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Investigation of the Chemical Compounds, Antioxidant Effect and Therapeutic Properties of *Crocus sativus L.* (Iridaceae): A Review

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ABSTRACT

Saffron *Crocus sativus L.* (family Iridaceae) is produced in autumn also, is an expensive spice development in Mediterranean climates It takes between 110,000 and 200,000 flowers to harvest one kilogram of stigmas. Stigmas of Croci Sativa (Croci stigmas) is a pharmaceutical primary source, the important factors that impact the quality are soil and climate more than the quality of saffron is determined by secondary metabolites, including as a culinary addition due to their rich perfume, vivid color, and bitter flavor. However, it is more susceptible to forgery for commercial gain, causing danger to public health. The more crucial criterion for identifying crocin concentration is the property of saffron. A new source of antioxidants is the usual medication for depression. Crocus sativus, the central nervous system, depression, dopamine, the dopaminergic and serotonergic systems, picrocrocin, phytotherapy, neurotransmitters, safranal, saffron, serotonin, and physiologically active chemicals are all associated with antidepressant action. It has also been consumed in conventional medicine to handle a range of illnesses, including inflammatory and neurological problems. Saffron includes critical minerals and vitamins. Saffron's anti-aging and anti-oxidant properties make it popular in numerous regions around the globe. Furthermore, the capacity of crocetin, saffron, and crocin to lower the deleterious drug modulator effects of chemotherapeutic components was revealed. Properties saffron and its extract were found to be low- or non-toxic. The aim of this study for show a more therapeutic effect also how to use it to treat disease and produce saffron for medicine.

INTRODUCTION

Iridaceae family: *Crocus sativus L.*, is sometimes also called saffron crocus, so it needs little water for development (Masoomi et al., 2024; Rajabalizadeh et al. 2024) and is a native of Asia and Southern Europe Minor that is consumed medicinally, and areas with cold winters (Anaeigoudari, et al., 2023, Anaeigoudari & Kheirkhah-Vakilabad 2023). The plant may be found growing in Greece, Morocco, Spain, Italy, Iran, India, and Afghanistan (Cicco, 2022; Malavi et al. 2024). It is vegetatively reproduced. Also, asexual reproduction causes no genetic changes between farmed plants, thus there are no crosses or various types found globally. The plant has basal, stiff, lanceolate leaves and an underground tuber. Lilac-purple blooms with three stamens and six tepals are paired with a long-styled pistil and a tripartite dark orange stigma. Stigmas, also known as saffron, are in their flowering season and quickly dry after being harvested by hand. One kilogram of stigmas is harvested from between 110,000 and 200,000 blossoms. Stigma croci, or stigmas of Croci sativi, is used as a medicinal raw material. They are the most expensive raw materials and of significant economic importance (Bakshi et al. 2022; Lorenzo et al. 2023; Matraszek-Gawron et al. 2023).

The dehydrated stigmas from the Iridaceae perennial flower Crocus sativus Linn (Merzougui et al. 2024) provide saffron, a valuable plant. It is also known "red gold" or "golden condiment", Throughout history and geography, it has been documented in pharmacopeias and cookbooks such as the works of Avicenna's Canon of Medicine (Persian, 11th century), Apicius (Roman, 1st century), Materia Medica (Greek, 1st century), and the Ebers Papyrus (Egyptian, 1550 BC) are examples of Ayurvedic literature from India. In addition, it is used as an aromatic in fragrances and cosmetics and as a color in food and textiles, saffron is recognized for its ability to decrease the pigment melanin. It effectively lightens the skin (Berrichi, 2019; Kour et al., 2023; Mzabri et al., 2019). Also For over 3000 years, flowers like roses and saffron have been employed in Iranian cuisine (Spence, 2023a). These floral dried parts are frequently the colorful flowers of the stigmas, even if they could also include other floral tissue, including filaments and styles. The plant is red, and it smells quite good and tastes harsh. In addition to its many other uses, traditional medicine has employed it as an antidepressant, an anticarcinogen, and a stimulant. Because of its polyploidy, saffron is sterile; it only multiplies vegetatively through the daughter corms. Its asexual reproduction prevents breeding, so the selection of advantageously modified corms is the only direction it may go. Regional variations in morphology and biochemistry exist between these clones. Aberrant morphology is uncommon. Usually, this manifests as stigmas with three branches or fewer that are created when buds fuse to form blooms. The limited production methods of saffron contribute to its value. Harvesting is a laborious process that cannot be easily mechanized. Autumnal saffron blooms. Harvesting should only be done in the first bloom as the previous night's frost will damage the flower. Picking is therefore restricted to single blooms. The subsequent process of separating the stigmas and styles is typically tedious as well, and the laborer must take care not to harm the plant (Siddiqui et al. 2022).

