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Capparis spinosa L; An important medicinal plant from Sistan and Baloochestan province, Iran

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Abstract
Capparis spinosa belonging to the family Capparidaceae is a xerophytic plant growing in a broad range of climatic conditions, varying from dry deserts to cooler altitudes of mountains. Dry heat and intense sunlight make the preferred environment for caper plants. The local name of the plant is "Krep" or "Karap" in Baloochestan. The caper is used essentially for flower buds, and other parts also are used in folk medicine due to their analgesic, wound healing, cell regeneration, tonic, and diuretic effects. In Baluchistan popular medicine, an herbal tea made of caper root and young shoots is considered to be beneficial against rheumatism, and powder of leaves are use for skin diseases. The constituents of C. spinosa include the Saccharides and Glycosides, Flavonoids, Alkaloids, Terpenoids and Volatile oils, Fatty acids and Steroids. The major compounds found in C. spinosa are Flavonoids, Indoles, and Phenolic acids.
Keywords: *Capparis spinosa*, Baloochestan, important medicinal

Introduction

Sistan and Baloochestan with the extent of 187502 Squarer kilometer has dedicated equally 11.5 percent of the country's area to itself. this province is located between 25 degree and 3 minute to 31 degree and 29 minutes of northern width and 58 degree and 49 minutes to 36 degree and 20 minutes of eastern length and is limited to Sothern Khorasan from the north, to Oman sea from the south, to Afghanistan and Pakistan from the east, and to Kerman and Hormozgan provinces from the west. Through the census of 1385, the population of this province was estimated as 2405742 people. Based on the latest division of the country Sistan and Baluchistan has 14 counties, 36 cities, 40 borough 102 vials, 8908 coded village.

Capparis spinosa belonging to the family Capparidaceae is a xerophytic plant growing in a broad range of climatic conditions, varying from dry deserts to cooler altitudes of mountains (Pugnaire, 1989). The plant

had been a part of the Mediterranean diet for over 5,000 years and several archaeologists has unearthed caper seeds, along with grape, pistachio, almond and olive seeds in Mediterranean basin, which belonged to the middle Bronze age. The famous traveller, Evliya Celebi mentioned caper plants 400 years ago in Osmancik town of Corum city in Anatolia region (Muharrem et al., 2009). Although, the flora of the Mediterranean region has considerable endemism, it is uncertain whether the caper bush is indigenous to these regions. However, it could have originated in the tropics and later naturalized to the Mediterranean basin (Pugnaire, 1989). Currently, capers naturally grown in Spain, France, Morocco, Monaco, Italy, Malta, former Yugoslavia, Greece, Tunisia, Algeria, Africa, Southeast Asia, Himalayas, Pacific islands and some parts of Australia (Bilgin, 2004). The main production areas are in harsh environments found in Morocco, the south eastern Iberian Peninsula, Turkey, and the Italian islands of pantelleria and Salina (Sozzi, 2001). Caper grows spontaneously on the steppes of northern Africa and Mediterranean countries, but recently caper is cultivated and exported (Moufid et al., 2015). Capers probably originated from dry regions in west or central Asia. This species has developed special mechanisms in order to survive in the Mediterranean conditions, and introduction in semi-arid lands may help to prevent the disruption of the equilibrium of those fragile ecosystems (Sozzi, 2001). Known and used for millennia, capers were mentioned by Dioscorides as being a marketable product of the ancient Greeks. Capers are also mentioned by the Roman scholar, Pliny the Elder. The relationship between capers and human beings can be traced back to the stone ages. Remains of C. spinosa were unearthed in archaeological sites as early as the lower Mesolithic (Hansen, 1991). The caper bush has been introduced as a specialized culture in some European countries in the last four decades. The economic importance of the caper plant led to a significant increase in both the area under cultivation and production levels during the late 1980s.

In these countries, locally capers are collected from wild plants within their natural range. C. spinosa has a great economic, cosmetic and medicinal importance. This plant has developed special mechanisms in order to survive in the semiarid lands conditions and consequently its introduction may help to prevent the disruption of the equilibrium of those fragile ecosystems and the soil degradation. The caper is used essentially for flower buds. Also, flower buds, root bark, and fruits are used in folk medicine due to their analgesic, wound healing, cell regeneration, tonic, and diuretic effects (Arslan et al., 2010). In Baluchistan popular medicine, an herbal tea made of caper root and young shoots is considered to be beneficial against rheumatism, and powder of leaves are use for skin diseases.

