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ABSTRACT

The natural products have been the source of most of the active ingredients of medicines and this is widely accepted since olden times even before the advent of high-throughput screening and the post-genomic era. Akarkara roots have an important part in the ancient Ayurvedic and Unani system of holistic health and herbal medicine of the East. Anacyclus pyrethrum DC. (family - compositae) is the biological name of the Akarkara drug. Especially the roots of the plant Anacyclus pyrethrum DC are reported to have good medicinal value in traditional and modern system of medicine. Pyrethrum has temperate and somewhat dry warmth and because of this good temperament it is a pure and has a good powerful action. A. pyrethrum roots hard, fusiform root, compact, about the size of little finger, with sometimes leaf –remnants at the top and beset with few or no hair-like rootlets, brownish externally and deeply fissured longitudinally. The present review highlights the biological study of Anacyclus pyrethrum including different activity such as antibacterial, antifungal, antiabetic, antioxidant, anticonvulsant, antidepressant, anxiolytic, inhibit release of acetylcholinesterase enzyme, anabolic, aphrodisiac, and reproductive, immunological active polysaccharides and memory enhancing activity. These studies are conducted using different animal models of each one activity. The main conclusion of this review article is that it is useful for the treatment of all the type of disease like the Alzheimer’s disease, diabetes, Anabolic, Aphrodisiac and Reproductive by using the different solvents like ethanol, petroleum, etc. Ethanolic root extract gives the maximum reliable results of Anacyclus. pyrethrum

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INTRODUCTION

Today, the medicinal plants have become more important in primary health care, because of their secondary metabolites which may play copious biological activities, against cancer and infectious diseases [1]. About 70% of population of all the world use traditional medicines derived from plant species for their treatment [2]. *Anacyclus pyrethrum* DC (Spanish chamomile) commonly known as Akarkara. It is widely recognized in ayurvedic system of Indian medicine as tonic and rejuvenator [3]. *Anacyclus Pyrethrum* from Asteraceae family and *Anacyclus* genus is a native plant of India and Arabic countries. The roots has therapeutic effects which is 5 to 10 cm in length and dark, grayish brown in colour. The roots have strange taste and causes saliva to flow. It is reported that the roots of *Anacyclus Pyrethrum* are strong sialagogue. The main active constituent of *Anacyclus pyrethrum* is Pyrethrine. The plant contain resinous matter include pelletoin, tannin, gum, potassium sulphate, carbonate, potassium chloride, calcium phosphate and carbonate. *Anacyclus Pyrethrum* has different uses. It relieves the dental pain, tooth decay and treating gingival diseases. The search of *A. pyrethrum* indicates the management of different disease. The main objective of this review study is to summarize the various biological activities of the plant *Anacyclus pyrethrum* which is commonly known as Akarkara.

BIOLOGICAL STUDIES

Antibacterial Activity and Antifungal Activity

In the oral cavity approximately or more than 500 different species of bacteria presents. After the first year of life *Streptococcus mutans* colonies appears but *Streptococcus sanguinis* colonies appears after tooth eruption. About the periodontal diseases, *streptococcus sanguinis* and *staphylococcus aureus* lead to gingivitis and peri implantitis respectively [4,6]. The main reason of the tooth decay is *Streptococcus mutants*. It has different uses for dental and periodontal disease.

The antibacterial effect of *Anacyclus pyrethrum* root was tested *in - vitro* [5,6]. For the screening of medicinal plants and identification of active principles a versatile microplate bioassay method is use for the quick and sensitive determination of antibacterial activity [7]. The pure extract of Akarkara gave the zone of inhibition 20mm, 17mm, 18mm and 17mm against *staphylococcus aureus*. The effective zone was calculated by subtracting the observed zone from actual diameter of disc i.e. 5mm. *Anacyclus pyrethrum* gave the antibacterial activity with the alcoholic extract [8]. The antifungal activity was determined by the disc diffusion method. The agar plates were inoculated and the activity was determined after 72 h of incubation at 28°C. diameter of inhibition zone was measured in mm [9,10].

