

# ***Capparis spinosa* var. *inermis* Turra: Presentation, Uses and Socio-economic Benefits**

**Refka Zouaoui <sup>a\*</sup>, Hanine Ben Aoun <sup>a</sup>, Mejda Abassi <sup>a</sup> and Youssef Ammari <sup>a</sup>**

<sup>a</sup> *Laboratoire d'Ecologie Forestière, Institut National de Recherches en Génie Rural, Université de Carthage, Eaux et Forêts, LR161INRGREF03, Rue Hédi Karray, BP. 10, Ariana, 2080, Tunisie.*

## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

The caper (*Capparis spinosa* var. *inermis* Turra) is a bushy sub-shrub, 30 to 50 cm high. It is a small "sarmentose" shrub with unarmed twigs belonging to the Capparaceae family. It is a species of Saharo-Arabian and Mediterranean origins, which is characterized by food, ecological, socio-economic and ornamental importance. It is also known for its medicinal and therapeutic virtues, which are very interesting given the pharmacological activities of the phytochemicals present in the different parts of the caper tree (roots, leaves, buds, fruits, bark and seeds). Its mode of propagation is by seed or by semi-woody, woody, semi-herbaceous and herbaceous cuttings.

**Keywords:** *Capparis spinosa*; use; ecology; multiplication techniques; importance.

## **1. INTRODUCTION**

Tunisia by its particular geographical situation, contains a very varied range of climates supporting the development of the flora which contains more than 2160 vegetable species of

which, one has more than 350, known by medicinal plants [1].

This important biodiversity and richness of the flora is due to its location between the humid northern and dry southern regions [2].

\*Corresponding author: E-mail: refkazouaoui19@gmail.com;

This immense heritage, whose seeds, fruits, leaves and even roots are used by man or his livestock. Among which, the forest and semi-forest species with socio-economic value capable of growing in the wild or cultivated state.

The aim is to promote the cultivation of multipurpose, fast-growing trees or shrubs and to develop management methods that can be easily adopted by the rural population and that ensure the sustainability of systems and biodiversity.

For this reason, great attention has been paid to the study of the Caper because of its use in various fields especially in food and medicine [3]. The Caper is a plant of the family Capparidaceae, developed in the countries of the Mediterranean basin [4]. It gathers to a shrub of length varies between 0.3 m and one metre [5] which meets in rocky and mountainous ground [6]. It is a perennial species, resistant to drought and well adapted to the Mediterranean ecosystem. Its cultivation is interesting having an economic importance [7] thanks to capers, the flagship product of this species.

The Mediterranean basin is among the regions of the world that have seen a serious development of the Caper [8,9]. According to Barbera et Di Lorenzo, [10], in 1960, Italy is the main place of production with 95% of the world production specifically in Sicily and the small islands (Salina and Pantelleria). While Spain was the main caper producing country until the end of the 70's, the caper growing areas are the coastal regions of the south-eastern provinces (Almeria, Murcia, Granada) and in the Balearic Islands [11]. We also find that Morocco is the main producer of capers in the Mediterranean basin [8]. Let us also point out that the Algerian Caper occupies spaces with marginal particularity or steep grounds such as the most productive are Annaba, Constantine, Biskra, Tebessa [12,13]. In Tunisia, the caper is abundant in the hilly areas north and northwest of Tunis, they produced around 300 tons of capers in the 90s [14]. It is within this framework that the study on the caper (*Capparis spinosa* var. *inermis*) is included. The present study proposes to list, through a bibliographic synthesis on the ethnobotanical characterization, the ecology and the utility of this plant in order to provide a reference document for the researchers who are involved in the research on this species.

