#### SOURCES OF OILS AND FATS

#### 1. GROUNDNUT OIL:

Arachis hypogaea L. (Fabaceae)

Morphology: Peanut is an annual herbaceous plant growing to a height of 30 to 50 cm. The peanut plant can be erect or prostrate with a well-developed taproot and many lateral roots and nodules. The leaves are opposite and pinnate with four leaflets; each leaflet is 1 to 7 cm long and 1 to 3 cm across. The flowers are 1.0 to 1.5 cm across, bright yellow or yellowish orange with reddish veining. They are borne in axillary clusters on the stems above ground and last for just one day. One to several flowers may be present at each node and are usually more abundant at lower nodes. The first flowers appear at 4 to 6 weeks after planting and maximum flower production occurs 6 to 10 weeks after planting. 8 to 14 days after pollination, a short stalk at the base of the ovary elongates to form a thread-like structure known as a "peg". This pushes the ovary down 5 to 8 cm into the soil, where it develops into a pod. Pods are 3 to 7 cm long, normally containing one to four seeds. Pods reach maximum size after 2 to 3 weeks in the soil, maximum oil content in 6 to 7 weeks, and maximum protein content after 5 to 8 weeks. The peanut crop matures after 7 to 9 weeks in the soil, maturity being measured by maximum levels of protein, oil, dry matter, and the presence of darkened veining and brown splotching inside the pod. Peanuts usually require a minimum of 100 to 150 days from planting to maturity depending on the variety. Flowering continues over a long period, and pods are at all stages of development at harvest. Pegs will eventually rot in the soil and the resulting loose pods are lost during harvest.

**Uses**: About 41% of the world peanut crop is used for oil production, whereas 45% is used directly as human food. Peanut kernels, usually cooked or toasted, are appreciated worldwide as a flavourful snack food, nutritionally dense due to its high energy, protein and fat content. Peanuts are also the primary ingredient of many finished products such as peanut butter, confections, nutritional bars, and are used in numerous dishes. Peanuts are usually too valuable to be used as animal feed. However, whole or shelled peanuts, or even roasted peanuts are sometimes fed to livestock. In 2001, for instance, raw peanuts, in excess of the peanut quota in the USA, were sold on the feed market. Likewise, abnormal peanuts, or peanuts with a higher aflatoxin content than that permitted by the food regulations, have been used as feed ingredients for cattle. Peanuts meant for oil production, or for the manufacture of confectionary or peanut butter may also be available for livestock. In the USA, it has been estimated that less than 1% of the annual production is fed as raw peanuts to cattle.

#### 2. COCONUT OIL:

Cocos nucifera L. (Arecaceae)

**Morphology**: *Cocos nucifera* is a large palm, growing up to 30 metres (100 feet) tall, with pinnate leaves 4–6 m (13–20 ft) long, and pinnae 60–90 centimetres (2–3 ft) long; old leaves break away cleanly, leaving the trunk smooth. On fertile soil, a tall coconut palm tree can yield up to 75 fruits per year, but more often yields less than 30. Given proper care and growing conditions, coconut palms produce their first fruit in six to ten years, taking 15 to 20

years to reach peak production. The coconut fruit is a drupe, not a true nut. Like other fruits, it has three layers, the exocarp, mesocarp and endocarp. The exocarp is the glossy outer skin, usually yellow-green to yellow-brown in colour. The mesocarp is composed of a fibre called coir, which has many traditional and commercial uses. Both the exocarp and the mesocarp make up the "husk" of the coconut, while the endocarp makes up the hard coconut "shell". The endocarp is around 4 millimetres ( $\frac{1}{8}$  inch) thick and has three distinctive germination pores micropyles on the distal end. Two of the pores are plugged (the "eyes"), while one is functional.

# Cultivation

Coconut palms are normally cultivated in hot and wet tropical climates. They need year round warmth and moisture to grow well and fruit. Coconut palms are hard to establish in dry climates, and cannot grow there without frequent irrigation; in drought conditions, the new leaves do not open well, and older leaves may become desiccated; fruit also tends to be shed.