The life cycle for saffron consists of a summer resting duration, an autumnal production of foliage and flowers, and stubborn leaves that disappear by the end of spring or early summer. The life cycle depends critically on the temperatures of the soil and air, which influence the onset and end of dormancy as well as floral induction throughout the dormant season. For corms to yield blooms in the fall, they need to be exposed to summertime temperatures of between 23 and 27 °C for almost 50 days. Summertime highs of 30 °C encourage the production of larger corms for the next spring. Numerous production tactics, such as planting date and depth, can change the temperature that the corm is exposed to. Cultivating saffron corms is widespread. 10 to 30 cm deep, while the majority of studies point to a depth of 10 to 20 cm (Abd Rahim et al. 2024; Amine Ayari et al., 2022b). During the summer, soil temperature declines with depth, implying that planting should be done. In northern latitudes, which are closer to the surface than in warmer regions. However, planting too shallowly might expose the corm to the cold. Additionally, research has demonstrated that as depth decreases, corm or bulb growth increases in several geophytes, including saffron. On the North American market, imported corms are available only in August, even though native plants don't reach maturity until early July. Because of this, corms sourced locally could not be available for purchase until at least mid- to late-July. Although saffron grows slowly, mineral fertilization increases the crop's yield (Amine Ayari et al. 2022a). Further research was conducted to examine saffron's photosynthetic efficiency, biomass partitioning, shape, and metabolic properties as well as the impacts of various red and blue light ratios (such as 100%, 75%, 50%, 40%, 25%, and 0% blue light). Increases in the blue-to-red ratio have been shown to modify biomass partitioning to harvestable organs (flowers and corms) in saffron and increase the output of high-quality daughter corms (Gao et al. 2023). Therefore, the current study aims to know the effective properties of saffron and the possibility of using it in the fields of medicine and nutrition as it is a strong antioxidant.

METHODS

The knowledge presented in this article review was gathered by exploring various scientific websites. This research included the antioxidants, chemical compounds of saffron, the benefits, and the medical usage of saffron 2024.

Drying Saffron

Saffron is the dried stigma of the Crocus sativus L. blossom and is consumed as an addition culinary and considered a valuable commodity due to its yellowish hue, bitter flavor, and distinctive scent (Abd Rahim et al., 2024). Saffron is a dried flower known like *Crocus sativus L.* is highly valued in the market. This study tested how numerous dryers, such as Oven drying, Pyrex glass, and a reflectance window (RW) with Mylar membrane 200 or 300 μm, impact saffron at 25, 60, 70, and 80 degrees Celsius. An RW drier with higher temperatures Pyrex glass surface (70 and 80 degrees Celsius) produced the greatest amounts of picrocrocin, safranal, and crocin for saffron stigma. They discovered that the crocin content was highest (15–17%) in samples dried at 35–50 °C in a Cineithera sun dryer or oven drier. Indices for conventional (25 °C), Spanish-modified (55 °C), and saffron microwave ovens (300 W). We used a hybrid solar dryer that combines photovoltaic and thermal technology with a heat pump to dry saffron. We next examined the drying kinetics and indicators of the dried samples. They found that a 62% reduction in drying time was achieved by increasing the air temperature. In addition, using a heat pump reduced drying time by forty percent (Aghaei et al., 2018) however, to make 1 kilogram of dried saffron threads, between 70,000 to 200,000 blooms must be hand harvested (Spence, 2023b).

Chemical Compound of Saffron

Table 1. Chemical compound of saffron

Rates %	Chemical compound
12%	Protein
10%	Moisture
5%	Minerals
5%	Fat
5%	crude fiber
63%	Sugars

(starch, pentosans, reducing sugars, pectin, and gums) (Mirhadi and Malaekeh-Nikouei, 2020).