## 2. TAXONOMY AND BOTANICAL DESCRIPTION OF *Capparis spinosa* var. *inermis* Turra

**Table 1. Taxonomy of *Capparis spinosa* var. *inermis* Turra**

Reign	Plantae
Sub-kingdom	Viridae
Class	Equisetopsida (Agardh, 1825)
Clade	Spermatophyta
Subclass	Magnoliidae (Novák ex Takht., 1967)
Order	Brassicales (Bromhead, 1838)
Family	Capparaceae (Juss., 1789)
Genre	<i>Capparis</i> L. (1753)
Species	<i>Capparis spinosa</i> subsp. <i>inermis</i> (Zohary, 1960) (Synonymes: <i>Capparis inermis</i> Turra, 1780 ; <i>Capparis orientalis</i> Veill., 1801)
French name	Câprier inerme des roches
Arabic name	Cabbar « كيار »
English name	Caper

### 2.1 Morphological and Botanical Characterization of the Adult Plant

The species is a bushy sub-shrub, 30 to 50 cm high. It is a small shrub "sarmentous" with inerminous branches of 1-2 m long [15]. *Capparis spinosa* var. *inermis*, it is distinct from the var. *spinosa* by the shape of the branches and leaves.

#### 2.1.1 Aerial part of the plant

The caper plant is characterized by woody stems at the base and very branched with the appearance of a developed tuft, bearing stems at the neck (Fig. 1). These stems are woody and short, from which herbaceous branches emerge every year and gradually become woody [15]. The leaves of this species are distinctly oval, with a rounded tip and a distinctly cordate base, sometimes succulent, due to the absence of spines. They are often deciduous at the juvenile stage [16]. They are alternate, whole, simple, rounded to oval. They are light green in color, well developed and clearly petiolated with a network of veins protruding from the paler lower side [17]. These leaves are characterized by relatively thick cuticles capable of restricting the

transpiration of the plant in dry and difficult conditions. The leaves of the caper have at the base two stipules transformed into fine bristles which become deciduous giving the appearance of plants without spines in the botanical variety *C. spinosa* var. *rupestris* or *inermis* [18] (Fig. 1).

Capers are closed flower buds harvested before flowering (Fig. 2). They have a very high moisture content (83%) and must have certain dimensions to be marketed [19]. Capers are harvested at specific dates and prepared in

different ways (vinegar, salt) depending on the country [20].

Concerning the flowers, they are of purplish blue color and are clearly bilabiated. The posterior lip being very developed that the inferior lip [18]. Caper flowers are exceptionally beautiful but ephemeral (Fig. 2). They bloom at the end of the afternoon and wither during the following morning. The caper is an allogamous plant with entomophilic pollination provided mainly by moths [21].



**Fig. 1. (a) Adult caper shrub in vegetative rest ; (b) new leaves ; (c) branched stems and (d) adult caper shrub in vegetative stage (Photos by Refka Zouaoui, 2020)**



**Fig. 2. (a) Flower buds or caper; (b) Caper flower; (c) Mature caper shrub rich in caper fruit; (d) mature caprons; (e) Caprons in dehiscence and (f) Caper seeds of *Capparis spinosa* var. *inermis* Turra**

(Photos by Refka Zouaoui, 2020)



**Fig. 3. Adaptation of *Capparis spinosa* var. *inermis* Turra to rocky and infertile soil types**  
(Photos by Refka Zouaoui, 2021)

They are solitary in the axils of the leaves [22]. The fruit of inermis caper (capron) is an oblong, ovoid, ellipsoid or globular berry, green in color with well-defined longitudinal nerves, along which a dehiscence occurs later. A fruit, which is dark purplish in color and soft under the fingers, usually contains ripe seeds [23,24] (Fig. 2).

Phytochemical detections of capers showed the presence of flavonoids and tannins. Total phenols were estimated to be in the order of 51.1 mg GAE/g extractive [20].

Several active compounds in caprons such as total phenols (17.56 mgGAE/ g extract), flavonoids, glucosinolates, alkaloids, tannins... have been identified [25,26,20]. The caper seeds are multiple. They are generally of brown color at maturity (Fig. 2), immersed in a reddish or yellow pulp.