# Cultivars

Coconut has a number of commercial and traditional cultivars. They can be sorted mainly into tall cultivars, dwarf cultivars, and hybrid cultivars (hybrids between tall and dwarf). Some of the dwarf cultivars such as 'Malayan dwarf' have shown some promising resistance to lethal yellowing, while other cultivars such as 'Jamaican tall' are highly affected by the same plant disease. Some cultivars are more drought resistant such as 'West coast tall' (India) while others such as 'Hainan Tall' (China) are more cold tolerant. Other aspects such as seed size, shape and weight, and copra thickness are also important factors in the selection of new cultivars. Some cultivars such as 'Fiji dwarf' form a large bulb at the lower stem and others are cultivated to produce very sweet coconut water with orange-coloured husks (king coconut) used entirely in fruit stalls for drinking (Sri Lanka, India).

Traditional areas of coconut cultivation in India are the states of Kerala, Tamil Nadu, Karnataka, Puducherry, Andhra Pradesh, Goa, Tripura, Assam, Maharashtra, Odisha, West Bengal, Gujarat and the islands of Lakshadweep and Andaman and Nicobar. Though Kerala has the largest number of coconut trees, in terms of production per hectare, Tamil Nadu leads all other states.

In Goa, the coconut tree has been reclassified by the government as a palm (rather than a tree), enabling farmers and developers to clear land with fewer restrictions and without needing permission from the forest department before cutting a coconut tree.

**Uses**: The coconut palm is grown throughout the tropics for decoration, as well as for its many culinary and nonculinary uses; virtually every part of the coconut palm can be used by humans in some manner and has significant economic value. It is one of the most useful trees in the world.

## Culinary uses

## Nutrition

A 100-gram reference serving of raw coconut flesh supplies about 354 kilocalories of energy and a high amount of total fat (33 grams), especially saturated fat (89% of total fat), along with a moderate quantity of carbohydrates (15 g), and protein (3 g). Micronutrients in significant content include the dietary minerals, Mn, Cu, Fe, P, Se and Zn. The various parts of the coconut have a number of culinary uses.

The edible white, fleshy part of the seed (the endosperm) is known as the "coconut meat", "coconut flesh", or "coconut kernel". Grated coconut that is dehydrated by drying or baking is known as "desiccated coconut." It contains less than 3% of the original moisture content of coconut meat. It is predominantly used in the bakery and confectionary industries (especially in non-coconut-producing countries) because of its longer shelf life compared to freshly grated coconut. Desiccated coconut are used in confections and desserts such as macaroons. Dried coconut is also used as the filling for many chocolate bars. Some dried coconut is purely coconut, but others are manufactured with other ingredients, such as sugar, propylene glycol, salt and sodium metabisulphite.

Coconut meat can also be cut into larger pieces or strips, dried, and salted to make "coconut chips" or "coco chips". These can be toasted or baked to make bacon-like fixings.

Coconut milk, not to be confused with coconut water, is obtained by pressing the grated coconut meat, usually with hot water added, which extracts the coconut oil, proteins, and aromatic compounds. It is used for cooking various dishes. Coconut milk contains 5% to 20% fat, while coconut cream contains around 20% to 50% fat. Most of the fat is saturated (89%), with lauric acid being the major fatty acid. Coconut milk can be diluted to create coconut milk beverages. These have much lower fat content and are suitable as milk substitutes.

Coconut milk powder, a protein-rich powder can be processed from coconut milk following centrifugation, separation and spray drying.

Coconut milk and coconut cream extracted from grated coconut is frequently added to various dessert and savoury dishes, as well as in curries and stews. It can also be diluted into a beverage. Various other products made from thickened coconut milk with sugar and/or eggs like coconut jam and coconut custard are also widespread in Southeast Asia. In the Philippines, sweetened reduced coconut milk is marketed as coconut syrup and is used for various desserts. Coconut oil extracted from coconut milk or copra is also used for frying, cooking, and making margarine among other uses.

