**Chick pea (origin, morphology and uses; importance to man and ecosystem)**

**Scientific name:** Cicer arietinum L.

Family: Fabaceae

Origin: An area of present-day south-eastern Turkey and adjoining Syria.

**Chickpea**, (Cicer arietinum), also called **garbanzo bean**or **Bengal gram**, [annual](https://www.britannica.com/science/annual) [plant](https://www.britannica.com/plant/plant) of the pea family ([Fabaceae](https://www.britannica.com/plant/Fabaceae)), widely grown for its nutritious seeds. Chickpeas are an important [food](https://www.britannica.com/topic/food) plant in [India](https://www.britannica.com/place/India), Africa, and Central and South America. The seeds are high in [fibre](https://www.britannica.com/science/dietary-fiber) and [protein](https://www.britannica.com/science/protein) and are a good source of [iron](https://www.britannica.com/science/iron-chemical-element), [phosphorus](https://www.britannica.com/science/phosphorus-chemical-element), and [folic acid](https://www.britannica.com/science/folic-acid). The chickpea most probably originated in an area of present-day south-eastern Turkey and adjoining Syria. Three wild annual species of *Cicer,* closely related to the chickpea, are found there: *C. bijugum* K.H. Rech., *C. echinospermum* P.H. Davis and *C. reticulatum* Lad. The latter, first described by Ladizinsky (1975), could also be classified as a wild variety or subspecies of *C. arietinum*. The former two were described recently (Rechinger 1952, Davis 1970). *Cicer reticulatum* can be considered as a progenitor, or perhaps had a common ancestor with chickpea.

**MORPHOLOGY**

*Cicer arietinum* is a short annual herb, attaining a height of less than a metre. Depending on the angle of the branches and the soil surface, the plant assumes erect, semi-erect, spreading, semi-spreading and prostrate’ growth habit. Branching starts from the base at ground level giving plant a bushy appearance. The plant surface including roots, stem, leaves and pods are pubescent, covered with glandular and non-glandular hairs. The glandular hairs secrete a mixture of acids containing malic, oxalic and citric acids. This acid mixture acts as a defence mechanism against sucking pests. The exudation from the roots helps in solubilizing the soil nutrients.

Stem: The stem is firm due to hypodermal collenchyma, angular with ribs, straight or flexuous and pubescent. The plant produces three types of branches—primary, secondary and tertiary. The lowest nodes of the plant produce 1–8 primary branches. Alternately, the primary branches may arise from seed shoot as well. The primary branches are thick, woody with thick cuticle, and often mistaken for the main stem. The secondary branches arise from the buds on the primary branches and are comparatively thin. These branches bear the leaves and flowers. Depending on the genotype and growing conditions, tertiary branches may or may not be present. The plant grows to a height of up to 100 cm generally and occasionally reaching 150 cm depending on the growing conditions.

Leaf: The compound leaves contain 5–7 pairs of hairy leaflets per leaf, opposite or alternate, and the rachis ends in a leaflet. The leaflets are oval or elliptic in shape with serrated margins. Simple leaf types also exist.

Root: The root system is characterized by a thick tap root with several side roots developing into a robust system. The epidermis is hairy, exodermis is absent, and endodermis is thin. The presence of nodules on roots indicates symbiotic relationship between chickpea and the *Rhizobium* bacteria (*Mesorhizobium ciceri*) leading to biological nitrogen fixation. The tap root system is so robust that it reaches more than 3 m in soil favouring the plant to survive in moisture stress conditions .

Inflorescence: The inflorescence is an axillary raceme with generally a single papilionaceous flower though two to three flowers were also reported to occur rarely at the same node. The peduncle is 6–30 mm long, while the pedicel is 6–13 mm long. Both the peduncle and pedicel look like a single part because they are straight in line up to fertilization, and then the pedicel bends down.

Flower: The flower can be described as regular, bisexual, with five fused hairy sepals in a single whorl which form a calyx tube, five petals (pink, white, purple or blue in colour) in a typical papilionaceous arrangement with a big standard, two wings and two keel petals which form a boat shape, ten stamens in a diadelphous arrangement (9 stamens fused and a free 10th stamen) with orange-coloured pollen grains, linear style with globose stigma, sessile pubescent ovary containing 1–4 ovules.

Flowering: Commencement of flowering in chickpea is dependent on the duration of the genotype and the environment including soil and weather. Generally, flowering starts in the range of 24 days to 80 days after sowing and continues till the depletion of moisture owing to the indeterminate growth of chickpea. When moisture levels go down significantly, plants which bear pods and leaves start to senesce reaching maturity. Chickpea is a highly self-pollinated crop. The anthers dehisce one day before the flower opens ensuring self-pollination.