Systematic, Morphology and Anatomy

The genus Capparis includes about 250 species distributed in the tropical and subtropical regions of the Old and New World. The polymorphic C. spinosa L. complex shows a large palaeotropical and subtropical distribution. As regards the cultivated forms in Italy, these often show marked heterogeneity and more or less close affinities with the wild populations. This is particularly evident in the island of Pantelleria, where propagation by seeds is used. Furthermore less productive forms are increasingly neglected by the farmers. While the wild populations are usually preserved from the effects of anthropogenic disturbance, conservation programmes should be devised for these disappearing cultivated races (Fici and Gianguzzi, 1997). The two subspecies are allopatric the sites of these two subspecies are characterized by different ecological conditions (Saadaoui et al., 2011).

This plant also known as the caper bush, is a perennial winter deciduous species that bears rounded, fleshy leaves and large white to pinkish flowers (Ramezani and Aghel, 2008). Caper is belongs to Capparis genus, and Capparis spinosa L. and Capparis ovata Desf are the main cultivated species (Kan and Arslan, 2004). C. spinosa has three sub species; C. spinosa var. inermis Turra, C. spinosa var. spinosa Zoh, and C. spinosa var. aegytia Lam. On the other hand, C.ovata Desf. is also included three sub species such as C. ovata var. palestina Zoh., C. ovata var. canescens (Coss.) Heywood, and C. ovata var. herbacea Willd. Higton and Akeroyd divided C. spinosa into two subspecies: subsp. spinosa and subsp. rupestris (Sm) Nyman (Saadaoui et al. 2013). In general caper plant is a shrub with 30-50 cm height. However, C. spinosa can be reach up to 2.5 m and can be found between 200-300 a.s.l (Kan and Arslan, 2004). C. ovata is generally has horizontal growth habit with 20-30 cm height. This specie can be seen at the

altitude of between 300-1500 a.s.l (Davis, 1965). Inocencio et al (2005 and 2006), using molecular analysis, subdivided the genus Capparis into ten species in Central and Western Asia, North Africa and Europe. Five species have been recorded in the Mediterranean region (C. spinosa L., Capparis sicula Veill, Capparis aegyptia (Lam.) Boiss, Capparis orientalis Veill. and Capparis ovata Desf.).

The aerial parts of capers can be cover approximately 15 m2 soil area. The plant has very strong perennial root system. It can be reach up to 40 m under the soil (Olmez et al., 2004). For this reason, the plants are used in erosion control studies. The plant is also suitable for dry areas. Leaf stipules may be formed into spines. Flowers are born on first-year branches (Rivera et al., 2002; Yilmaz et al., 2002).

Capers flowers has mild aroma and it include 4 sepal and 4 petals which has white to pink color and numerous anthers and only one stamen. The anthers are in violet color. The flowers has nectarium. It can be pollinated by bees or vasps (ozzi, 2001; Rivera et al., 2002). Pedicel 2–6 (–9) cm. Calyx zygomorphic; sepals 1.5–2 × 0.6–1.1 cm, outside ± with trichomes, inside glabrous; sepals of outer whorl navicular lanceolate, outside with several glands, basally shallowly saccate; sepals of inner whorl 1–2 cm, not saccate or galeate, not broadest near base, 3–4.5 mm deep in distal half. Petals dimorphic, ± as long as or slightly longer than anterior sepals; anterior 2 petals white, distinct, claw 4–7 mm, blade oblongobovate, 1–2 cm, outside with trichomes, apex subemarginate; posterior 2 petals yellowish green to green, enclosed by sepals, thickened, margin connate from base almost to middle. Stamens ca. 80; filaments 2–4 cm, unequal; anthers 2–3 mm. Gynophore ca. 1 cm, sometimes basally sparsely villous; ovary ellipsoid, 3–4 mm, glabrous, apically with vertical thin furrow and ridge; placentae 6–8; ovules numerous; style and stigma obscure, moundlike. Stipular spines 4–5 mm, ± flat, apex recurved. Petiole 1–4 mm; leaf blade ovate, obovate, broadly elliptic, or suborbicular, 1.3–3 × 1.2–2 cm, 1–1.7 × as long as wide, fleshy when fresh but later leathery, midvein abaxially raised but gradually becoming obscure from base to apex, secondary veins 4(or 5) on each side of midvein, base rounded, apex acute, obtuse, or retuse but spine-tipped. Flowers solitary in upper axils; buds ± symmetrical.