Coconut water serves as a suspension for the endosperm of the coconut during its nuclear phase of development. Later, the endosperm matures and deposits onto the coconut rind during the cellular phase. It is consumed throughout the humid tropics, and has been introduced into the retail market as a processed sports drink. Mature fruits have significantly less liquid than young, immature coconuts, barring spoilage. Coconut water can be fermented to produce coconut vinegar.

## **Coconut flour**

Coconut flour has also been developed for use in baking, to combat malnutrition

## 3. LINSEED OIL/ FLAXSEED OIL:

Linum usitatissimum L. (Linaceae).

Flax is grown for its oil or its fibre, depending on the variety and linseeds usually come from flax varieties intended for oil production. Linseeds are rich in oil and protein and are suitable for livestock, particularly as a source of polyunsaturated and omega-3 fatty acids.

**Morphology:** Flax is a summer annual erect plant, 20 to 150 cm high, with a tap root. The height and the branching habit of the plant mainly depend on its intended use. Large-seeded genotypes intended for oil production are many-branched and shorter than typical fibre flax. The leaves are alternate, linear to linear-lanceolate, 15-55 mm long x 3-13 mm broad, and drop as the plant matures. The flowers are apical and borne in panicle-like inflorescences.

The fruits are round, dry capsules, 5-9 mm in diameter, that contain 10 seeds in large-seeded oil varieties and less in fibre varieties. Linseeds are ovoid, 3.3-5 mm long. The weight of 1000 seeds ranges from 4 to 13 g. The seeds are yellow, dark brown or olive coloured. Linseeds from oil varieties contain high amount of oil and protein in the endosperm and in the cotyledons. Mucilage produced in the epidermal cells protects the seed from digestion by animals, which may or may not result in health benefits for the consumer (human or animal).

**Uses:** Linseeds are primarily used for the production of linseed oil, which is used in paints and other industries, such as the manufacture of linoleum. Linseed meal, which is the by-product of oil production, is a valuable protein-rich feed for livestock. Whole linseeds are, like other oilseeds, primarily an energy feed due to their lipid content. Linseed has attracted considerable attention since the 1990s due to the presence in the oil of polyunsaturated fatty acids (PUFA), notably alpha-linolenic acid (ALA, an omega-3 fatty acid), and conjugated linoleic acid (CLA). Adding these fatty acids to the diets of livestock alters the fatty acid profile of meat, milk and eggs in order to provide health benefits to human consumers. Other benefits include laxative properties and positive effects on the appearance of skin and hair. Linseeds and linseed oil contain large amount of lignans, which act in mammals as phytoestrogens and have anticarcinogenic properties.

#### 4. SOYBEAN OIL:

Glycine max L. (Fabaceae).

Soybean is the largest oilseed crop, with 276 million tons produced in 2013, the main producers being the USA, Brazil, Argentina and China. The value of the crop is partly driven by the demand for soybean meal, which is the by-product of oil extraction, one of the major feed commodities (172 million tons used worldwide in 2011) and the main protein source in many animal diet. Whole soybean seeds, usually called soybeans or full-fat soybeans to differentiate them from soybean meal, are also used for animal feeding.

**Morphology**: Soybean pods generally contain one to three seeds each. There are large variations in seed shape, size and colour. Shape varies from almost spherical to flat and elongated. Seed size ranges from 5-11 mm and seed weight from 120-180 mg/seed. Soybean hulls may be yellow, green, brown or black, either all one colour or a pattern of two colours. Cotyledons are yellow or green, and the hilum may be black, brown, buff or light yellow.