Pod: Pods start appearing about six days after fertilization and may take up to four weeks for completing seed development. Initially, the pod wall starts to grow followed by the seed. The number of pods per plant depends on the genotype and the environmental conditions, especially availability of moisture. The pod size is generally in the range of 15–20 mm and may go up to 30 mm depending on the genotype, especially in kabuli types. Each pod contains generally one to two seeds and rarely three. Towards the end of the seed development, leaves start to turn yellow first and then the whole plant dries up indicating maturity.

Seed: The shape of the seed generally resembles a ram’s (Aries) head, hence the name ‘arietinum’, while other shapes do exist such as globular or quasi-spheric with a characteristic beak. The surface of the seed coat may be smooth or tuberculate. Endosperm is absent. Seed size and colour is a varietal character andhighly influenced by environmental conditions, especially moisture availability and heat. There are two types of cultivated chickpea based on seed size and colour—desi and kabuli. Desi type: The seeds are generally small (around 0.2 g per seed); seed coat is thick with varying colours such as cream, yellow, brown, black and green. The stem and leaves may contain anthocyanin pigmentation. Kabuli type: The seeds are generally large (around 0.3–0.5 g per seed) to extra large (more than 0.5 g per seed); seed coat is thin and mainly cream or beige coloured, sometimes white. The plants will not have anthocyanin pigmentation. Seed colour in desi types assumes different shades of brown, black and green depending on the genotype, while the kabuli types have mainly beige-coloured seed. Cotyledons are mainly in three colours: cream, green or orange (Cubero 1987). Seed size exhibits huge variation starting from 0.08 g to nearly 0.8 g per seed. Generally, the kabuli types have larger seed size compared to the desi types.



## Uses of Chick pea

1. Chickpeas are used for human consumption and for animal feed.
2. Chickpeas are rich in protein and energy, which makes them great for animal feed. Raw chickpeas have been shown to be a healthier alternative than similar legumes, such as peas. Research has shown that chickpeas have no adverse effects on livestock, allowing animals to grow and produce milk equally as well as soy or cereal.
3. For human consumption, chickpeas are nutrient dense, providing more than 20% daily value of protein, dietary fiber, folate, and minerals like iron and phosphorous. They also provide a moderate amount of zinc, thiamin, vitamin B6, and magnesium. Cooked chickpeas are high in amino acids.
4. When cooking chickpeas for human consumption, preparation typically involves 10 minutes of boiling followed by a long period of simmering. Dried chickpeas must be cooked for 1 to 2 hours, but this can be cut to half an hour with 12-24 hours of soaking.
5. [Hummus](https://www.britannica.com/topic/hummus) (or hummous)—chickpeas mashed to a paste with lemon juice, [olive oil](https://www.britannica.com/topic/olive-oil), and [tahini](https://www.britannica.com/topic/tahini) (sesame paste)—is widely eaten in the [Middle East](https://www.britannica.com/place/Middle-East) as a sauce and dip for bread. Mashed cooked chickpeas are formed into small flat cakes or balls and fried for [falafel](https://www.britannica.com/topic/falafel), a popular Middle Eastern dish. In southern Europe and [Latin America](https://www.britannica.com/place/Latin-America), chickpeas are a common ingredient in soups, salads, and stews. A kind of meal or flour is also made from chickpeas and can be used to make a flatbread known as socca or mixed with wheat or other flours for baking.

PIGEON PEA

Scientific name: ***Cajanus cajan* L.**

**Family: Fabaceae**

**Origin: T**he origin of pigeon pea (Cajanus cajan) is **either North-Eastern Africa or India** (Ecocrop, 2016; van der Maesen, 1989)

The **pigeon pea** (***Cajanus cajan***) is a perennial [legume](https://en.wikipedia.org/wiki/Legume) from the [family](https://en.wikipedia.org/wiki/Family_(biology)) [Fabaceae](https://en.wikipedia.org/wiki/Fabaceae). Since its [domestication](https://en.wikipedia.org/wiki/Domestication) in the [Indian subcontinent](https://en.wikipedia.org/wiki/Indian_subcontinent) at least 3,500 years ago, its seeds have become a common [food](https://en.wikipedia.org/wiki/Food) in Asia, Africa, and Latin America. It is consumed on a large scale in [South Asia](https://en.wikipedia.org/wiki/South_Asia) and is a major source of [protein](https://en.wikipedia.org/wiki/Protein) for the population of the Indian subcontinent. It is the primary accompaniment to rice or [roti](https://en.wikipedia.org/wiki/Roti) (flat bread) and has the status of [staple food](https://en.wikipedia.org/wiki/Staple_food) throughout the length and breadth of India.

