

Conservation Strategy for protecting *Crataegus x sinaica* against climate change and anthropologic activities in South Sinai Mountains, Egypt

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ABSTRACT

The genus name *Crataegus*, is derivative from a Greek word *kratos* meaning hardness of wood. *Crataegus* relates to family *Rosaceae*; it contains about 280 species of deciduous spiny shrubs and small trees where most of these species are grown as ornamentals and hedging plants, they are broadly distributed in Northern temperate zones of Asia, Europe and America. In Egypt, it is confined to mountainous South Sinai; it grows on the high elevated wadis in Saint Catherine area. Many *Crataegus* species have been traditional used in folk medicine since ancient time for the cure of heart problems such as hypertension, angina, arrhythmia, and congestive heart failure. Researches of *Crataegus* species usually concentrate on the identification and quantification of flavonoids and anthocyanin, which have been shown to have pharmacological activity. But there is a continuous reduction in habitat quality for this species through time. This reduction observed in *Crataegus sinaica* is likely caused by climate changes in the past few decades and human activities (over cutting for fuel and food, unmanaged collection for scientific researches, uncontrolled tourism and establish of bedouin settlements). We aim to highlights these challenge threatening *Crataegus* population and suggest conservation plans to protect this species from extinction and finally make further studies about this important threatened species.

Keywords: *Crataegus sinaica*, *Rosaceae*, flavonoids, Cardiovascular, Conservation.

INTRODUCTION

The genus name *Crataegus*, is derivative from a Greek word *kratos* meaning hardness of wood (Verma *et al.*, 2007). *Crataegus* relates to family *Rosaceae*; it contains about 280 species of deciduous spiny shrubs and small trees where most of these species are grown as ornamentals (Hyam and Pankhurst, 1995). Hawthorn is public name of all plant species in the genus *Crataegus*, is a thorny shrub or small tree is called in common as Za`roor Al-Awdya or Za`roor grows wildly on the mountains of Saint Catherine Protectorate, South Sinai, Egypt. Flavonoids and procyanidins are considered as the most important components and responsible for the pharmacological activity of Hawthorn. The fruits contain reasonably low levels of flavonoids and consist of oligomeric and polymeric procyanidins.

Many *Crataegus* species have been used in traditional folk medicine since long ancient time for the cure of heart diseases as deficiency of the coronary supply and arrhythmias (Fugh-Berman, 2000) due to their evident improvement of heart functions in declining cardiac performance (Refaat *et al.*, 2010; Ahmed *et al.*, 2001), besides their hepatoprotective (Refaat *et al.*, 2010), antimicrobial activity (Tadic *et al.*, 2008), anti-HIV (Shahat *et al.*, 1998), anticomplementary (Shahat *et al.*, 1996), cytotoxic activity (Min *et al.*, 2000; Hamahameen and Jamal, 2013), hypotensive, antioxidant (Amel *et al.*, 2014), antispasmodic, hypotensive (Ercisli *et al.*, 2015; Tahirović and Bašić 2014; Kumar *et al.*, 2012). These plants are usually contain high amount of flavonoids, proanthocyanidins and catechins which are the main components responsible their biological activities.

In the last 20 years, over 60% of new drugs for the cure of cancer and 75% of new drugs used to cure infectious diseases were of natural origin (Newman and

Cragg, 2007). More than 25% of pharmaceuticals are derived from plants and the potential of this high resource is massive, (Lambert *et al.*, 1997). These products include those which have been made from *Crataegus* species (hawthorn); available products include tinctures, tablets, teas, and aqueous extracts of *Crataegus* leaves, flowers, and fruits. Hawthorn products are currently marketed as an alternative treatment for hyper tension, angina, arrhythmia, and the early stages of congestive heart failure.

Due to many threats affecting the existence of *Crataegus sinaica* in its environments including overgrazing, over-cutting and climate change, this review article we aimed to make efficient natural control, wise management for present populations and figure out a conservation strategy for protecting *Crataegus x sinaica* as a threatened plant species growing in Saint Catherine Protectorate in South Sinai.

Distribution

Crataegus is documented in northern temperate regions, including North America, Europe, Asia Minor, China, Japan, the Old World and the Himalayas. This plant species represents the concept of endless variation, with numerous variants that in the late nineteenth century led to the naming of upwards of 1,000 species of hawthorn. *Crataegus sinaica* is restricted to central and eastern parts of the Mediterranean region; on rocky mountain slopes, in scrub and woodlands; 100-1800 m a.s.l.

Crataegus is well distributed in the flora of Syria, Palestine and Egypt (Post, 1896). In Egypt, *Crataegus sinaica* is distributed in the Catherine Mountains of southern Sinai (Fig. 1a). It is abundant mainly in the timber line zone and occurring at different elevations on Gebel Catherina, Wadi El-Raha, Gebel El-Ahmer, Gebel Musa, Wadi El-Rutig, and Gebel Um Alawi

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Figure (2): a) *Crataegus sinaica* tree, b) a branch *Crataegus sinaica* bears fruits, c) immature fruit of *Crataegus sinaica*.