The shape, color and size of the seed have limited taxonomic value [22]. Caper seeds are exalbuminous and have 27.3 to 37.6% volatile oils. The embryo is curved, voluminous and occupies a large proportion of the seeds [21].

### 2.1.2 Root system

The underground part of the caper is characterized by a very deep taproot system [17]. This characteristic confers to it a strong tolerance to the drought from where its

adaptation to the dry regions. It has the particularity to develop on the poorest soils, the driest and on grounds with strong slopes [15].

## 2.2 Life Cycle of the Species (Phenology)

The vegetative budding of the caper takes place in the spring at the first sun rays. In arid areas, the leaves are evergreen. The leaves are deciduous at the end of the summer [27]. The flowers of the caper bloom from June to September [28]. The collection of fruits takes place from July to September and from May in the warmest regions [29]. The harvest of mature caper seeds is done at the end of the summer on ripe fruits [24,23].

## 3. CAPER PROPAGATION TECHNIQUES

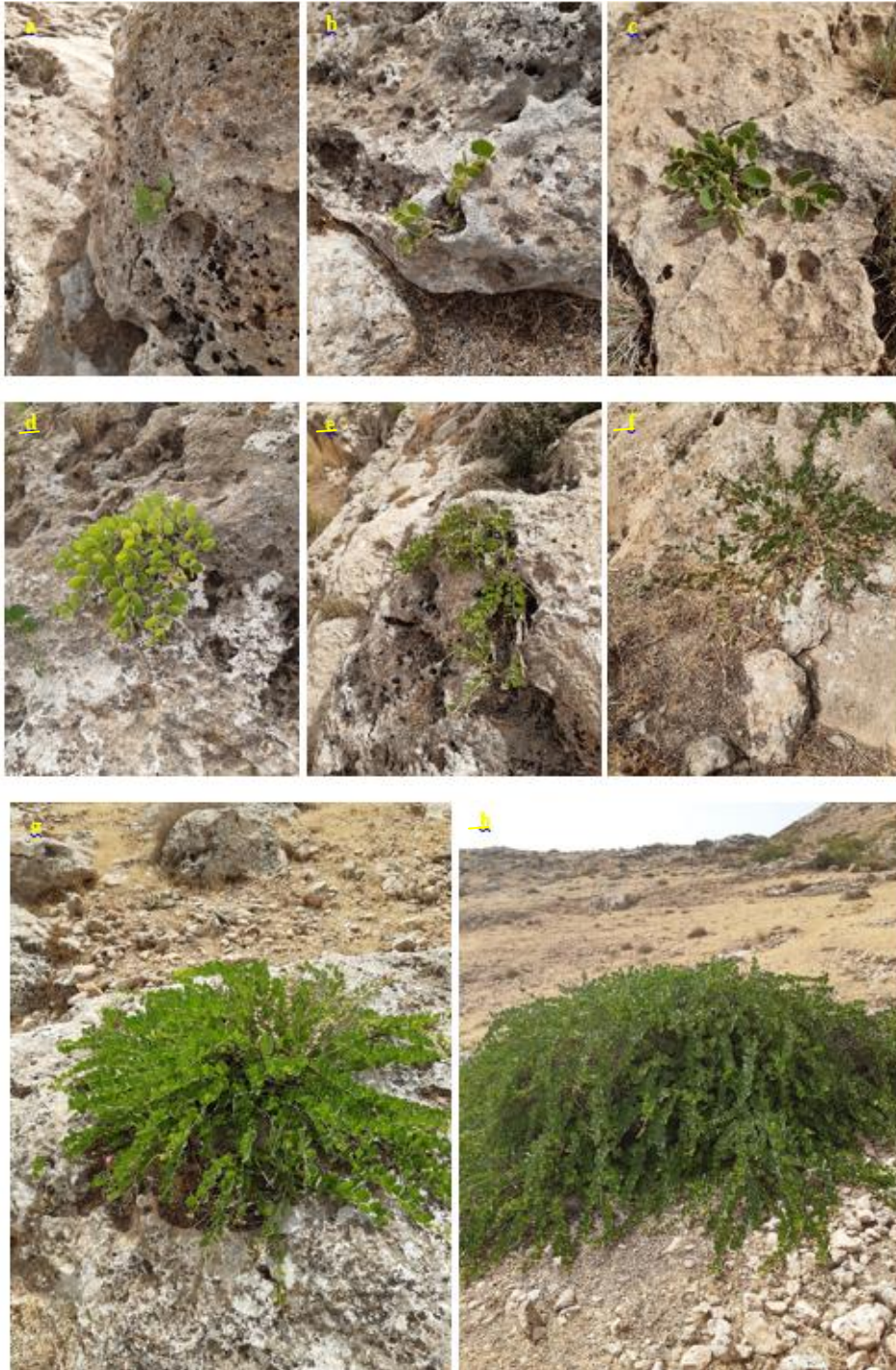
The multiplication of the caper can be done by several methods :