The caper fruits named as caperberry and it is elipsoid or ovate shape. The maturated fruits suddenly opened and seeds go outside (Sozzi, 2001). The C. spinosa fruit is a berry with a long gynophores (35–70 mm), it's oblong to somewhat pyriform. Fruit dark green when dry, ellipsoid to oblongobovoid, 1.5–4 × 0.8–1.8 cm, with 6–8 lengthwise thin ridges, dehiscent; fruiting pedicel and gynophore 3–7 cm, 1.5–2 mm in diam., forming a right angle with each other.

Seeds (2-4 mm) are reniform (Tutin et al, 1993). Morphological parameters seeds show a difference between the two subspecies: C. spinosa subsp. spinosa and C. spinosa subsp. rupestris; the 1000 seed weight is 10,1 and 11,5 g for respectively for subsp. rupestris and subsp. spinosa (Tlili et al., 2001b). Seeds 40–60 per fruit, reddish brown, reniform to globose, 3–4 mm, smooth. Fl. Jun–Jul, fr. Aug–Sep. 2n= 24 (Shan Gan Shu. 2008).

Cultivated forms

Cultivation of capers occurs today under particular climatic conditions, with a prolonged xerothermic period and high exposure to wind. The production of flower buds, extending from April to September, reaches its maximum during the hottest mounths. The recent selection of vigorous and productive plants from wild populations gave origin to cultivated 'biotypes' (Barbera, 1991) that is often markedly heterogeneous. Subsp. rupestris is widespread in cultivation in Pantelleria, where propagation by seeds is carried out by farmers. Due to their neighbouring habitats and entomophilous pollination, gene flow between cultivated plants and wild populations is high. The cultivated forms from Salina are more homogeneous, since, propagation by cuttings is widespread. Also these are to be referred to subsp. rupestris, although showing diverging vegetative characters from wild populations, such as more or less marked presence of spiny stipules (Fici and Gianguzzi, 1997).

Climate

Capers can be grown on semi-arid conditions. Dry heat and intense sunlight make the preferred environment for caper plants. Plants are productive in zones having 200-600 mm annual precipitation and easily survive summer time temperatures higher than 35-40°C. However, caper is a cold tender plant and

has a temperature hardiness range similar to the some kind of subtropical fruits for example pomegranate, fig and particularly olive trees (-9 °C) (Kan and Arslan, 2004). However in Northeast Anatolia, caper plants can be seen in colder areas where olive trees cannot be found (Muharrem et al., 2009).

Soil

Plants grow well in nutrient poor sharply-drained gravelly soils. It usually thrives in rocky and anhydrous habitats fully exposed to the sunrays, and is able to withstand high temperatures above 40°C (Levizou et al., 2004). Mature plants develop large extensive root systems that penetrate deeply into the soil. Therefore it can be grown in very poor soils as well. Capers are salt-tolerant and flourish along shores within sea- spray zones. The caper's vegetative canopy covers soil surfaces which helps to conserve soil water reserves (Olmez et al., 2004).

Propagation

Capers can be propagated either from seed or cuttings. For seed propagation, caper seeds are minisculeand are slow to nurture into transplantable seedlings. Fresh caper seeds germinate readily-but only in low percentages. To obtain high germination percentage, stratification should be applied on caper seeds. In this way, seeds placed moist medium and waited 2-3 months in cold storage near 0oC (Tansu and Kocabaa, 1997; Sozzi, 2001; Yilmaz et al., 2002). The seed coats of capers very resist to obtain water inside (Cesari, 2003). The seed coats are also include lignins. The use of plant growth regulators, particularly gibberellins has been reported increased seed germination ratio in caper seeds from 22% to 64% (Macchia and Casano, 1993; Soyler and Khawar, 2007; Suleiman et al., 2009). The seeds can be dispersed by some animals (Tansu and Kocabaa, 1 997; Sozzi, 2001). Caper cuttings are hard-to-rooting (Soyler and Arslan, 2000; Kan et al., 2002). The best cutting collection time are February, March or April in Mediterranean areas. The stem cuttings can be prepared from basal portions, greater than 1cm diameter and 8 cm in length with 6-10 buds. The rooting media must be well drained with bottom heat. The use IBA can be helpful to increase rooting (Muharrem et al., 2009).