Anticonvulsant Activity

The Ethanolic root extract of *Anacyclus pyrethrum* was determined for acute toxicity in the female albino mice. The doses of the ethanolic extract was given in 300, 2000, 5000 mg/kg. The evaluation of the anticonvulsant activity was determined by using maximum electroshock-induced seizures. The electric stimulus was applied using a stimulator apparatus[11]. The different phases of convulsions, viz. tonic flexion, extension, clonus and mortality due to convulsions, were timed. The pentylenetetrazole (PTZ) method is also used for studying the effect on seizure[12,13].

Antidiabetic Activity

*Anacyclus pyrethrum* has been effective remedy for the treatment of a variety of diseases. The aqueous root extract of *Anacyclus pyrethrum* DC was evaluated at a different concentration in alloxan induced diabetic rats. The experimental rats kept for 15 days to maintain the diabetic condition. In this the extract useful to treat the diabetic disease without causing hypoglycemic effect. The extract decreases the glucose level in alloxan diabetic rats. So it means the root aqueous extract of the plant *Anacyclus pyrethrum* is useful for the treatment for the diabetes mellitus [14].
Antidepressant Activity and Anxiolytic Activity

Depression and cardiovascular diseases are combined to each other. It means when patient suffers from cardiovascular diseases then there is a risk of increase the chances of depression and when it developed, cardiovascular risk is exacerbated further [15-17]. Different animal models are used for the evaluation of the antidepressant activity like forced swim test, tail suspension test, clonidine-induced hypothermia, Reserpine-induced hypothermia, locomotor activity, Haloperidol-induced catalepsy. In forced swim test is used for detect the immobility of the mouse in the water glass jar [18]. There is checking the total immobility of the animal. Anacyclus pyrethrum shows significant results with forced swim test and tail suspension test. Agitation is a highly energy consuming and immobility is an energy conservative process [19].

The action of anxiety and depression shows more severe and chronic illness and anxiety increase the risk of suicide in older patients with depression. Marble burying behavior is the model which makes an expression of defensiveness, some forms of anxiety, possessiveness, or compulsiveness [20,21].

Inhibit the Release of Acetylcholinesterase Enzyme

Alzheimer’s disease (AD) is a degenerative disorder [22] and is mainly associated with neurodegenerative changes which compromise not only cognitive functioning but also decline in functional abilities [23,24]. The patient which suffers from AD it means there is imperfection in the cholinergic system, for treat this disease there is necessary to increase the acetylcholine level in the brain and it is possible by inhibition of acetylcholinesterase enzyme (AChE)[25,26]. Three extract of different solvents like hexane, chloroform and ethanolic extract of Anacyclus pyrethrum were tested for their In-Vitro anticholinesterase inhibitory effect at different concentrations. Inhibitory activity on acetylcholinesterase enzyme of Anacyclus pyrethrum extracts was evaluated and percentage inhibition was calculated. But from these three extracts only ethanolic extract is active in action and Hexane extract don’t show any anticholinesterase inhibitory effect. On the other hand, chloroform extract shows there IC_{50} value at 150±3.68µg/ml. The presence of the phytoconstituent in the ethanolic extract can be preparing a safe and ideal drug for Alzheimer’s disease [26].

Antioxidant Activity

In vitro the antioxidant activity, in this determination of DPPH (1-1-Diphenyl 2-Picryl Hydroxy) is done by the different activity studies like Radical-scavenging, Hydroxyl Radical scavenging, Hydrogen peroxide scavenging, determination of reducing power, nitric oxide scavenging and assay of lipid peroxidation method is done for the Ex vivo study. Antioxidant activity gives the in vitro results. Anacyclus pyrethrum’s ethanolic extract was competent of scavenging the hydroxyl radical and hydrogen peroxide in a dose dependent manner. Phenol is the active compound found in the screening of Anacyclus pyrethrum. Due to the presence of phenolic compound nitric oxide have scavenging effect and the scavenging activity of EEAP increases in dose dependent manner. The result of reducing power it found that it is increases with the increased concentration of the test compound [27].