### 3.1 Sexual Multiplication by Sowing Seeds

Seeds from crushed ripe fruit (late summer) are rinsed with tap water, dried in the shade and stored at room temperature in polyethylene bags until use [24,23]. For germination, caper seeds can be used immediately after harvest. On the other hand, with maturity, their envelopes become hard and require pretreatments before

the setting in germination [18]. In the southern European countries where the caper is cultivated, the sowing in nursery at the end of winter (February) and the transplanting of the plants obtained at the end of spring is a common technique for the propagation by seed of this

species. According to Barbera and Di Lorenzo [10], 5% of the seeds sown in February can germinate in May. The plants obtained are transplanted in summer when they reach the 3-4 leaf stage and measure between 10-20 cm.



**Fig. 4. Different sizes and forms of the smooth caper (*Capparis spinosa* var. *inermis* Turra) in a rocky environment: since little age (a, b and c); middle age (d, e and f) and old age (g and h) (Photos by Refka Zouaoui, 2021)**

### 3.2 Vegetative Propagation by Cuttings

Caper can be propagated by semi-woody, woody, semi-herbaceous and herbaceous cuttings.

Concerning the semi-linear cuttings, the cuttings are taken from the apical part of the branch bearing an apical bud in addition to the axillary buds. These cuttings are taken from adult shrubs or from the stump of two year old plants [30].

In the caper, this type of cutting is done from July to October with a percentage of rooting which varies between 50 and 70 % for the caper inerme [31]. Whereas woody cuttings are taken from the Augusted branches of mature shrubs. It is the most practiced method to obtain plants of several trees and shrubs. The taking of cuttings is done in periods of rest of the mother plant in October-November after the end of the harvest and the fall of the leaves. The caper cuttings, 20 to 30 centimeters long, are taken from the basal part. They are then put in stratification during all the winter period either in the sand or in a cold room at a temperature of 3 to 4°C [14]. These cuttings will form roots after 4 to 5 months and planting can take place in March-April. The rooting percentage of this type of cuttings varies between 50 to 70 % [31].

Herbaceous cuttings, on the other hand, involve cuttings taken from green twigs. The success rate of herbaceous cuttings varies from one nursery to another. It can reach 90% from the cuttings resulting from the vitro-plants in the caper inerme taken in May [32].

### 3.3 Caper Cultivation and Caper Production

Caper cultivation can be combined with other fruit crops such as olive, vine, almond and citrus [33,31].

#### 3.3.1 Planting substrates for cuttings

The choice of the substrate for the plantation of the cuttings is an important criterion for the success of the cutting. This is due to the physical properties of the growing medium which can affect by drainage and aeration [34]. The absorption of water by the cuttings is indirectly proportional to the water content of the medium which is determined by the properties of water retention and aeration of the medium [35]. Planting the cuttings in a substrate composed of

a mixture of sand and perlite promotes the greatest number of roots [36]. Perlite-based substrates have better aeration and higher water retention capacity [37]. Indeed, the use of this substrate allows plants to optimize water and oxygen. It can affect the growth and development of roots and shoots in a direct or indirect way [15].