The cultivation of the pigeon pea dates back to at least 3,500 years ago. The centre of origin is probably peninsular India, where the closest wild relatives (*Cajanus cajanifolia*) occur in tropical deciduous woodlands. Archaeological finds of pigeon pea dating to about 3,400 years ago (14th century BC) have been found at [Neolithic](https://en.wikipedia.org/wiki/Neolithic) sites in [Kalaburagi, Karnataka](https://en.wikipedia.org/wiki/Gulbarga_district) ([Sanganakallu](https://en.wikipedia.org/wiki/Sanganakallu)) and its border areas ([Tuljapur Garhi](https://en.wikipedia.org/wiki/Tuljapur) in [Maharashtra](https://en.wikipedia.org/wiki/Maharashtra) and [Gopalpur](https://en.wikipedia.org/wiki/Gopalpur,_Odisha) in [Orissa](https://en.wikipedia.org/wiki/Orissa,_India)) and also the south Indian states such as Kerala, where it is called Tomara Payaru. From India it traveled to East Africa and West Africa. There, it was first encountered by Europeans, so it obtained the name Congo Pea. By means of the slave trade, it came to the American continent, probably in the 17th century.

**MORPHOLOGY**

Pigeon pea is an erect, short-lived perennial leguminous shrub that usually grows to a height of about 1-2 m, but can reach up to 2-5 m high. It quickly develops a deep (2 m depth) poisonous taproot. The stems are woody at the base, angularand branching. The leaves are alternate and trifoliate. The leaflets are oblong and lanceolate, 5-10 cm long x 2-4 cm wide. Leaves and stems are pubescent. The flowers (5 to 10) are grouped in racemes at the apices or axils of the branches. The flowers are papilionaceous and generally yellow in colour. They can also be striated with purple streaks. The corolla is about 2-2.5 cm. The fruit is a flat, straight and pubescent pod, 5- 9 cm long x 12-13 mm wide. It contains 2-9 seeds that are brown, red or black in colour, small and sometimes hard-coated.

**USES**

Pigeon peas are both a food crop (dried peas, flour, or green vegetable peas) and a forage/cover crop. In combination with [cereals](https://en.wikipedia.org/wiki/Cereals), pigeon peas make a well-balanced meal and hence are favoured by nutritionists as an essential ingredient for balanced diets. The dried peas may be sprouted briefly, then cooked, for a flavor different from the green or dried peas. Sprouting also enhances the digestibility of dried pigeon peas via the reduction of indigestible sugars that would otherwise remain in the cooked dried peas.

In India, it is one of the most popular [pulses](https://en.wikipedia.org/wiki/Pulse_(legume)), being an important source of protein in a mostly vegetarian diet. In regions where it grows, fresh young pods are eaten as a vegetable in dishes such as [*sambar*](https://en.wikipedia.org/wiki/Sambar_(dish)). Whole pigeon peas are called *arhar dal* in [Hindi](https://en.wikipedia.org/wiki/Hindi). In [Ethiopia](https://en.wikipedia.org/wiki/Ethiopia), not only the pods, but also the young shoots and leaves, are cooked and eaten.

In some places, such as the Caribbean coast of [Colombia](https://en.wikipedia.org/wiki/Colombia), [Dominican Republic](https://en.wikipedia.org/wiki/Dominican_Republic), [Panama](https://en.wikipedia.org/wiki/Panama) and Hawaii, pigeon peas are grown for canning and consumption. A dish made of rice and green pigeon peas called [moro de guandules](https://en.wikipedia.org/wiki/Moro_de_guandules) is a traditional food in the Dominican Republic. Pigeon peas are also made as a stew, with [plantain](https://en.wikipedia.org/wiki/Plantain_(cooking)) balls. In [Puerto Rico](https://en.wikipedia.org/wiki/Puerto_Rico), [*arroz con gandules*](https://en.wikipedia.org/wiki/Arroz_con_gandules) is made with [rice](https://en.wikipedia.org/wiki/Rice) and pigeon peas and is a traditional dish, especially during Christmas season. [Jamaica](https://en.wikipedia.org/wiki/Jamaica) also uses pigeon peas instead of kidney beans in their [rice and peas](https://en.wikipedia.org/wiki/Rice_and_peas) dish, especially at Christmastime. [Trinidad and Tobago](https://en.wikipedia.org/wiki/Trinidad_and_Tobago) and [Grenada](https://en.wikipedia.org/wiki/Grenada) have their own variant, called [*pelau*](https://en.wikipedia.org/wiki/Pelau), which includes either beef or chicken, and occasionally pumpkin and pieces of cured pig tail. In the [Atlántico department](https://en.wikipedia.org/wiki/Atl%C3%A1ntico_Department) of Colombia, the [sopa de guandú con carne salada](https://en.wikipedia.org/wiki/Sopa_de_guand%C3%BA_con_carne_salada) (or simply "gandules") is made with pigeon peas.