Planting, Irrigation, Pruning and Fertilization

For commercial production, the planting can be star t in January, February or March. The planting distances can be applied 2x2 or 3x3 in dry areas an d 4x4 or 5x5 in irrigated areas. Depending on the roughness of the topography; about 2,000 plants per hectare can be planted. The first year plants do not prefer excess irrigation. If possible, drip irrigation is better (Muharrem et al., 2009). Sakcali et al (2008) investigated the diurnal time course of water relations of C. spinosa L. growing on healthy and degraded sites. Water stress was analysed on the basis of Stomatal conductance (gs), leaf water potential (ψw) and transpiration rate. The species appeared to be a drought resistant with lower WSIS (16 MPa h), showing a negligible difference between the two sites. A highgs, with lowest WSIS value shows that despite being a water spender, C. spinosa dynamically recovers even in the warmest hours of the day and under drought conditions. The long roots and wide ecological amplitude allow it to withstand harsh environments. The species thus appears to be a suitable candidate for the protection of degraded areas.

Domestication of capers as medicinal, vegetable or soil surface coverage plant is complicated by limited and variable seed germination under artificial conditions. In order to examine the role of different levels of KNO3 (0, 500, 1000, 2000, 4000 and 8000 ppm) and gibberellic acid (GA3) (0, 50,100, 250, 500, 1000 and 2000 ppm) and durations (3, 12, 24 and 48 hr) on germination of Iranian caper seeds. In general 2000 mg/l gibberellic acid treatment resulted in more vigorous seed germination (42%) at any duration compared to any other concentration of the gibberellic acid. The highest seed germination of 26% was achieved when the seeds were treated 24 hour with 4000 ppm KNO3 solution but it was decreased in 8000 mg/l. The highest germination percentage (72%) was observed in seeds placed in filter papers wetted with in 250 ppm gibberellic acid after treatment with 8000 mg/l KNO3for 24 hour (this duration was the best time span in two previous experiments). It seems that GA3and KNO3can replace partly to improve seed germination of caper. The highest seedling dry weight was achieved as seeds were treated in 100 ppm

gibberellic acid plus 1000 ppm potassium nitrate. Therefore, it can be concluded that for best germination percentage of caper seeds, 250 ppm GA3and 8000 ppm KNO3and for the strongest seedling 100 ppm GA3 plus 1000 ppm KNO3could be recommended (Saeed Khaninejad et al., 2012).

A full yield is expected after 3 to 4 years. Plants are pruned back in winter to remove dead wood and water sprouts. Pruning is crucial to high production. Heavy branch pruning is necessary, as flower buds arise on one year old branches. Three year old plants will yield 1 to 3 kilo grams of caper flower buds per plant. Caper plantations can be lasted 20 to 30 years. Fertilization is a not big issue in caper production (Muharrem et al., 2009).

Harvest and Processing

As well known caper is produced mainly for unopened flower buds. These unopened flowers are exported after harvest (Soyler and Aslan, 1999). For harvest, it is very crucisal that only unopened flower buds should be picked on a dry days. Harvesting is carried out regularly throughout the growing season. In Turkey and the other producer countries, caper flower buds are collected mainly by hand. The unopened flowers can be picked up 5-6 time per season. After harvest, unopened flowers are preserved either in vinegar or under layers of salt at the concentration of 20% in a jar. The collected caper buds classified according to diameter of buds. In Italy, capers are graded on a scale from '7' to '16', which indicates their size in millimeters. The diameter lower than 7 mm is accepted the best one. This classification is not applied in Turkey. Among two main species, C. ovata is better physical and chemi cal properties for processing (Ozcan and Akgul, 1999; Giuffrida et al., 2002). Protein and oil seeds can be utilized in several forms for food, feed and industry. Tunisian C. spinosa seeds are found to be rich in lipids with oil (23 to 33%). The oils had a high content of Oleic and Linoleic acids. But, the fatty acids composition varies between regions (Tlili et al., 2009). Indeed, the fatty acids profile of the seed oil has great systematic value in the plant kingdom, and there are many studies reporting phylogenetic relationships paralleled by differences in seed fatty acids profiles (Pujadas Salvà and Velasco, 2000).

