlic powder has largely replaced garlic in all its uses. Garlic salt is prepared by mixing garlic powder (20 per cent), pulverized salt (78 per cent) and anti-caking agent (2 per cent).

20.5.5 Mustard (*Brassica nigra*)

Mustard seed is also known as rapeseed, is a condiment plant. Mustard greens, Indian, Chinese leafy mustard resembles headless cabbage like kale hence called as mustard cabbage. Mustard has a sharp pungent horseradish flavour and is used in soul food cuisine.

Archeological excavations in the Indus valley (Indian subcontinent) have revealed that mustard was cultivated there. That civilization existed until about 1800 BC.

It had varieties wild white mustard (*Sinapis alba*), black mustard (*Brassica nigra*), brown Indian mustard (*Brassica juncea*), white mustard (*Brassica hirta*), and wild mustard (*Brassica campestris*).

Locations renowned for their mustard include *dijon* (medium-strength) and Meaux in France; Norwich (very hot) and Tewkesbury's mustard, in the United Kingdom; and Düsseldorf (hot) and Bavaria in Germany.

Mustard contains glucosinolate, isothiocyanate such as allyl isothiocyanate. Because of these, it has anti-bacterial properties and does not require refrigeration.

The world production is 6,99,038 tonnes in 2016.

The role of various types of mustard as an important oilseed crop in India has been dealt within Chapter 19. The spice value of mustard seeds is due to the thiocyanates which are present in them as glycosides and are released by the action of an enzyme, in the presence of moisture under suitable conditions. The whole seeds after drying are used in pickling, preserving and seasoning vegetables. White mustard is ground with black mustard for preparing table mustard.

20.5.6 Mace and Nutmeg (*Jaipatri and Jaiphal*)

These are two species of the same tree, *Myristica fragrans*, which is native to Indonesia. The fleshy fruit splits when ripe and exposes the mace as a scarlet fleshy covering called the aril enclosing the seed, which is the nutmeg. The mace is carefully removed, flattened and dried, during which process it turns brown. The nutmeg is also dried. The most important constituent of nutmeg and mace is the volatile oil which forms 4–15 per cent of mace and 7–16 per cent of nutmeg. The oil of mace contains 93 per cent terpenes and 7 per cent aromatics. The nutmeg oil contains 84 per cent terpenes and 11 per cent aromatics. Nutmeg yields 24 to 30 per cent fixed oil, also known as nutmeg butter. Both mace and nutmeg are used for flavouring foods; generally, mace is used for flavouring savoury dishes and nutmeg for sweet dishes. The volatile oil is used for flavouring foods, dental preparations, essences, confectionery, vegetable dishes and beverages. Both have medicinal properties and are used as drugs.

The Moluccas Islands are also the source of nutmeg and mace, the first being the but and the second the scarlet aril which envelopes the but and becomes visible when the fruit is stripped away. The nutmeg in Sanskrit is *Jaiphal*, the mace is *javitri*, and the bushy, evergreen tree is botanically *Myristica fragrans*.

The world production is 1,22,151 tonnes and India is 38,000 tonnes, 2016. In the year 2016-17, India produced 15 million tonnes of nutmegs.

20.5.7 Onion (*Allium cepa*)

Onion is grown in practically every country of the world. In India, it is grown throughout the country. India is one of the largest producers of onion and exports considerable quantities of it. There are different varieties of onions—white, yellow and red, of varying sizes and shapes. They also differ in their pungency. The culinary uses of onions are extraordinarily numerous. They are eaten raw, fried, boiled and roasted, in soups, *curries*, and a great variety of other savoury dishes. They are the main ingredient in many pickles and *chutneys*. Its spice value is due to its sulphur compounds (see Chapter 9). Dehydrated onions, onion flakes and onion powder are also used as flavouring agents.

20.5.8 Saffron (*Crocus sativus*)

It is probably native to Greece, being recorded in the 4th century BC. Saffron or *kesar* consists of rich gold or yellowish-red stigmas of the flower of *C. sativus*. Saffron is produced in India to a limited extent and considerable quantities are imported from other countries, particularly Spain and France. It has been used as a spice, or dye (saffron yellow), a cosmetic and a medicine since classical times. Its high cost limits its uses. Saffron contains a glycoside, crocin, which is its chief colouring principle. The flavour and spice value are due to the volatile and fixed oils present to the extent of 1.4 and 13.4 per cent respectively. In India, saffron is widely used in all sweetmeats.

20.5.9 Tamarind (*Tamarindus indica*)

The ripe fruits (pulp) of the tree are used as an acidulant in some food preparations. India is the only country producing a commercial crop of tamarind (*imli*). The pulp is rich in free acids (10 per cent) and combined acids (7 per cent) and plays an important role in the preparation of foods like "*sambar*", "*rasam*", "*curries*", "*chutneys*," etc. which are very popular in South India. The use of pulp is cumbersome because of fibre, seeds, etc. Tamarind juice concentrate and dehydrated tamarind powder are in the market, and these can be easily dissolved in hot water and used in culinary preparations.