Unlike in some other parts of the Greater Caribbean, in [The Bahamas](https://en.wikipedia.org/wiki/The_Bahamas) the light brown colored dried seeds of the pigeon pea plant are used (instead of the fresh green pigeon peas used elsewhere) to make the heartier, heavier, signature Bahamian staple dish "Peas 'n Rice." A slab of partially cubed or diced pork "fatback" lard with skin on (bacon is a common substitute), diced onions and sweet pepper, and a mixture of spices are all sauteed in the bottom of a deep pot. Tomatoes and tomato paste are added. Then water is added along with the peas and rice, and slow boiled until tender. The dish becomes a medium-dark brown color, resulting from absorbing the colors of the browned initial ingredients and the cooked tomato paste. The pigeon peas themselves absorb the same, becoming a much darker brown, providing some contrast while still complementing the distinctive "browned" theme of the dish.[[22]](https://en.wikipedia.org/wiki/Pigeon_pea#cite_note-22)

In [Thailand](https://en.wikipedia.org/wiki/Thailand), pigeon peas are grown as a host for [scale insects](https://en.wikipedia.org/wiki/Scale_insect) which produce [lac](https://en.wikipedia.org/wiki/Lac), the key ingredient in [shellac](https://en.wikipedia.org/wiki/Shellac).

Pigeon peas are in some areas an important crop for [green manure](https://en.wikipedia.org/wiki/Green_manure), providing up to 90 kg nitrogen per hectare. The woody stems of pigeon peas can also be used as firewood, fencing and thatch.

It is an important ingredient of animal feed used in West Africa, especially in Nigeria, where it is also grown. Leaves, pods, seeds and the residues of seed processing are used to feed all kinds of livestock.

In [Western Visayas](https://en.wikipedia.org/wiki/Western_Visayas) region of the [Philippines](https://en.wikipedia.org/wiki/Philippines), pigeon peas or locally known as "kadyos", is the main ingredient of a very popular dish called "KBL" - an acronym for "Kadyos" or pigeon pea, "Baboy" (pork), "Langka" or [jackfruit](https://en.wikipedia.org/wiki/Jackfruit). It is a savory soup with rich flavors coming from the pigeon peas, smoked pork preferably the legs or tail, and souring agent called "batuan" or [garcinia binucao](https://en.wikipedia.org/wiki/Garcinia_binucao). Raw jackfruit meat is chopped and boiled to soft consistency, and serves as an extender. The violet color of the soup comes from the pigment of the variety commonly grown in the region.

**PROCESSING OF PULSES**

### Milling process

Essentially milling process involves cleaning, grading, pitting, treatment milling and polishing operations. Usually milling processes are described for the toughest to mill pulse grains i.e., pigeon pea. The major steps involve in pulse milling are discussed below:

#### Cleaning and grading

It involves removing dust, dirt, foreign material, off sized, immature and damaged grains and grading in two or more fractions to process separately.

#### Pitting

Use of emery-coated roller is a common practice in commercial dal mills. The emery coating is used for abrasive or refractory action. Whole pulses are passed through abrasive roller machine for scratching of seed to facilitate the entry of oil/water in the grain during pre-milling treatment.

#### Pre-milling treatments

The treatment is given for loosening of husk from cotyledons, which is attached through a gum layer is called pre-milling treatment. Mostly premilling treatments are developed for pigeonpea. Water soaking, oil and water application, mixing of sodium bi-carbonate solution and thermal applications are commonly recommended and adopted pre-milling treatments. For commercial milling in large capacity dal mills, oil and water treatment is commonly adopted, whereas for household milling, water treatment is popularly used.

Different methods are employed in different regions depending upon type of grain. This also varies from mill to mill. Pre-treatments can be broadly classified into i) wet treatment and ii) dry treatment.

