

An exhaustive study of multifunctional plant **CRATAEGUS CRENULATA: in vogue findings** accompanied by its therapeutical and pharmacological importance

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ABSTRACT

Crataegus crenulata Roxb. Syn. *Crataegus crenulata* (D. Don) M. Roemer, Fam. Rosaceae) are commonly called firethorn. To treat different abnormalities and as a folk diet it's eaten globally as a traditional remedy. It's native to the hills of Himalayan and also widely distributed from Himachal Pradesh to Nepal. Its other synonyms are hawthorn, thorn apple, May tree, white thorn or haw-berry. This plant has several biological activities such as antihypertensive, antioxidative, antimicrobial, hepatoprotective and reno-protectives as well as anticancer activity. It also inhibits activity of some enzymes such as lipase, alpha-amylase, alpha-glucosidase, and tyrosinase. However, some research on this plant reveals that it is initially used in treatment of circulatory disorders and respiratory illness. Moreover, the research concludes that the fruit and flower part of this plant shows several pharmacological activities such as antispasmodic, diuretic, sedative and vasodilation properties. The plant contains fruit which is sometime known as 'Haw'. The fruits of this plant are small in size which is esculent and rich in sugar. The fruit of this plant consists of cardiogenic, coronary vasodilator and hypotensive properties. The leaves are used to formulate herbal tea. It is generally applied as tea or tincture. The leaves of hawthorn also reported to impart several activities such as; antioxidant, immuno-modulatory and anti-inflammatory activities. Hawthorn berries are rich in nutrition as it consists of flavanoids, Vitamin 'A', vitamin 'B12', Vitamin 'C', Vitamin 'E', protein, calcium, magnesium and potassium. By using its berries and herbal tea of its leaves, Defence Institute of Bio-Energy Research (DIBER) institute has developed herbal beverage which is named as "Hridayamrit".

KEY WORDS: *Crataegus crenulata*, red berries, Himalayan hill, Ghingharoo, firethorn.

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I. INTRODUCTION

Crataegus crenulata Roxb. Syn. *Crataegus crenulata* (D. Don) M. Roemer, Fam. Rosaceae) is native to the Himalayan hill of ranging about from 900 m to 2400 m AMSL (Above Means Sea Level). It has a large genus of shrub and tree, and is native to the region of the northern hemisphere in Europe, Asia and northern America. In Uttarakhand it is known as Ghingharoo. In barren, rocky and dry grasslands this dense bushy shrub species grows widely. This species has attractive pulpy red berries with hard seed coat. they are rich in nutrition, it contains flavonoids, Vitamin 'A', vitamin 'B12', Vitamin 'C', Vitamin 'E', protein, calcium, magnesium and potassium. The most bioactive constituents present in berries of *Crataegus crenulata* are flavonoids and oligomeric proantho-cyanidins. During the month of April-May the flowering occur which is in nature hermaphrodite (bisexual) with 20 stamens and 01 ovary. It is widely distributed from Sutlej to Nepal 1600–2500 m. The fruit of this plant is small in size, are esculent and rich in sugar. The leaves are used to forge herbal tea. The fruit of this plant have cardiogenic, coronary vasodilator and hypotensive properties.

This shrub is reported as potent antihypertensive. In scientific research of different part of world and clinical trials shown that the total flavonoids of *Crataegus* reduce cholesterol level and improve cardiac functions. The leaves of hawthorn also reported as antioxidant, immuno-modulatory and anti-inflammatory activities. The fruits and flowers are used in the preparation of direct and mild heart tonic thus consider as cardiogenic herb. In the traditional medicine, Application of fruit and flower of this herb are found to be useful in conditions such as hardening of the arteries, heart failure, irregular heartbeat, high blood pressure and chest pain. It generally applies as tea or tincture. To enhance the blood supply to brain cells, the leaves of *Crataegus crenulata* is mixed with ginkgo (*Ginkgo biloba*) and apply as tea or tincture.[1]