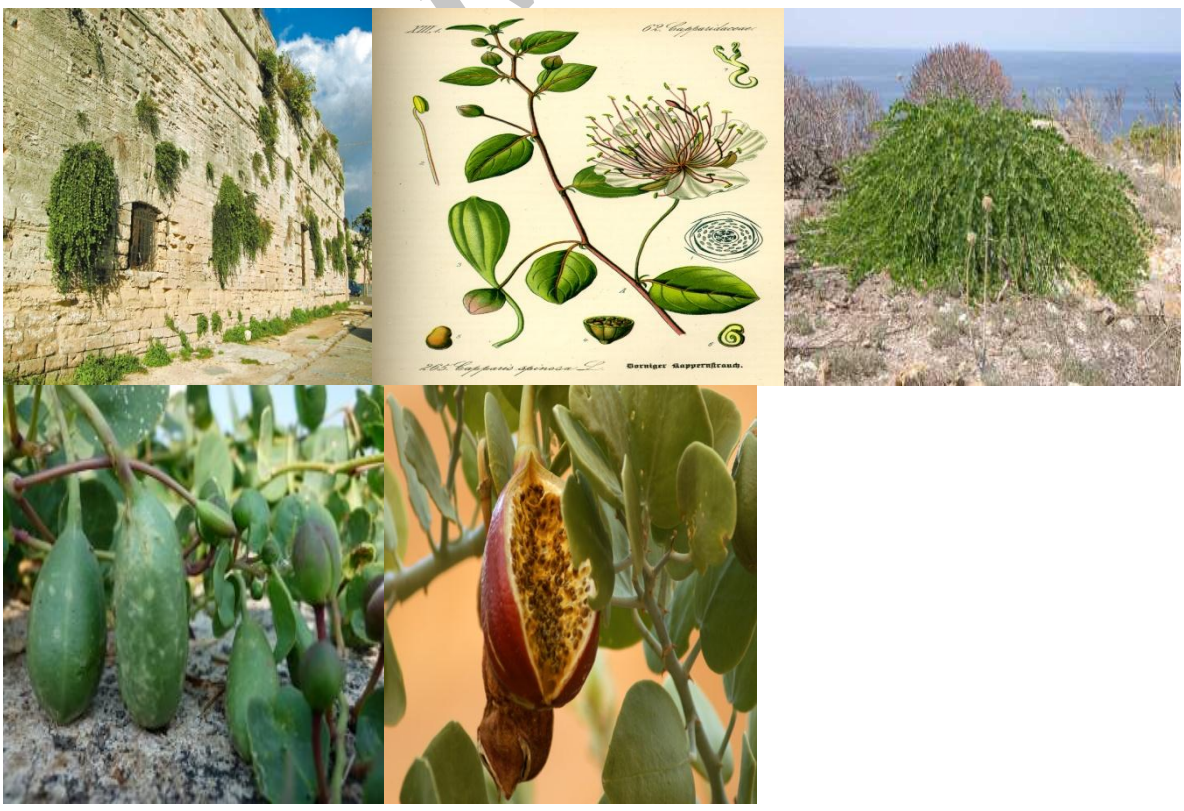

Figure 1: all about *Capparis spinosa* L.

Culinary Uses:

As mentioned before, unopened flower buds of capers have an important commercial value in capers producer countries. These flower buds either pickled in vinegar or preserved in granular salt. Moreover, semimature fruits (caperberries) and young shoots may also be pickled for use as a condiment. Capers have a sharp piquant flavor and add pungency, a peculiar aroma and saltiness to comestibles such as pasta sauces, pizza, fish, meats and salads. It was interesting that the flavor of caper similar to that of mustard and black pep per which comes from mustard oil: methyl isothiocyanate (rele ased from glucocapparin molecules) arising from cru shed plant tissues. Capers make an important contribution to the pantheon of classic Mediterranean flavors that include: olives, rucola (argula, or garden rocket), anchovies and artichokes. In most parts of the world, tender young shoots of caper plants can be eaten as a vegetable, or pickled. More rarely, mature and semi-mature fruits are eaten as a cooked vegetable (Muharrem et al., 2009).