**Wet treatment**

In this method of treatment, soaking and drying are considered as effective technique to loosen the husk. This method has the advantage of facilitating dehusking and splitting the cotyledons, giving less breakage. This can be attributed to lower deshusking percentage of grains in water treatment process. However, it has the disadvantage of being weather dependent and labour intensive. Dal produced by this method cooks better but takes longer time to cook. Commonly adopted red earth treatment is considered as wet method. In this method, grains are thoroughly mixed with a paste of red earth after soaking in water for about 12 hours and heaping for about 16 hours. The grains are spread in thin layer in drying yards for 2–4 days. When dried, the red earth is removed by sieving and the grains are then milled on power operated stone or emery coated vertical chakki to yield dal.

**Dry treatment**

Dry milling treatment is reported to produce dal that cooks faster, however, losses due to broken and powdering are high. In dry method, oil/water application followed by drying are important steps in processing of pulses.

n this process, after cleaning and grading, grains are pitted and then mixed with about 1% oil (linseed), thoroughly and spread for sun drying in thin layer, for 2–3 days. At the end of drying, 2-5% of water is sprayed, mixed thoroughly and tempered for overnight. Tempered grains are dehusked in roller machines to give dehusked grains and dal.

#### Tempering

Once the pre-milling treatment is given, conditioning is done to have uniformity of treatment throughout the grain mass. This process gives time for better penetration of oil/water beneath the seed coat to dissolve gums.

#### Drying

In most of the mills in India, sun drying method is commonly practiced. Grains are spread in thin layer on pucca floor under the sun and stirred frequently with rake/feet for even drying. This operation makes process of dal milling a very lengthy requiring (2-3 days). In this case, sun-dried grains require more passes and consumes more energy. The drying time with the use of dryers ranges between 2-3 hrs, which results in tremendous time saving. Dryers are used in few mills that too in rainy seasons for drying of treated grains.

#### Dehusking and splitting

Dal mills by and large use emery rollers for dehusking and splitting. In case of pigeonpea, more than 3 passes are required for complete milling. Other pulses take one or two passes in emery mill in order to achieve maximum milling. The physical, chemical and structural strength of grain coupled with the functional and mechanical characteristics of processing units jointly play an important role. Grain properties such as hardness, load deformation behaviour, shape, size density and variety of grain etc. have considerable effect on dal yield. The machine parameters such as roller speed, clearance, emery size etc. have vital role to play on dal recovery. As a result of milling, unhusked and dehusked whole grains, split cotyledons, broken, husk and powder are obtained. Whole grains are passed again for further dehusking and/or splitting after water treatment. Husk and powder produced during milling is generally separated with the help of aspirator and are used as cattle feed.

#### Polishing

Polishing is done to increase consumers appeal and is a form of value addition, though not desirable. Dal is polished in different ways, such as nylon polish, oil/water polish, leather and makhmal polish. Generally polishing is done using soap stone, oil or water. Polishing gives uniform look and shine to each grain.

#### Pigeonpea

This is the most difficult kind of pulse to mill because of tight attachment of husk to the seed coat. The clean and graded grains are pitted (scratched over the seed surface), oil smeared (0.2-0.5%), tempered for half to one day in bins, treated with water (in the ratio 1:20-25), stored overnight and sundried for 2-3 days before passing through the emery roll. Such type of husk loosening and dehusking operations are repeated 2-4 times till more than 90% grains are dehusked. Dal obtained during this method is termed as Grade-II dal as edges of most of the dal gets rounded off during milling. The mixture of dehusked and unhusked whole grain is further sprinkled with water and tempered for few hours, sundried and splitted in horizontal or vertical chakkies or by using patka machine. The dal thus obtained is considered as Grade-I dal since it has no chipped edges dal and has better customer acceptability. The recovery of pigeonpea varies from 68-75%, depending upon variety milled and method followed.

#### Chickpea

It falls in easy-to-mill category of pulse. Dehusking after cleaning and grading can be done in roller mills. Splitting of ‘gota' (dehusked whole grain) is carried out by treating the grain with water in ratio 1: 2.5 to 3.0, followed by tempering for 12 hours and splitting in disk sheller. This does not require oil application for loosening of husk. The process is repeated till all the grains are dehusked. Recovery from dal varies from 78–82%. Chana dal and broken can further be processed to produce besan. At household level, the burr mill is used to obtain besan. Hammer mills, which beat the dal to the particle size till it passes through the sieve of desired particle size, are employed at cottage and large scale for besan making. The recovery from these besan plants is 98% and only 2% of dal is lost due to burning and are lost in form of unrecoverable dust.