Obesity is an important health issue, and it has emerged as a high-risk factor for a variety of noncommunicable illnesses, including hypertension, stroke, coronary heart disease, type 2 diabetes, and some malignancies. The World Health Organization (WHO) reports that 39% and 13% of adults over the age of 18 are overweight or obese, respectively. The most common solutions offered by doctor's nutrition and exercise are important for fat individuals. However, some people are not able to reduce their weight to a healthy BMI range. Anti-obesity medication treatment, like the serotonin and noradrenaline inhibitor and the pancreatic lipase inhibitor orlistat sibutramine, must thus be administered. Nevertheless, chronic use of these drugs for the management of obesity may have undesirable side effects, such as increased heart rate and blood pressure, reduced high-density lipoprotein, and gastrointestinal side effects in obese individuals. Nowadays, interest in obesity medications is growing rapidly products, particularly those derived from plants, are used to treat obesity. Technically speaking, saffron is called *Crocus sativus L*, and is a stemless, perennial plant. Aside from coloring and flavoring components, saffron has long been employed in Middle Eastern and Mediterranean traditional medicine as a natural remedy. Three primary bioactive components of saffron are its fragrant Safranal, picrocrocin, its bitter components, and its coloring agents, crocetin, and its glycoside, crocin (Asil, 2023). It has been found that saffron and its bioactive component crocin significantly reduce food intake, body weight increase rate, In obese mice, total fat pad, body-to-epidymal fat weight ratio, plasma triacylglycerol (TAG), and total cholesterol. Nevertheless, it is still unclear how saffron reduces obesity through what mechanisms. Consequently, further preclinical research is needed to determine whether saffron can be used to make safe and effective anti-obesity medications (Ramli et al., 2020).

Saffron, or the stigma of the Crocus sativus flower, has been utilized as a functional diet to ward against disease. Safflower's pharmacological and biological characteristics, as well as its active component, as well as its potential therapeutic applications for a variety of disorders, have been thoroughly investigated. In comparison to the control, saffron extract (80 mg/kg body weight) significantly reduced plasma total cholesterol levels and improved the atherogenic index (lower LDL/HDL values). Furthermore, Experimental rats were injected with 0.8 g/kg body weight of saffron aqueous extract, causing edema in the rat's paw. This allowed researchers to assess the minimal to moderate anti-nociceptive and anti-inflammatory impacts of saffron extract-consuming Wistar rats, an animal model of chronic inflammation (Mashmoul et al., 2016).

Saffron has been consumed as a nutritional staple in several regions of the globe since prehistoric times. It is consumed for culinary purposes (Poudel et al., 2023). It has also been consumed in conventional medicine to heal a variety of conditions, including inflammatory and neurological problems. Saffron's pharmacological actions are linked to numerous of its active ingredients, including coloring ingredients (e.g., crocetin and crocins), bitter basics (such as picrocrocin), and volatile agents (such as safranal). Crocetin's cis and trans glucosyl ester is crocin, a special kind of water-soluble carotenoid (Asdaq et al., 2024; Poudel et al., 2023). It has been demonstrated that saffron and its main component, crocin, have hypotensive, antihyperlipidemic, and antidiabetic effects. However, other data suggest that saffron might increase satiety and encourage weight loss. So, bioactive components of saffron can affect many metabolic diseases that occur via various routes. The current randomized clinical research aimed to examine the effects of saffron a major carotenoid, crocin, on lipid profiles, hunger levels, nutritional consumptions, anthropometric measures, and the constitution of the body in individuals suffering from heart attack in the coronary heart (Abedimanesh et al., 2017).

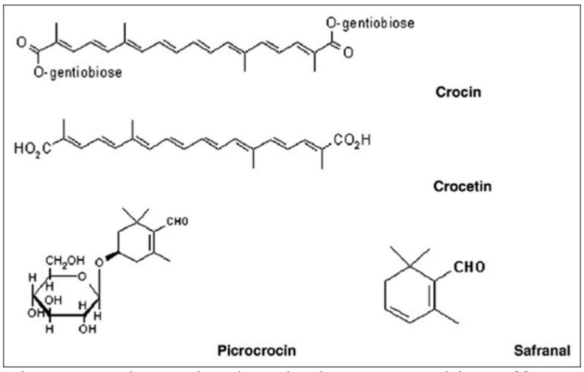

Figure 1. The main chemical compound in saffron

Saffron includes critical minerals and vitamins. It is also high in vitamins, including vitamin A, B1 (thiamin), B2 (riboflavin), niacin (B3), B9 (folic acid), vitamin E, and mineral salts (Cerdá-Bernad and Frutos, 2023). The saffron flower's development requires the primary nutrients (nitrogen, phosphorus, and potassium), trace elements (iron copper zinc manganese molybdenum, and boron), and additional minerals known as major (Ca, Mg, Na, and K) (Oubella et al., 2023). Saffron's anti-aging and anti-oxidant properties make it popular in some regions of the globule. Furthermore, the capacity of crocin and crocetin in saffron to reduce the deleterious impacts of chemotherapy constituents demonstrated their medicine-modulator properties. Saffron and its extract were found to be low- or non-toxic. In a randomized controlled experiment, sub-chronic administration of 100 mg/day saffron was found to have transient immunomodulatory efficacy without any renal, hepatic, hematological, or other adverse effects. Studies have shown that these chemicals induce anti-inflammatory and ant-fibrotic replies by lowering mediators of inflammation in various animals, It is in line with our earlier research, which showed how crocin reduces inflammation in a mouse model. Saffron effectively reduced the levels of Bleomycin-induced lung fibrosis: the role of malondialdehyde and inflammatory cytokines. Additionally, crocin significantly reduced the upregulation of fibrotic markers in hepatic fibrosis, including collagen 1a, a-smooth muscle actin, and transforming Growth Factor-β (Arjmand et al., 2021).