Phytochemistry

Several phytochemical studies have tried to elucidate the phytocompounds of C. spinosa. The constituents of C. spinosa include the saccharides and glycosides, flavonoids, alkaloids, terpenoids and volatile oils, fatty acids and steroids (Yang et al., 2008). The major compounds found in C. spinosa are flavonoids, indoles, and phenolic acids (Zhou et al., 2010). Interestingly, a study has revealed the presence of both α- and γ-tocopherol in buds of C. spinosa as well as an appreciable level of vitamin C (Tlili et al., 2011). Lutein and Violaxanthin are the main carotenoids and the principal form of tocopherol detected in leaves was alpha-tocopherol (Tlili et al. 2009). Other investigations have demonstrated that C. spinosa contains in large amounts many secondary metabolites like flavonoids (rutin, quercetin, quercetin-3- rutinoside, kaempferol-3-rutinoside) phenloic components, different alkaloids (capparispine, capparispine 26-O-β-d-glucoside and cadabicine 26-O-β-d- glucoside hydrochloride) and organic acids (Yang et al., 2010). Moreover, the different glucosinolates found in C. spinosa were glucocapparin, mercaptoglucocapparin, 4-hydroxyglucobrassicin and glucobrassicin and glycinyl-glucocapparin (Bianco et al., 2012).

The leaf oil was composed of isothiocyanates, n-alkanes, terpenoids, a phenyl propanoid, an aldehyde and a fatty acid. The main components of this oil are thymol (36.4%). Isopropyl isothiocyanate (11%), 2-hexenol (10.2%) and butyl isothiocyanate (6.3%) wasreported. The volatile oils of the ripe fruit and the root are composed mainly of the methyl isothiocyanate, isopropyl isothiocyanate and sec-butyl isothiocyanates was reported (Ahmed et al,1972). Also the leaves of C. spinosa have kaempferal, quercetin, isorhamnetin and their O-methyl derivative, thomnocitirin, rhamnetin andrhamnozin (Juan and Martinez,1998). The p-methoxy benzoic acid isolated from the methanolic soluble fraction of the aqueous extract of C.spinosa was reported (Callis et al., 1999). It was found to possess significant antihepatotoxic activity against carbontetrachloride and paracetamol induced hepatotoxicity in vivo and thioacetamide and galactosamineinduced hepatotoxicity in isolated rat hepatocytes,using in vitro technique (Gadgoli and Mishra,1999). The seed oils showed remarkably high contents of 5-avenasterol (Matthaus and Ozcan, 2005). More researches about capers proved that principal form of tocopherol detected in leaves is alpha-tocopherol. In buds and flowers, there were both alpha and gamma tocopherols. The combined content of pro-vitamin A and vitamin E in capers encourages researchers to more explore and find developments for this plant (Tlili et al, 2009).

Table 1: Qualitative phytochemical analysis of Capparis spinosa (aerial parts) extract (Fatin and Mustafa, 2012)

Chemical Tests	Ethanolic Extract	Aqueous Extract
Alkaloids	+	+
Steroids	-	+

Glycosides	+	-
Carbohydrates	+	+
Flavonoids	-	+
Tannins	+	+
Phenols	+	+
Triterpenoids	+	-
Saponins	-	+

Pharmacology

Recently, the pharmacology and chemistry of this plant have been extensively studied. Biological studies have revealed significant anti-diabetic, antisclerosis, antimicrobial, anti-oxidative, anti-inflammatory, immunomodulatory and antiviral activities providing a support to the ancient uses (Tlili et al., 2011a). Other activities included antifungal (Ali-Shtayeh and Abu Ghdeib, 1999), antiproliferative and HIV-1 reverse transcriptase inhibitory activities (Lam and Ng, 2009). Caper seeds contain also ferulic acid and sinapic acid which contribute to its medicinal value (Tzi-Bun and Sze-Kwan, 2011). The seeds are rich in protein, oil, and fiber; they could be an alternative source of edible proteins (26%) and oil (30%).