#### 3.3.2 Transplanting cuttings

The plantation of the cuttings can be done from February but preferably in April. Considering the fragility of the root system of the caper, it is necessary to work well the ground before the plantation. The holes of plantation must be from 30 to 50 cm of depth [38]. According to Lakrimi [33], it is also recommended that the planting holes be placed 15 to 20 cm lower than the soil level to provide better protection for the young plants [15].

#### 3.3.3 Planting density

The planting density varies from 1600 to 2500 plants per hectare depending on the region and the vigour of the variety used [37]. According to Lakrimi [33], the density of plantation can vary from 1200 (3x2.5m) to a maximum of 2500 (2x2m) plants per hectare depending on different factors (the nature of the soil, the region and the vigour of the variety used).

#### 3.3.4 Caper production

The production of capers varies according to countries. In 2005, the main caper exporting countries were: Morocco, Spain and France [39]. Other recent studies have noted that Morocco is the first caper producing and exporting country in the world with an annual production of 20,000 tons and holds 3/2 of world exports. Turkey is found to join the other main producing countries.

On the other hand, the main importing countries of capers are the countries of the European Union (Italy, Spain), the countries of Latin America (Brazil, Venezuela,), as well as the Asian markets. Exports are made up of several types, namely the semi-preserved, packed in barrels and the type preserved in metal boxes or glass bottles [40]. In particular, the production of capers in Tunisia remains very limited compared to the production of the other Mediterranean countries. In 1997, the export of a quantity of 4717 kg of capers, brought 11.345 DT. In 2001, the national production was 151 tons of capers for a value of 398 000 USD. The production has

clearly regressed since it was 358 tons in 1982. A part of capers is exported by the industrialists in food canning [41]. In fact, it has fluctuated between 160T and 200T per year coming essentially from the wild groundwater [39].

According to the size of the flower buds harvested, six categories of capers are distinguished in the trade : not the same (diameter less than 7mm) ; surfines (7 to 8 mm diameter) ; nasturtiums (8 to 9 mm diameter) ; hoods (diameter from 9 to 11 mm) ; fine (diameter from 11 to 12 mm) and semi-fine (diameter over 12 mm) [41].

#### **4. GEOGRAPHICAL DISTRIBUTION AND ECOLOGICAL REQUIREMENTS OF *Capparis spinosa* var. *inermis***

##### **4.1 Geographical Distribution**

The species *Capparis spinosa* var. *inermis* is of Saharan-Arabic and Mediterranean origin. It is observed in small colonies in the central and northern Sahara [33,42]. In Tunisia, the smooth caper *C. spinosa* var. *inermis* Turra is present in the national park of Zembra [43]. In the north of Tunisia, the island of Tabarka, island of Pilau Rafraf, island of Zembra, DJ Ichkeul, Oued Sedjenane, Ras Zbiba, El Haouaria, Korbous, Sidi Bou Saïd, Ariana. In the center of Tunisia: Oued Marguellil, Kef, Kessra, Sbikha, Sidi Bouzid. In the south of Tunisia: Kébili, Matmata, Chenini of Tataouine [18,44,32]. The caper slicks have been severely degraded over the last 20 years. They are estimated at 226 ha distributed in different regions: Beja, Zaghouan, Kef and Kairouan [45].

##### **4.2 Ecological Requirement**

Caper is a xerophytic plant that tolerates drought and extreme climatic conditions in arid and semi-arid areas [46,47]. It tolerates extreme temperatures ranging from -4 to over 40°C [33]. In the Mediterranean region, rainfall favorable to the caper varies from 200 to 400 mm. In Spain (island of Majorca), in Morocco and in Turkey rainfalls less than 400 mm characterize the regions of caper production. In Italy (Sicily) the most productive caper plantations receive less than 450 mm. Moreover, this species tolerates perfectly the sea winds loaded with salts, which means that it must also show a certain tolerance to the salinity [33]. It normally grows on hills exposed to winds for several months of the year

[8]. Concerning the edaphic requirement of the species, it is a calcareous shrub which requires stony calcareous soils slightly clayey and well drained. It adapts perfectly to various types of calcareous soils, even the most rocky and the most ungrateful [48,47]. It develops on cliffs, gorges, slopes, rocky soils, wadi banks and high points of talwegs (Fig. 3). This species is also found on the old walls [33].