**Uses**: Whole soybeans are used as food in tropical Africa and Asia. Western countries are a new market for soya food (exotic foods, soybean milk, tofu, etc.). The beans are used to make flour, milk, tofu and tofu-like products. They may be roasted and eaten as a snack, or fermented to make tempeh, miso, yuba and soy sauce. Soybeans are also used for animal feeding due to their high oil (20%) and protein content (40%). They are the richest in protein of all the common seeds used for animal feeding, and in 2011, 13 million t of whole soybeans were reported to be used as feed. Raw soybeans are usually processed in order to improve their nutritional value, either by removing antinutritional factors or by making the protein less degradable for ruminants. Treatments include many types and combinations of heat (dry or moist) and pressure, such as toasting and extrusion. Full-fat soybeans sold for specialty uses are often marketed under a brand name.

**Distribution**: Soybean is native to Asia. It was domesticated in North China 3000 years ago. The main producing countries are the USA, Brazil, Argentina, China and India. Optimal growth conditions are average day-temperatures around 30°C, 850 mm annual rainfall with not less than 500 mm water during the growing season, and soil pH ranging from 5.5 to 7.5

with good drainage. Soya is sensitive to soil acidity and aluminium toxicity. It can withstand short periods of both waterlogging and drought.

## 5. MUSTARD OIL:

Brassica campestris (Brassicaceae)

**Morphology**: Mustards, (*Brassica* spp.) are herbaceous annual plants in the family Brassicaceae grown for their seeds which are used as a spice. Mustard plants are thin herbaceous herbs with yellow flowers. The leaves of the plant are toothed, lobed, and occasionally have the larger terminal lobes. Plants can reach 16 cm (6.3 in) in length. The yellow flowers grow in spike like clusters of 2–12 flowers and individual flowers are 8 mm (0.3 in) in diameter. The seeds are red to brown in colour and produced from each flower. Mustard can grow 1.2-2 m (4–6.6 ft) in height and as an annual plant, survives only one growing season. Mustard may also be referred to as mustard, brown mustard, red mustard, yellow mustard or wedlock and is believed to have originated in the temperate regions of Europe.

Mustard grows very well in cool climates with short growing seasons, at temperatures as low as 4.4°C (40°F). Seedlings can tolerate some light frost but severe frost will kill the plants. The mustard plant can be grown in sandy, loamy or clay soils with a pH between 4.9 and 8.2 and prefers moist soil. The plant will tolerate partial shade.

**Propagation:** Mustards is propagated from seed and due to the small size of the seeds, should be planted in a well prepared seed bed which is firm and flat. Mustard seeds should be sown in Spring once soils have warmed to  $4.4-7.2^{\circ}$ C ( $40-45^{\circ}$ F) and should be planted at a depth of 1.25-2.5 cm (0.5-1.0 in) at a density of 8-14 lbs of seeds per acre. The seed can be spread by broadcasting in the home garden or, in the case of commercial production, using a seed drill. Mustard generally matures in 80-85 days.

**General care and maintenance:** Weeds can cause huge losses in mustard cultivation as they quickly out compete seedlings and are difficult to eradicate once established. The best method of preventing weed growth in a mustard field is to plant seeds at the appropriate depth. Shallow planted seeds germinate rapidly, allowing the development of a uniform plant stand. Established plants are less susceptible to competition from weeds. soil should be tested to determine nutrient requirements prior to planting. Mustard will benefit from the addition of supplemental nitrogen and this is generally applied at a rate of 100–120 lb per acre.

**Harvesting:** Mustard is generally ready to harvest 80 to 85 days after planting. The crop should be harvested promptly to reduce losses to shattering. In commercially grown fields the recommended method of harvest is swathing. The plants should be cut just below the height of the lowest seed pods. In the home garden, mustard can be harvested by hand by cutting the plants. The seeds can then be recovered from the pods and dried for storage.

**Uses:** The leaves and shoots of the mustard plant are consumed as a vegetable in some countries. Mustard seed is incorporated into seasonings and dressings. Mustard may be grown as a cover crop in rotation with other vegetables.