Its Ethanolic and aqueous extracts reduced carrageen induced edema in rats (Ageel et al., 1986) and showed antihepatotoxic activities (Gadgoli and Misha, 1999). Extracts of different parts of C. spinosa have been shown to possess biological activity against a large number of pathogens. Antifungal, antibacterial, anti-amoebic, and anti-worm activities have been demonstrated (Asolkar et al., 1992; Gaind et al., 1969). Antimicrobial susceptibility test showed that the C. spinosa was 100% effective against gram positive isolates and 90% activity against gram negative isolates. Also it was found that mixture containing of Aloe vera, C. spinosa showed prominent antibacterial activity against gram negative and positive (Orooba and Ibrahim, 2012). In one report its extract agglutinated Leishmania (parasite) and killed it in the vector Phlebotomas papatasi (Jacobson and Schlein, 1999). In addition, C. spinosa is extensively used as an antihelminthic (Gaind and Juneja, 1965).

Infusions and decoctions from caper root bark have been traditionally used for dropsy, anemia, arthritis and gout. Capers contain consider able amounts of the anti-oxidant bioflavinoid rutin. Caper extracts and pulps have been used in cosmetics, but there has been reported contact dermatitis and sensitivity from their use (Muharrem et al., 2009). Recently, it have shown that all parts of C. spinosa possess antioxidant effects with certain correlation with their polyphenols and flavonoids contents (Arrar et al., 2013). Acetylcholine is the primary parasympathetic neurotransmitter in the airways, and is traditionally associated with inducing airway smooth muscle contraction and mucus secretion (Gosens et al., 2006). Parasympathetic activity is increased in airway inflammation, which is the basis for the use of anticholinergic therapy in asthma and chronic obstructive pulmonary disease (Gross & Skorodin, 1984).

Table 2. Main pharmacological properties of Capparis spinosa (Moufid et al., 2015)

Pharmacological activity	Animal model	Part of the plant
Treatment of rheumatism and inflammatory disorders	Kun Ming mice, wistar rats, human chondrocytes	Fruits, Flower buds
Antiallergic and antihistaminic	Male guinea-pigs and allergic patients	Flower buds and fruits
Antidiabetic and hypolipidemic	C57BL/6J mice and Type 2 diabetic Patients	Fruits
Antihepatotoxic	Wistar rats, mice	Aerial parts, roots
Antimicrobial	Deinococcus radiophilus, Gram-positive & negative bacteria	Whole plant and roots

Antiviral and immunomodulatory	Herpes simplex virus (Type HSV-2)	Flower buds
Antioxidant	Swiss albino rats	Aerial parts and Fresh buds
Anti-apoptotic	Human dermal fibroblasts	Fruits
Stimulating melanogenesis	B16 murine melanoma cells	Leaves
Antimutagenic	In vitro	Flower buds
Antiparasitic	Plasmodium falciparum	Aerial parts
Diuretic effect	Wistar rats	Fruits
Antiproliferative	Human hepatoma HepG2 , colon human cancer HT29, human breast cancer MCF-7	Seeds
HIV-1 reverse transcriptase inhibitory	DNA molecule	Seeds
Anti-complement	In vitro	Fruits

Genetic and biotechnological aspect

Bassam Al-Safadi et al (2014) investigated the genetic diversity and relationships among Capparis species growing in Syria using IRAP and ISSR techniques. Forty-seven samples of three Capparis species genotypes were collected from 21different locations in Syria. The genotypes were morphologically identified based on the descriptions available in the literature. When IRAP technique was used, an average of 71.5% of the amplified fragments were polymorphic compared to 82.04% in ISSR. Morphological character ization along with the cluster and PCoA analyses of the data divided the studied genotypes into three groups. The groups included genotypes identified as C. spinosa, C. sicula Duh., and C. aegyptia Lam. Based on the morphological description, molecular studies and statistical analyses of this study, C. aegyptia could be suggested as a separate species and not a varietal rank of C. spinosa (C. spinosa var. aegyptia (Lam.). Two samples (Alep1 and Idl) were not placed in any of the three distinctive groups, despite their closeness morphologically to C. spinosa. In PCoA analysis, sample Alep1 came between C. sicula and C. spinosa and Idl was placed between C. sicula and C. aegyptia. Although hybridization between Capparis species could occur, it was not clear from the present stud y if these two genotypes were hybrids.