Because of its pharmaceutical and nutraceutical features, the Defence Institute of Bio-Energy Research (DIBER), Haldwani has made successful endeavour in exploitation of this species. By using its berries and herbal tea of its leaves DIBER institute has developed herbal beverage which is named as “Hridayamrit”. [1][2]

II. TAXONOMY

Crataegus crenulata M. Roem., syn. *Crataegus crenulata* Roxb. is a plant of family Rosaceae, it's frequently known as Himalayan firethorn, Indian firethorn and Nepalese firethorn. These are commonly known name of this plant but in earlier this plant was known as “CRATAEGUS”. This word come from Greek language in which kratos means “strength” and akis means “sharp” which is refer to the thorn of some species. Its other synonyms are hawthorn, thorn apple, may tree, white thorn or haw-berry. It belongs from the family of rosaceae, in which it has a large genus of shrub and tree, and it is native to the region of the northern hemisphere in Europe, Asia and northern America. [1]

Table No.-1 The systematic classification of *Crataegus crenulata* plant [1]

Kingdom	Plantae
Phylum	Anthophyta
Class	Magnoliopsida
Order	Rosales
Family	Rosaceae
Genus	<i>Pyracantha</i>
Specie	<i>Crenulata</i>

III. BOTANY

The species of *Crataegus* are shrub or sometime small trees, it is mostly grows up to 5-15m in height with pulpy fruit (berries) and thorny branches. The thorns of it are sharp –tipped branches that either arise from the trunk or other branches, which are typically 1-3cm long but it has recorded as upto 11.3 cm in one case. The arrangement of leaves show growing spirally, on long shoots and in clusters on spur shoots on the branches or twigs. It consists of fruit which is sometime known as ‘Haw’. [1]

IV. MORPHOLOGY

The plant *Crataegus crenulata* is a thorny, hard woody shrub with the height range is up to 2-5 m and it's native to the hills of Himalayan. It is also widely distributed from Himachal Pradesh to Nepal 1600-2500m. Morphology of *Crataegus crenulata* is shown in Figure no.1.

Table No.-2 The Morphology of plant *Crataegus crenulata*[1] [Figure no.1:[A to F]

Root	i) Highly developed with primary, secondary, tertiary branches ii) Fine root hair for absorption of water and minerals
Leaves	i) Dark green with smooth surface ii) 2.5cm-4.0cm in length iii) 1.0cm-2.0cm un width iv) Rich with antioxidant and phenolics
Seed	i) Each berry contains 5 triangular brown coloured seeds 3 or 4 seed also observed which covered with hard seed coat
Flower	i) April-may flowering occur ii) Hermaphrodite (bisexual) having 20 stamens and one ovary in the centre. iii) Each flower contains five sepals and five petals

Fruit	i) Pome fruit type ii) Pulpy berries iii) Proper ripe in july-september month in Uttarakhand
Thorn	i) Shard-tipped thrones ii) Size varies between 1-3 cm (sometime also bigger than up to than 4.0-4.5cm)

Table no. 3: The physical parameter of *Crataegus crenulata* fruit [1]

Length(mm)	15.9±1.3
Width(mm)	16.4±1.9
Weight of 1000 fruit(g)	260±8.2
Color	Orange-Red
pH fruit juice	2.82±0.4

Table no. 4: The Biochemical composition of fresh fruits (g/100g) *[1][2]

Carbohydrate	5.90± 0.96
Protein	0.60± 0.29
Lipid	0.270± 0.19
Moisture	82.6± 1.9
Total ash	0.27± 0.06

V. MICROSCOPY

On the performing the powder microscopy of leaf[Figure no.2(A)], the features of the species *Crenulata* of genus *crataegus* observed are following, such as starch grain[Figure no.2(B)], Glandular fiber[Figure no.2(C)], prismatic calcium oxalate crystal[Figure no.2(D)], oil gland and vascular bundle. All collective data could provide the significant information on standardization and evaluation of the leaves and fruits of *Crataegus crenulata*. [3]