Anabolic, Aphrodisiac and Reproductive Activity

For the determination of sexual activity different studies should be performed. These are like as sexual organ weight, orientation behavior, penile erection, sexual behavior analysis, mounting, intromission behavior and effect of drug after withdrawal of treatment. After the use of petroleum ether extract the weight of body and sexual organ is increased [28,33]. The orientation behavior of the male treated rats is increased towards the females and this behavior of the rats recorded by using the camcorder (Sony, India) [29,33]. The penile erection is increased with the application of extract and this penile erection is determined by method which is reported by Benassi-Benali et al [30, 33]. The parameters follow for the detection of sexual behavior of the rats and it is done using the light and chamber [31-33]. In the PEE treated group of rats the mount latency and intromission latency were reduced.
The study of these parameters is completed in 28 days and the result of the behavior studies is conducted in 7 and 15 days after withdrawal of treatment. From this petroleum ether extract it is finally reported that the herbal drugs gives their effect sustained performance after the withdrawal of drug or extract and it is useful for the improved[33]. The study of histological examination gives the detail of microscopic evaluation and histoarchitecture of the thin section of testis [34,35].

There is In-Vivo and In-Vitro sperm count preservation should be done by using the male rats. The spermatozoa can be measured by using hematocytometer. For In-Vivo sperm count left and right epididymes of rats of each group were homogenized and prepared the suspension with 5ml of 1% sodium citrate solution and squashed it with the help of needle and forceps. The prepared suspension filtered through 80µ mesh and finally volume makes up to 10ml [36,35].

For In-Vitro the same procedure is repeated like In-Vivo method but in this 1mg/ml solution of aqueous extract is prepared and added in the sperm specimen in test sample in a ratio of 0.1:1. The spermatozoa were counted at 0 and 30 min. after incubation at room temperature (25± 1ºC) [37,35]. Seminal fructose content in aqueous 50 treated group the seminal fructose content is reported 2.04 ± 0.06 mg/g and in Aq100 it is 2.48 ± 0.62 mg/g [35].

**Immunologically Active Polysaccharides**

Medicinal plants having a large class of biopolymers with different structure which isolated the polysaccharides [38,43]. Different procedures are studied for determination of polysaccharide activity of *Anacyclus pyrethrum* extract. (1) Preparation of cell suspension (2) clearance rate of carbon particules (3) mitogenic activity (4) alkaline phosphatase assay. Lymphocyte suspension harvested according to Severinson and Larsson [39,43]. Prepared lymphocyte suspension divided in 2 parts (1) unfractionated lymphocyte suspension (2) placed through nylon wool column to obtain enriched-T- cell suspension. Enriched-B lymphocytes are obtained by washing off nylon wool adherent cells into cold culture medium RPMI 1640[40,43].

From the result of carbon clearance test it is found that PSI, PSII, PSIII increases the activity of macrophage In-Vivo[41,43]. Macrophages are the first line of defense against foreign invasion and neoplastic disease. Result of MTT assay indicate that polysaccharide PSI, PSII and PSIII had a mitogenic effect on T and unfractionated lymphocytes but the stimulation in case of unfractionated cells was higher than that observed with T cells alone [42,43].

**Memory Enhancing Activity**

*Anacyclus pyrethrum* ethanolic extract is useful in memory dysfunction. Three types of passive avoidance paradigms, elevated plus maze and social learning task is used for assess learning and memory. If the group is treated with *Anacyclus pyrethrum* extract then the transfer latency is decreased and cognition improvement indication in Elevated plus maze model. Ethanolic extract of A. pyrethrum improve the memory in different experimental paradigms in social learning task when it is given orally and brain cholinesterase level was measured to use central cholinergic activity. The ethanolic extract study of *Anacyclus pyrethrum* it increases the brain cholinesterase level and possess the memory enhancing activity in scopolamine induced amnesia model by enhancing central cholinergic neurotransmission [44].

**CONCLUSION**

*Anacyclus pyrethrum* DC has a great role in treatment of the disease. From the biological study of A. pyrethrum it is found that the root extract of this drug is very helpful in develop the different type of drugs related to the disease which is cured by A. pyrethrum extract. This plant is safe and very applicable for diabetes. It has a little antibacterial effect against oral bacteria like *streptococcus aureus* and *streptococcus sanguis*. It is active pharmacologically and rich in many constituents like pyrethrine, N-isobutyldienediynamide and
polysaccharides [45, 46, 47]. *Anacyclus pyrethrum* confirms the traditional uses of plant and it is used for the potential investigation for its Medicinal purposes as well as in the food industry.

**AUTHORS’ STATEMENT**

**Competing Interest**
The authors declare no conflict of interest.

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