In the year 2016-17, India produced 197 million tonnes.

20.5.10 Cloves (*Eugenia caryophyllus*)

The species originates from the Moluccas in eastern Indonesia, which are also called the spice island. The word *lavanga* first appears in writing in the Ramayana and Chakara Samhita.

The world production is 1,80,520 tonnes, 2016 and India produced 1 million tonnes in 2016-17.

The world production is 1,80,520 tonnes, 2016 and India produced 1 million tonnes in 2016-17. Cloves or *lavang* are flower buds of the clove tree. When the base of the flower buds turns reddish in colour, they are harvested and dried. Clove is the second most important spice of the world from the commercial point of view, coming next to pepper. More than 80 per cent of the world crop is in Tanzania. Some clove is produced in India but most of our requirement is met by imports. Clove buds contain 16-17 per cent essential oils, which contain 90-95 per cent eugenol. The spice value of clove is mainly due to its volatile oil. In India, cloves, both whole and ground, are a popular ingredient in spice mixtures. In medicine, clove oil is used as an aid to digestion and for its antiseptic and anti-microbial properties for the cure of toothache.

20.5.11 Mint (*Mentha arvensis*)

Mint or *pudina* is an aromatic herb. Many varieties of mint are grown in this country. Mint is an important source of peppermint oil and menthol. On steam distillation of leaves, a golden yellow volatile

oil is obtained. About 50 per cent of menthol separates on cooling the oil. On removal of menthol, the remaining oil is used as peppermint oil. Dementholized oil is used for flavouring mouthwashes, toothpaste and in pharmaceuticals and medicine. The very popular use of mint in India is in the preparation of *chamney*.

20.5.12 Vanilla (*Vanilla planifolia*)

Vanilla is a plant native to Eastern Mexico and Brazil. Attempts have been made to cultivate vanilla in India but not much headway has been made so far. The country imports most of its requirements. The fruit (pods) of the plant is a long bean in which a large number of small, hard, black seeds are present. The pods are cured by dipping them in boiling water followed by a long slow drying process. During this period, the enzyme (β -glucosidase hydrolyzes the glycoside vanillin with the formation of vanilla, which has a dominant aromatic flavour. The beans are cut into small pieces and are extracted with dilute alcohol which gives the flavouring extract or vanilla essence. Vanilla is used in flavouring various confectioneries, puddings, ice creams, etc. Vanillin is made synthetically, but natural vanilla remains in demand because it contains other useful aromatic substances as well as vanilla.

The world production is 7,940 tonnes in 2016.

20.5.13 Asafoetida (*Ferula foetida*)

Hingu occurs in early Buddhist Mahavagga. Hing is the exudate of the species, namely *Ferrula asafetida*, *F. narthex* and *F. galbaniflua* each of which shows slight differences in properties.

Asafoetida or *hing* is the gum resin exuded from the rhizome of several species of *Ferula*, some of which are grown in India. It contains gum, resin and essential oil in varying proportions, which together are responsible for the strong flavour. Therefore, in trade, compounded asafoetida is marketed using flour of corn, wheat, barley and gum as diluent. It is believed that steam volatile organic sulphur compounds predominantly contribute to the characteristic asafoetida odour. Asafoetida is extensively used in India for flavouring *curries*, sauces and pickles, in conjunction with other spices. It also finds use in the Ayurvedic and Allopathic systems of medicine.

20.5.14 Allspice or Pimento (*Pimenta dioica*)

Allspice comprises the dried unripe berries which are nearly globular, with a somewhat rough surface and a reddish-brown colour. The name "allspice" is derived from the fact that the spice is said to possess the characteristic flavour and aroma of cloves, nutmeg, cinnamon and black pepper, all combined in one spice.

The allspice tree is indigenous to the West Indies and tropical Central America. It is also reported to be cultivated in gardens in some parts of India.

Allspice owes its characteristic odour to the presence of an essential oil (3.3–4.5 per cent). In addition, it contains an acid responsible for the astringency, a soft resin with a burning taste, fixed oil (5.8 per cent), proteins (5.8 per cent), crude starch (20 per cent), and traces of alkaloids.

The berries are used as a flavouring ingredient in ketchup, soups, sauces, pickles, meats, etc. It is an important ingredient of spice mixture of *curry* powders, mincemeat *pies*, etc. The berry oil is rich in eugenol (65–80 per cent) and is used for flavouring condiments, food products and in perfumery. The oil can replace ground spice in all preparations. The pimenta leaf also contains an oil, but it is inferior in flavour and odour to the berry.