RESULTS AND DISCUSSION

Antioxidant Effect of Saffron and its Active Compounds

Crocin is carotenoid ($C_{44}H_{64}O_{24}$) a key component of saffron, and has been found to have strong antioxidant capabilities (Mohd et al., 2023; Rajabalizadeh et al., 2024). Aβ (Amyloid beta) and Tau proteins are linked to oxidative stress in Alzheimer's disease. Free radicals are what cause OS, which are groups or atoms like hydroxyl, superoxide, and nitric oxide that have unpaired electrons. The nerve cells' lipid, protein, RNA, and DNA bilayers are among the bodily tissues and cells that OS may damage. Neurodegenerative illnesses (NDs) like Parkinson's disease, amyotrophic lateral sclerosis, and Alzheimer's disease have been linked to oxidative damage to nerve tissue. Research indicates a robust connection between Tau protein, amyloid β (Aβ), and OS in neurons. Aβ collection can harm mitochondria, resulting in malfunction and the generation of OS reactive oxygen species (ROS). ROS can also increase the synthesis of Aβ. Tau phosphorylation and aggregation may be accelerated by free radicals, such as oxidized Fe3+.

Moreover, tau accumulation and hyperphosphorylation may impede mitochondrial activity, producing a large amount of ROS. Hyperphosphorylation of Tau can result in structural changes and aggregation, and hyperphosphorylation can be caused by chronic OS and peroxides like as 4-hydroxynonenal. Important roles in AD pathogenesis are played by Aβ aggregation and Tau hyperphosphorylation. Moreover, substantial amounts of iron ions have been seen in the brains of people with Parkinson's disease and Alzheimer's disease, and OS is associated with free iron concentration in cells. Consequently, one may say that OS and ND are intertwined, but, Enzymes such as catalase, superoxide dismutases, and glutathione peroxidase offer cellular defense against free radicals (Hosseinzadeh &Montahaei, 2007; Yang et al., 2023).

Utilizing C. Sativus for Therapeutic Action, Industry, and Herbal Medicine

C. sativus bioactive substances have a wide variety of uses due to their beneficial health effects. They are utilized in a variety of sectors, including pharmaceuticals, cosmetics, dairy, and foods. Additionally, the production of nutraceuticals and nanotechnology—including nanomedicine and nanocosmetics—uses these phytochemicals. In addition, they are employed in genetic research, cosmetic marketing, adjuvant therapy, chemopreventive treatment, therapeutic practice, and transgenic plant manufacturing. Numerous research and cell line investigations are now being undertaken in several biological field models and clinical trials are now underway to test the saffron crocus's organs' physiologically active chemical components' pharmacological effectiveness in treating certain ailments. These chemicals have a wide range of beneficial therapeutic effects, including antidepressant, anxiolytic, and anti-inflammatory properties. Saffron crocus' biologically active chemical components have several kinds of action that have been shown, leading to antibacterial, anticancer, analgesic, anticonvulsant, antitussive, antigenotoxic, and anticytotoxic, relaxant, antihypertensive, and antioxidative properties (Bhagat & Vakhlu, 2024; Matraszek-Gawron et al., 2023).

In an animal model, saffron was also shown to alleviate cognitive problems associated with Alzheimer's disease. As far as we are aware, just one research looked at the neuroprotective properties of crocin on traumatic brain injury in a controlled cortical model in mice influence, illustrating improvements in brain edema, a reduction in microglial activation, and a decrease in cell apoptosis 24 hours after damage. The goal is to assess, by histological, and behavioral analysis explorations, as well as measurements of oxidation and inflammatory indicators, the neuroprotective qualities of crocin and saffron extract in a model of recurring moderate traumatic brain injury in mice. Encouraging results might aid in the development of therapeutic approaches, particularly for athletes and those who regularly suffer from head concussions (Salem et al., 2022). Furthermore, the active compounds in saffron stigma perform important functions in stimulating blood, resolving stasis, cell regeneration, stomach strengthening, and menstruation disorders (Zhu et al., 2022).