Traditional Treatments in Folk Medicine

Crataegus species (hawthorn) have been used usually since ancient times (Murray, 1995). It has been suggested that its antioxidant components make up its many favorable therapeutic effects. A decoction of leaves and undeveloped fruits are used as a cure for cardiovascular diseases, cancer, diabetes and sexual weakness in Arabian traditional medicine (Miller, 1998; Ju, 2005). In Mexico, diabetes is treated using hawthorn extracts. Such treatment may be of considerable benefit especially during the early stages of the illness (Rigelsky and Sweet, 2002; Ljubuncic *et al.*, 2005; Khalil *et al.*, 2008).

Side effects of Hawthorn were well accepted in studies lasting up to sixteen weeks. Some side effects, may have been related to hawthorn extracts cited in the literature are: mild rash, headache, sweating, dizziness, sleepiness, agitation, gastrointestinal complaints (Houser, 2006). The Drug interactions of *Crataegus sinaica* include the flavonoid components of hawthorn may be responsible for treatment of heart failure. However, these components may also affect P-glycoprotein function and cause interactions with drugs that are P-glycoprotein substrates, such as digoxin, which is also used to treat heart failure (Tankanow *et al.*, 2003).

Pharmacological activities

Crataegus species possesses massive medicinal applications, *Crataegus sinaica* has been monitored for its biological activities *Crataegus* may develop coronary artery blood flow and the contractions of the heart muscle, therefore used widely in cardiovascular disorders such as arrhythmia, myocardial infarction, congestive heart failure (Garjani *et al.*, 2000; Degenring *et al.*, 2003; Long *et al.*, 2006; Jayalakshmi *et al.*, 2006). *Crataegus* extracts also prevents elimination of plasma lipids like total cholesterol, triacylglycerides, LDL and VLDL fractions (Andrade-Cetto and Heinrich, 2005; Ljubuncic *et al.*, 2006).

Crataegus perhaps working as anti-inflammatory, gastro-protective, antimicrobial agent (Kao *et al.*, 2005; Tadic *et al.*, 2008) and used as hepatoprotective agent. It is also mildly inhibits angiotensin converting enzyme (ACE) and reduce production of the potent blood

vessel-constricting substance angiotensin II, therefore act as hypotensive and diuretic (Schroder *et al.*, 2003). *Crataegus* extract possess positive inotropic effect of amines such as phenethylamine, *O*-methoxyphenethylamine and tyramine. These amines were responsible for *in vitro* activity of *Crataegus* extracts on the guinea pig papillary muscle (Wagner and Grevel, 1982) and it also raised intracellular calcium thus prolongs the action potential, which supports for its inotropic activity (Kocyildiz *et al.*, 2006). Flavonoids and proanthocyanidins are the main components responsible for the biological and therapeutic activity of *Crataegus* species. These flavonoids and proanthocyanidins show anti-HIV activity (Shahat *et al.*, 1998) and antimicrobial activities (Cushnie and Lamb, 2005).

The antioxidant capacity of extracts of *Crataegus* plants which have long been used in herbal medicine for the cure of cardiac and circulatory functions has been considered. *Crataegus sinaica* has shown anti-inflammatory, gastro protective (Tadic *et al.*, 2008).

Threats facing *Crataegus* population

As the *Crataegus sinaica* is recorded as endangered plant species. It is must be to conserve it to gradually increase the population number. The conservation state should be based on knowledge of the genetic composition and structure of *Crataegus* populations as well as an understanding of mating patterns within its population. Also, knowledge of the main challenges and problems that threaten *Crataegus* to extinction.

Hybridization plays a role in their evolution (Phipps, 1984). According to Pojarkova (1939), Gladkova (1968) and Christensen (1982 a, b, and 1984), hybridization, introgression, and subsequent polyploidy play a major role in the evolution of *Crataegus* in the Old World.

Unsustainable use of *Crataegus* represents one of the main causes of reduction in *Crataegus* numbers, as the Sinai Peninsula Bedouins have common knowledge of using plants for medicinal purposes. In recent years, knowledge of traditional medicine has become well known there, so that there is over-collection of medicinal plants from their native habitats. Overexploitation of many species eventually leads to their disappearance, resulting in threatening their existence. It is to be noted that some of these species are in official pharmacopoeia. As well as *Crataegus* branches are cut by natives for fire, as the hawthorn wood is very tough so it has the hottest fire, while the fruit is consumed due to its palatability.