VI. SOME IMPORTANT SPECIES OF GENUS *PYRACANTHA*

The species *Crenulata* is very diverse in the *Crataegus* genus, this genus has more than 1000 species occurring in nature. Some species are apomictic microspecies. Some important species of *Crataegus* are discussed in Table No.-5. Few other species of genus *Crataegus* and their biological activities are given under below:

Table No.-5 Other important species of *Crataegus crenulata*[4]-[9]

Sr. No	Different species	Biological activities
1	<i>Pyracantha coccinea</i>	A) Antioxidative B) Antiapoptotic C) Antimalarial and larvicidal D) Cytotoxic E) Inhibit the enzymes such as: Acetylcholinesterase, butyrylcholinesterase, alpha-amylase, alpha-glucosidase and tyrosinase
2	<i>Pyracantha angustifolia</i>	A) Antioxidative B) Acaricidal C) Insecticidal
3	<i>Pyracantha koizumii</i>	A) Antioxidative B) Tyrosinase inhibitory C) Aflatoxin adsorbing
4	<i>Pyracantha fortuneana</i>	A) Antioxidative B) Antimicrobial C) Hepatoprotective and Reno-protective D) Anticancer E) Inhibit enzyme such as: Lipase, alpha-amylase, alpha-glucosidase and tyrosinase

VII. PHYTOCHEMICAL PROFILE OF *CRATAEGUS CRENULATA* PLANT

The berry of *Crataegus crenulata* are very small in size but it is rich in bioactive compounds. The various composition of *Crataegus* contains such as 75% moisture, 2-3% flavonoids, 289 IU/ 100g Vitamin 'A', 110 µg/100g vitamin 'B12', Vitamin 'C' (57.8mg/100g), Vitamin 'E' (289mg/100g). It also contains protein (1.6%), calcium (3.79 mg/100g), magnesium (1.38 mg/100g) and potassium (1.39mg/100g). The most bioactive constituent found in the fruit of *Crataegus* is flavonoids and oligomeric proantho-cyanidins. The heavy metals such as lead, arsenic, mercury and cadmium are present. [1][2][10][11]

Table No.-6 Phytochemical profile of *Crataegus crenulata* fruits[1][2][10][11]

SR NO	Biochemical constituent	Quantity*
1	Protein	1.8 ± 0.2%
2	Flavonoids	2.9±0.4%
3	Calcium	3.08 ±0.021mg/100g
4	Magnesium	1.4± 0.02%
5	Sodium	1.00± 0.2%
6	Potassium	1.43± 0.05%
7	Vitamin A	289±0.07 IU/100g
8	Vitamin B1	0.50±0.04 mg/100g
9	Vitamin B2	17.7±1.10 mg/100g
10	Vitamin C	55± 3.03 mg/100g
11	Vitamin E	272±5.0 mg/100g
12	Total Soluble Solids	82.14%

Within this biochemical composition, there are also preliminary phytochemical screening of *Crataegus crenulata* reported. To unlock the information about chemical constituent present in crude drug the preliminary phytochemical screening is very promising chemical identification method. So reported tests Phytochemical screening was performed for Alkaloid, carbohydrate, protein, flavonoids and Steroids. The result of preliminary phytochemical screening of *Crataegus crenulata* mentioned in table-7.[3]

Table No.-7 Preliminary phytochemical screening of *Crataegus crenulata* [3]

A	Test for Alkaloids	Observation
1	Dragendorff's test	+
2	Mayer's test	-
3	Hager's test	+
4	Wagner's test	+
5	Tannic acid test	+
B	Tests for Carbohydrate	Observation
1	Molisch test	+
2	Fehling test	+
3	Benedict test	+
4	Tollens test	+
C	Tests for Proteins	Observation
1	Biuret test	+
2	Millon's test	+
3	Xanthoprotein test	+
D	Tests for Steroids	Observation
1	Salkowski test	+
E	Tests for Flavonoids	Observation
1	Shinoda test	+
2	Sulfuric acid test	+

