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Review

Phytochemical and therapeutic potential of cucumber

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ABSTRACT

Cucumber (*Cucumis sativus* L.) is a member of the Cucurbitaceae family like melon, squash and pumpkins. It is a popular vegetable crop used in Indian traditional medicine since ancient times. This vegetable is very high in water content and very low in calories. It has potential antidiabetic, lipid lowering and antioxidant activity. Cucumber has a cleansing action within the body by removing accumulated pockets of old waste materials and chemical toxins. Fresh fruit juice is used for nourishing the skin. It gives a soothing effect against skin irritations and reduces swelling. Cucumber also has the power to relax and alleviate the sunburn's pain. The fruit is refrigerant, haemostatic, tonic and useful in hyperdipsia, thermoplegia etc. The seeds also have a cooling effect on the body and they are used to prevent constipation. Several bioactive compounds have been isolated from cucumber including cucurbitacins, cucumegastigmanes I and II, cucumerin A and B, vitexin, orientin, isoscoparin 2″-*O*-(6‴-(E)-p-coumaroyl) glucoside, apigenin 7-*O*-(6″-*O*-p-coumaroylglucoside) etc. Despite huge exploration of cucumber in agricultural field, comparatively very few studies have been published about its chemical profile and its therapeutic potential. This article reviews the therapeutic application, pharmacological and phytochemical profile of different parts of *C. sativus*. In this review we have explored the current phytochemical and pharmacological knowledge available with this well known plant and several promising aspects for research on cucumber.

Contents

1. Introduction

Cucumber (*Cucumis sativus* L.), belongs to the Cucurbitaceae family. It is commercially cultivated worldwide as a seasonal vegetable crop. It is native to India, found wild in the Himalayas

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from Kumaun to Sikkim and cultivated throughout the country with different vernacular names viz. cucumber (Eng.), Kheera (Hindi), Trapusha (Sanskrit), Shashaa (Beng.) and Vellarikkay (Tamil). Kirkbride (1993) has enlisted 70 synonymous for *C. sativus* [1].

It is widely consumed fresh in salads or fermented (pickles) or as a cooked vegetable [2]. Amongst 30 species of Cucumis, *C. sativus* has the most economic value [3,4]. The medicinal properties of the cucumber had been described since ancient times. Different parts of the plant viz. leaf, fruit and seed have been explored for their therapeutic benefits. *C. sativus* fruits and seeds (Fig. 1) have important therapeutic value in the Indian systems of medicine, particularly in Ayurveda where over 200 herbs, minerals and several formulations are available for management of aging [5,6]. They are widely used for various skin problems including swelling under the eyes and sunburn. It is believed that they promote refreshing, cooling, healing, soothing, emollient and anti itching effect to irritated skin [7]. In Chinese folk medicine the leaves, stems and roots are generally used as anti-diarrheal, detoxicant and anti-gonorrheal agents [8]. The leaves of the plant possess cooling and antioxidant effect. Several pharmacological activities including the antioxidant, antiwrinkle, antimicrobial, antidiabetic, and hypolipidemic potentials have been reported with this plant. Anti-hyaluronidase and anti-elastase activities have been proved for its cosmetic potentials [9]. Few bioactive compounds have been derived from this plant belonging to different chemical groups. Bitter principles Cucurbitacins (Cts) are the characteristic properties of this species. Despite the wide use of cucumber in folk medicine, very few studies have been reported in the scientific literature about its chemical consistency and its therapeutic activity [10]. In this review, we explore the current phytochemical and pharmacological knowledge about this well known plant species as well as several promising aspects for research on *C. sativus*.