In a rocky environment, we can meet the different sizes and shapes of *Capparis inermis* which imply variable ages (small age, middle age and old age) with a good adaptation to the solid substrate (Fig. 4).

#### **5. MULTIPLE USES AND INTERESTS OF *Capparis spinosa* var. *inermis* TURRA**

The smooth caper has multiple interests. It is also used as food, fodder, melliferous and ornamental plant. It has important medicinal qualities used in traditional medicine [38,31].

The caper has an undeniable economic importance. It is a species of socio-economic interest. Indeed, the preliminary ecological assessment of the work carried out shows that the caper could also have an implication in the fields of the rural economy [18,41]. It should also be noted that the cultivation of this shrub dates back to antiquity; its flower buds, young shoots and tender young fruits are used in human food [38]. The caper is a condiment commonly used in the kitchen of most Mediterranean countries. In Tunisia, the caper is an essential condiment in recipes (soups, salads, brik, pizza ...). In Turkey, the local people of Mersin ('Yoruk') use capers for salad, pickle and jam [49]. Italy is famous for the use of capers on different dishes [31]. In addition, thanks to their habit (upright or climbing) and their inflorescences, this species is considered as ornamental [50]. The caper with its beautiful flowers and flower buds has been used to decorate postage stamps in Tunisia, Algeria and Morocco.

The caper plant has been used for centuries in traditional herbal medicine, as an antifungal [51], anti-inflammatory, [23], anti-hepatotoxic [52]. It also has significant antioxidant activity [53,54]. In therapeutic medicine, each organ of the caper bush has its role. The Greeks made herbal teas and ointments from the leaves of this species to treat rheumatism [55], toothache and joint disease [56]. The roots are used as kidney disinfectants. It is used to alleviate symptoms



and treat diseases such as toothache, fever, menstruation [57]. The caper is also used for the treatment against certain cancers [55]. As for fruits, they are used to stimulate the appetite [58], treat seizures [59], diabetes [60,3] and Malaria [61].

Capers are also known in traditional medicine for their diuretic, astringent, tonic effect and their antirheumatic properties [62]. A study in Croatia has shown that the caper plant has molecules with an important role in the prevention of colon cancer [63]. In Iran, people use the roots, fruits and bark of the plant for its diuretic, tonic properties, against malaria and joint diseases [64].

In India the buds and roots of *Capparis spinosa* L are used in the treatment of boils and to treat fever, rheumatism, paralysis, toothache, the bark is used in the treatment of cough, asthma and inflammation [65,2,66]. In Indonesia the root of this species is used as a diuretic and against bronchitis, and the wood is used to treat stomach-ache [59].

## 6. CONCLUSIONS

This paper is a review on the Presentation, Uses and Socio-economic Benefits of *Capparis spinosa* var. *inermis* Turra. In fact, Caper cultivation plays a major socio-economic role in several regions of Tunisia. It offers the advantage of being little demanding in water and investment and of being tolerant to the conditions of aridity. Moreover, the production has extraordinary export outlets. *Capparis spinosa* var. *inermis* Turra is an important source of different secondary metabolites of interest to humankind. The traditional therapeutic applications of this species have been reported in Ancient Romans. A many bioactive phytochemical constituents have been isolated and identified from different parts (aerial parts, roots and seeds) of this smooth caper which are responsible alone or in combination for its various pharmacological activities. This suggests that there are many opportunities for the food and healthcare industry to explore the health benefits of different part of *C. spinosa* var. *inermis* because there is a potential growth market for it.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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