Table No.-8: Physical and chemical characteristics of seed part of *Crataegus crenulata* in lipid fraction[12]

Color	Yellow
Iodine value	121
Peroxide value	8.7
Acid value	2.5
Saponification value (mg KOH/g)	203
Unsaponifiable matter (%)	7.4
Iodine value of unsaponifiable	56.7
Refractive index (25 degree Celsius)	1.4770
Viscosity (cp; 25 degree Celsius)	57.94
Specific gravity (15 degree Celsius)	0.9205
Combustion heat (cal/g)	9.402

VIII. THERAPEUTICAL APPLICATION

Crataegus crenulata is a multipurpose plant of which every part is useful. In 1800s, it introduced for the application in treatment of circulatory disorders and respiratory illness. The secondary metabolite flavonoid is present that's why it is used in treatment of cardiac related problems. Its fruit and flower contain other pharmacological activities such as antispasmodic, diuretic, sedative and vasodilation properties. Some of the important pharmacological actions possessed by plant *Crataegus crenulata* are given below.[1] [2]

1) Reduce free radical damage

The damage caused by the free radical can be reduced by the antioxidants present in berries of hawthorn. It is considered as an enhancer of blood flow to heart muscle and brings normal heartbeats because of the presence of bioactive constituent flavonoids, responsible for this action, it is also used as reductive degeneration of the blood vessels. [1][2]

2) Cardio-tonic

The extract of fruit and flowers are directly used in preparation of direct and mild heart tonic. It is used to treat irregular heartbeat, high blood pressure, chest pain, hardening of the arteries, and heart failure. *Crataegus crenulata* is commonly used in weak heart combined with high blood pressure, old age, inflammation, arteriosclerosis and other heart problems.[1][2]

3) Memory enhancer

By the improving blood supply to the brain it improves the memory. The mixture of *Crataegus crenulata* and Ginkgo (*Ginkgo biloba*) leaves has been found to enhance the memory. [1][2]

4) Anti-hypertensive activity

Its potential in the treatment of hypertension. The heart patients in clinical trials shown that the total flavonoid of this plant reduce the cholesterol level and improve the cardiac functions. The leaves of this plant are antioxidant, immunomodulatory and anti-inflammatory.[1][2]

5) Other medicinal uses

For the stop of excess menstrual-flow the decoction of shoot and bark of *Crataegus crenulata* are used. The plant bark is astringent and has been used in treatment of malaria and other fevers. It is good protector of skin from sunburn and frost bite if cream prepared from its bark. The arteries of heart can be stimulated by its root. For the cure of diabetes, the juice of its fruit is found effective. [1][2]

IX. PHARMACOLOGICAL STUDY

1) Antihypertensive study

According to the clinical research, *Crataegus* has a potential for treatment of hypertension. The patients with the presence of hypertension have shown that the total flavonoids present in *Crataegus* reduce the cholesterol level and improve the cardiac functions in clinical trials. For the examination of effect of *Crataegus* herbal beverage, the study conducted at DIBER on hypertensive rats and the results confirmed the positive effect on hypertensive rats. For the examination, wistar male rats weighing 200-250g were used. In the studies of antihypertensive (normotensive rats, noninvasive model) formulation administered at the doses of 1, 1.5 and 2.0 ml/rat, to conscious rats produced lowering in the blood pressure in a biphasic manner. There is no any significant effect on heart was observed. In the normotensive rats, (noninvasive model) at each dose, the formulation lowered the mean blood pressure up to 5 hours. There is no any significant effect on heart rate was

observed. At the dose of 100 µl/rat in cadmium chloride induced hypertensive rats, the blood pressure was lowered up to 4 hours. [1][2][13]