Inter–Simple Sequence Repeat (ISSR) molecular markers and morphological analysis were used in order to characterize wild populations and cultivated forms of orphan crop species C. spinosa L. in a Mediterranean island complex. Nineteen wild populations belonging to two different subspecies, C. spinosa subsp. spinosa and subsp. rupestris, were sampled in different environments in Sicily and the surrounding islets Lampedusa, Pantelleria and Salina. Different biotypes cultivated in Pantelleria and Salina were analyzed. Six ISSR primers were selected for genetic characterization, and all clear and reproducible bands were scored and analyzed. Among the ISSR bands obtained, 97.5% were polymorphic. Results of ANOVA and STRUCTURE analysis suggested a clear genetic distinctness between subspecies at the regional level and suggested the existence of two taxonomic groups among wild populations, with different ecological preferences and distinctive morphological characters. Cultivated forms showed genetic affinity to subsp. rupestris. ISSR analysis not only provided specific molecular markers to discriminate the taxa, but also proved useful in supporting the hypothesis of a hybrid origin of the intermediate phenotypes found in overlapping distribution areas. The identified molecular markers provided a basic tool for the DNA fingerprinting of wild and commercial capers in the Mediterranean region and nearby territory (Silvestre et al., 2014).

Successful in vitro multiplication of C. spinosa was achieved on Murashige and Skoog (MS) medium supplemented with benzyl amino purine (BAP) at 0.8 mg/L. The highest shoot length (35.6 mm) was obtained with the use of 0.4 mg/L BAP and 0.2 mg/L 1-naphthaleneanacetic acid (NAA). Kinetin at 2.0 mg/L produced a multiplication rate of 9.7 microshoots per explants with an average shoot length of 21.3 mm. In vitro rooting was successfully achieved on MS media supplemented with different concentration of indole-3-butyric acid (IBA), indole acetic acid (IAA) or NAA at various concentrations. However, rooting did not occur in the absence of IBA, IAA or NAA. A total of 85% survival was achieved when rooted explants acclimatized ex vitro using a mixture of 1 perlite: 1 peat. In another experiment, in vitro C. spinosa were successfully stored without serious losses by using MS medium supplemented with an appropriate concentration of osmoticum (sucrose, sorbitol, mannitol or glucose) at various concentration (0, 3, 6, 9 or 12%). Two types of plant material were used (in vitro plantlets and in vitroplantlets without tips). The results obtained show that the two type of plant material could be successfully maintained in vitro and optimum treatments were identified for each plant material. Further studies are still needed on medium term conservation to enhance the survival percentages of different plant material type (Hana et al., 2112).

Nosrati (2012) used Madden (2002) method to extract DNA from seeds/seedlings or leaf of Capparis. He realizes that Population size has a dramatic impact on its genetic diversity. The results revealed that in the study region, fragmentation of Caper population has most likely occurred recently. The low genetic diversity revealed within Caper populations indicates high risk of extinction and suggests that urgent conservation action is needed to recover diversity in these populations. Inocencio (2005). Use Doyle and Doyle (1987). protocol to extract DNA from 45 accessions of C. Spinosa L. following DNA information, AFLP analysis indicates that a similar differentiation is also possible and four groups are defined. However, the AFLP study indicates the genetic distance among the Capparis spp.

Economic Importance

The European Union countries are the biggest market s for capers. They need high quality caper flower buds. As far as we know, the EU rejected imports from some North African countries recently because of the toxic residue found in the products. However, for the caper products that are appropriately certified, the world market is wide open. Further, organic production of capers will open an additional market niche. A goo d marketing concept will bring this local plant to an export success because the growing conditions for capers are outstanding in Turkey. On the other hand the plant needs to be advertisement on it. Therefore an effective advertisement can also increase its consumption in Turkey as well (Muharrem et al., 2009).

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