Development pressures and human activities represent danger for *Crataegus* (e.g., encroachment, adaptation, agriculture, and mining). The area of the St. Catherine Protectorate is inhabited by more than 10,000 people, including resident Bedouins as well as newcomers for services, or and Bedouin settlements are added. Uncontrolled tourism poses a risk to the existence of *Crataegus* and other endangered plant species. Every day several hundred people attempt the ascent of Mount Sinai, mainly to view the sun rising over a breathtaking series of mountain tops. The impact of this sensitive site is considerable values. The major threats arise from a combination of inappropriate urban

development, an expanding resident and migrating population, changes in life-style, and deficiencies in institutional planning. Tourism activates threaten the plant species for extinction danger, such as deformed landscape, localized overgrazing, disappearance of shrubby plants (for clearing the land, for fuel, or for sale if of medicinal value), damage by safari vehicles and depletion and contamination of the meager ground water resources. Also over-collection of *Crataegus* by botanists and scientists for scientific researches and studies is one of the causes of reduction of *Crataegus* numbers.

Moreover, the hawthorns are generally propagated by seed but both seed germination which is slow and difficult and mature tree cuttings which are difficult to root and rare to succeed (Bujarska, 2008; Nokes, 2001). The climate has great effect for distribution *Crataegus*. Temperatures and humidity increase from top to bottom and from mountains to the wadis. High temperature reduces the rate of seed germination, water scarcity and small underground water reservoirs increase the extinction danger of *Crataegus* in South Sinai.

Management and conservation

There is a continuing reduction in habitat quality for this species through time. Climate change plays role in decrease the population numbers (Grabherr *et al.*, 1994; Root *et al.*, 2003). This reduction observed in *Crataegus sinaica* is likely caused by climate changes in the past few decades and human activities. We need to work in different directions to protect this species from extinction: conservation through create genome reso-urce bank and build-up of, seed banks that can act as reservoirs of genetic variation, thus delaying the loss of genetic variation and maintaining the evolutionary potential of populations (Zaghloul, 2008). It is necessary to carry out regular monitoring to keep updated on the population size, distribution and its trends.

In situ conservation through work on rehabilitation and restoration the present population and create more fenced enclosures in the whole area in addition to the enclosure present in Saint Catherine Protectorate. It is important to expand and encourage sustainable use of plant species, control the unmanaged collection through Bedouin and also botanists and expand protected areas. Concerned experts must adopt public policies and environmental laws that promote protection and conservation of plant species, establish tax system for funding conservation and organize the uncontrolled tourism and tourist industry.

Raising the public awareness and establishment and improvement new educational systems in schools, universities and scientific research centers about the sensitivity of this important threatened species are one of essential points in conservation concept. Also support Bedouin with programs aiming to induce the Bedouin community to accept the idea of protection and conservation and participate in it.

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استراتيجية المحافظة على نبات الزعرور كنوع من أنواع النباتات ضد التغير المناخي والنشاط السكاني في جبال جنوب سيناء، مصر

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الملخص العربي

Crataegus x sinaica اسم الجنس *Crataegus* مشتق من الكلمة اليونانية *kratos* والتي تعني صلابة الخشب وينتمي هذا النبات الي عائلة الوردية، وانه يحتوي علي حوالي 280 نوعاً من الشجيرات الشوكية المتساقطة والاشجار الصغيرة حيث تزرع معظم هذه الانواع كنباتات نباتية ونباتات التحوط التي تحيط بالحدائق المنزلية، وهي موزعة علي نطاق واسع في المناطق المعتدلة الشمالية في آسيا وأوروبا وأمريكا. وفي مصر يقتصر وجودها علي جبل جنوب سيناء فقط، حيث ينمو علي الأودية المرتفعة في منطقة سانت كاترين. هناك العديد من أنواع *crataegus* تستخدم في الطب الشعبي لعلاج مشاكل القلب مثل ارتفاع ضغط الدم والذبحة الصدرية وعدم انتظام ضربات القلب وفشل القلب الاحتقاني. و في الغالب تتركز أبحاث أنواع *crataegus* علي تحديد وتقدير كمية مركبات الفلافونويد والأنثوسيانين، والتي ثبت ان لها نشاطاً دوائياً. ولكن هناك انخفاض مستمر في جودة الموائل لهذا النوع عبر الزمن و من المرجح أن يكون هذا الانخفاض الذي لوحظ فينباتات الزعرور سببه التغيرات المناخية في العقود القليلة الماضية والأنشطة البشرية (خلال عمليات القطع للوقود والغذاء، والجمع غير المدروس للبحث العلمي، والسياحة غير الضبوطة، وإنشاء مستوطنات البدو). ولذلك الاسباب نهدف إلي تسليط الضوء علي هذه التحديات التي تهدد سكان *Crataegus*، وتم اقتراح خطط حفظ لحماية هذا النوع من الإنقراض وأخيراً إجراء مزيد من الدراسات حول هذه الأنواع المهتدة الهامة.