2) Anti-microbial study

The significant of antimicrobial activity(18mm, 17mm & 15mm) showed by the ethanolic fruits extracts of *Crataegus crenulata*, against the *Shigella flexneri*, *Escherichia coli* & *Streptococcus pyogenes* against food poisoning bacteria. The fruit of it is rich with crude protein, crude fiber and carbohydrates (5.13%, 7.40% & 24.88%) and also antinutritional as phenolic, saponins and flavonoids (1.83%, 1.56% & 3.12%) respectively and phytochemical screening of plant for the presence of carbohydrates, glycosides, alkaloids, tannins and resin.[14]

3) Antiuroliithiaticactivity in Albino rats

When administration of chronic 0.75% (v/v) ethylene glycol aqueous solution, to male albino rats, it results into the hyperoxaluria(too much oxalate in urine). Oxalate, calcium and phosphate excretion were grossly increased in calculi-induced animals. But which is maintained by supplementation of juice and alcohol extracts of *Crataegus crenulata* fruit significantly (p<0.001). The deposition of oxalate, phosphate and calcium like crystalline component in the renal tissues, was increasing in stone forming rats, but it is overcome by the treatment of juice and alcohol extract of *Crataegus crenulata* fruit significantly (p<0.001).[15]

X. CONCLUSION

The *Crataegus crenulata* is a multifunctional plant. We have reviewed this article with the purpose to revealed its current information. Each and every part of this plant are rich with nutrient. Thus, each and every part should be after proper examination it can be convert to useful form. The different pharmacological activities depend on the part of plant which is going to be use. This review article shows the almost collective details about the plant *Crataegus crenulata*. As if, once it passed from the proper clinical trials the plant will be singularly use for multiple purpose.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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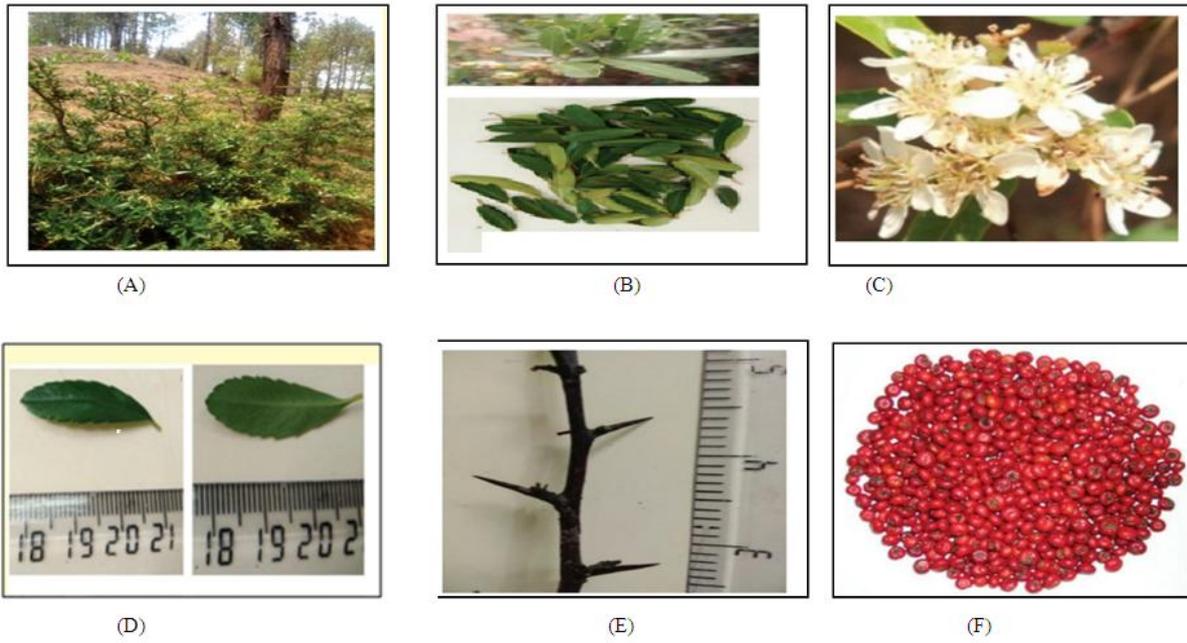