2. Origin and phyto-geography

The genus Cucumis holds great interest dates back to Linnaeus for the study of its evolution. Evolutionarily, Cucumis genomes are labile, therefore large genetic varieties of cucumber are found in different parts of the world. Genus Cucumis is having 2 types of subgenus. The first type of subgenus was developed in the African region whereas another was developed in the Asian region [1,11]. Cytological study revealed that *C. sativus* is the only species in the genus with a chromosome number of n = 7, which evolved from a presumed ancestral karyotype with n = 12 [12]. There is much evidence to suggest that the cucumber is indigenous to Himalayan origin of northern India [3] and are domesticated in Asia [13]. In China, it is cultivated for at least 2000 years and occupies 2nd largest area among vegetables after Chinese cabbage. In India, this species has been cultivated with two forms: creeping form, cultivated in the field during hot season; and climbing form, cultivated during the rainy season [3]. Verities of Cucumber are conventionally separated in to four categories: (i) the exotic group of European and American cultivars; (ii) cultivar from the western part of India that are xerophytic in nature; (iii) Chinese cultivars with long fruits and glossy skin; and (iv) Himalayan type, mostly with rusty skin [3]. National Seed Corporation is promoting the 'Poinsett' variety of cucumber which was introduced from the USA and now popular in northern India. It is highly resistant to downey mildew, powdery mildew, anthracnose and angular leaf spot. Poona Khira in Maharastra, Balam Khira in Uttar Predesh, Khira 95 and Khira 90 in Himachal Pradesh are the diverse varieties accepted by the cultivator at different regions in India. Indian Agricultural Research Institute (IARI), New Delhi developed some new varieties of cucumber such as DC-1, Sel. DC 2 (Pusa Uday), DC-3 etc. [14,15].

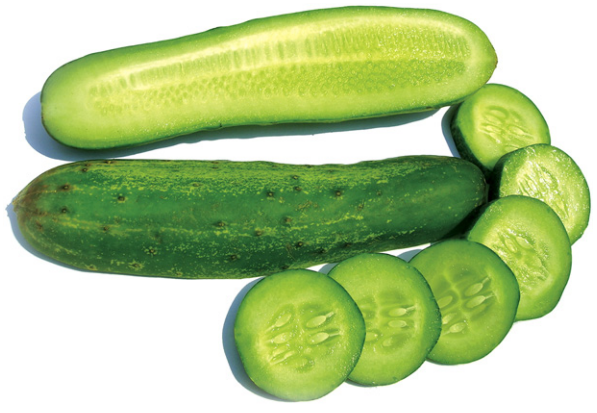

Fig. 1. *C. sativus* fruits and seeds.

3. Morphological characterization of different parts of plant

Cucumber is an annually growing creeping vine. Its leaves are hispidly hairy tralling or climbing type. Leaves are simple alternate, deeply cordate 3–5 lobed in both surfaces with a hairy margin denticulate. Flowers are yellow in colour; male flowers are clustered, bearing anthers with cohering, connective crushed or elevated above the cells whereas females are solitary thick covered with very bulbous based hairs [16]. Fruits are compressed, elongated, ellipsoid, dorsiventrally convex and laterally ridged with variable size. Seeds are cream or white, testa hard and smooth. Cucumber has enclosed dcoyledonous seeds and it develops from a flower, and therefore it is classified as a fruit. Micropyle pointed, distinctly visible; outer most layer of testa is absent and each cotyledon shows five distinct patches of small, thin walled, polygonal cells [6].

4. Phytochemical significance

Leaves, fruits and seeds of *C. sativus* contain numbers of phyto-constituents as shown in Fig 2. The presence of cucurbitacins (triterpenoid substances-well-known for their bitterness and toxicity), is the characteristic property of the family Cucurbitaceae. Structurally, Cts have a tetracyclic cucurbitane nucleus skeleton, namely, 9β-methyl-19-nor lanosta-5-enea, which is arbitrarily divided into twelve categories [17]. Cucurbitacins A, B, C, D, E and I **(1–6)** were identified in cotyledons of different verities of *C. sativus* seedlings [18]. Cucurbitacins have been reported as the bitter principle in the Cucurbitaceae family [19]. On maturity of the fruits due to the effects of the enzyme elaterase cucurbitacins are hydrolyzed