Figure no.: 1

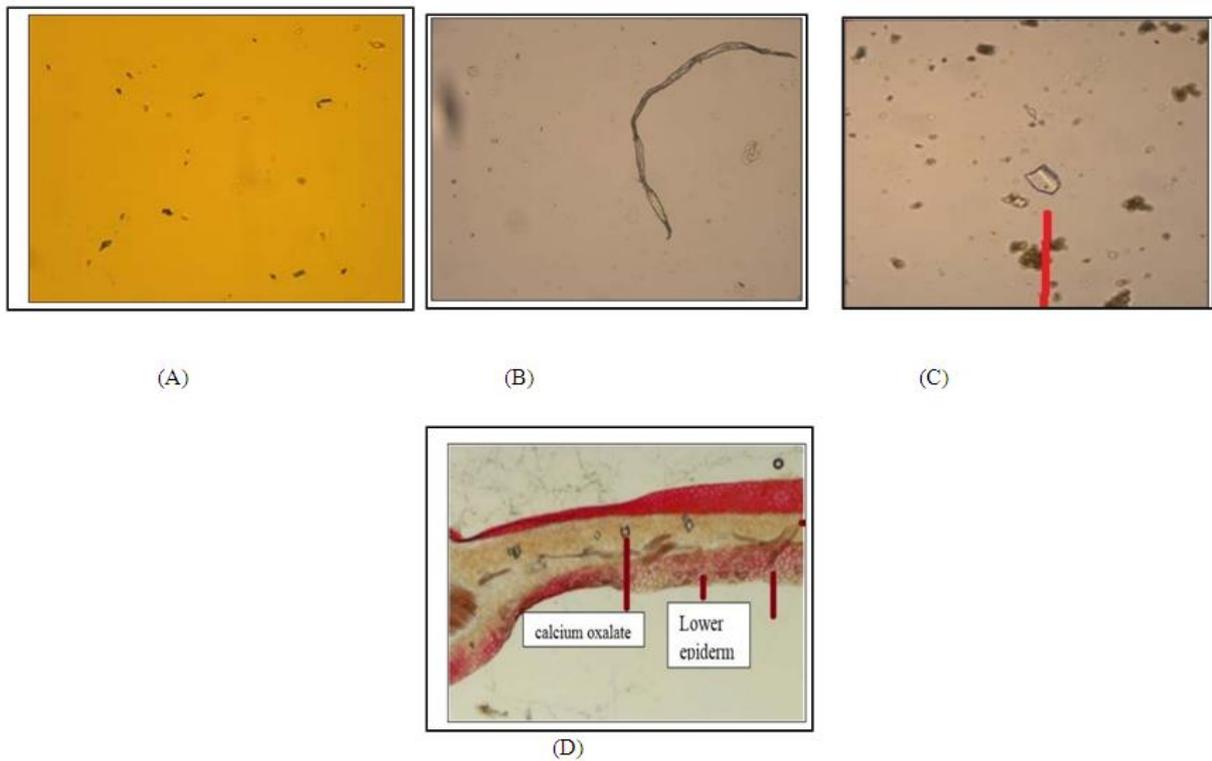


Figure no.: 2



Figure no.: 3

Figure no. 1: Morphology of *CRATAEGUS CRENULATA* [A] Plant, [B] Leaves, [C] Flower, [D] Leaf, [E] Thorns, [F] Fruit (Berries) [1]

Figure no. 2: Microscopy of *CRATAEGUS CRENULATA* [A] The leaf powder microscopy of *CRATAEGUS CRENULATA*, [B] Starch grain, [C] Glandular fiber, [D] Prismatic calcium oxalate crystal [3]

Figure no: 3: HRIDAYAMRI formulation made by Defence Institute of Bio-Energy Research (DIBER)[2]

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