Saffron Usage

Because of its extensive uses of therapeutic properties and pharmacological, it is the most expensive spice. Saffron has just three stigma, which was consumed in a variety of uses, including as a culinary addition due to their rich perfume, vivid color, and bitter flavor (Ruiz Pulpón, Cañizares Ruiz, and Martínez Sánchez-Mateos 2023). Despite ongoing efforts to boost production and cultivable areas, many restrictions hinder these initiatives. Saffron growth in a synthetic environment can benefit from automated settings made possible by the Internet of Things sensors. The following are difficulties in producing fake saffron: identifying optimal values of agricultural factors crucial for development (Kour et al., 2023). Another factor for poor quality is a lack of suitable storage rooms near harvesting areas that are developed according to scientific standards, giving a dry and dark environment to safeguard the crop from rots. Remove stigmas carefully so as not to damage the plant. To preserve the stigmas' advantages, it is important to keep drying temperatures low—below 55 °C—while preparing the stigmas for storage. The lack of suitable storage areas close to the harvesting areas, which are created by scientific guidelines and offer a dry, dark environment to prevent crop rots, is another factor contributing to the quality being degraded (Ganaie & Singh, 2019; Kour et al. 2023). The species of plant is triploid and is mostly grown from corms. The main environmental elements that influence saffron production are soil quality, temperature, photoperiod, and topography (Javed et al., 2023).

Using (Plant Growth-Promoting Rhizobacteria) treatments consisting of Paenibacillus durus CB1806 and Bacillus megaterium CB97032 (also known as the Pgpr treatment) and an AMF (Arbuscular Mycorrhizal Fungi) treatment consisting of Rhizophagus intraradices (also known as the Myc treatment), saffron was grown hydroponically in this study. These interventions were used alone as well as in combination. The study evaluated how these treatments affected several phases of crop growth, including blooming patterns, bloom and spice yields, secondary metabolites, ecophysiological parameters, and corm production. Underlying the investigation was the hypothesis that using these microbes in combination would have synergistic benefits. In this study, PGPR Bacillus megaterium CB97032 either alone or in conjunction with the AMF Rhizophagus intraradices (Myc therapy) and durus CB1806 (Pgpr treatment).

All crop stages were investigated for their effects on corm production, flower and spice output, blooming trend, secondary metabolites, and ecophysiological parameters under the theory that microbial synergy Positive influences were seen on these parameters. While the bioinoculants increased the safranal content (by up to 96% in all treated plants), they did not affect floral or spice yield. The saffron spice's total phenolic content was enhanced by 19% when the PGPR and AMF were combined. The ecophysiological analysis showed no alterations, however the infected plants produced more corms. More substitute corms (for Myc plants, up to +13%), may be produced with the single-type bioinoculants whereas less their dimensions and weight. The corms reverted to their previous size when united. Additionally, the weight of the highest corm part (> 1.5 cm) was increased by 24% by the PGPR and AMF. Hence, rather than serving as biofertilizers by raising yield, the bioinoculants can promote secondary metabolism in plants by devaluing qualitative characteristics, at least during blooming. All things considered, PGPR and AMF are viable horticultural methods in hydroponics for raising saffron quality, particularly when utilized in mixed formulations (Stelluti et al., 2023).

Intervention and Comparator Characteristics

Crocus sativus L. was supplied at dosages ranging from 15 to 100 mg per day. All trials administered saffron supplements in the form of pills, tablets, or capsules. Sahebari and colleagues utilized a pure saffron powder derived from saffron flowers. Dried and ground Crocus sativus L. stigma (IMPI-RAN, Tehran, Iran) was used in the Shakiba experiment to create tablets that were given out as saffron pills (not indicated). Procedures for extraction were included in only two studies. The presence of other chemicals in the supplied tabs was noted in two trials; however, no RCT was able to validate the precise composition of the final products based on the spectrometry analysis of the capsules' crocin and safranal contents. The intervention lasted between eight weeks and four months. Intervention and Comparator Characteristics The administered drug Four RCTs employed placebos, whereas one used duloxetine to compare its efficacy for depression in FM patients (Tsiogkas et al., 2021).

Effect of Saffron on Diabetes

One of the most prevalent diseases impacting individuals today is diabetes. Type 1 and type 2 diabetes are two categories of the chronic metabolic condition known as diabetes. The amount of glucose released into the circulation is controlled by the hormone insulin. A problem with insulin secretion or action is the cause of this disease. More than 90–95% of people with type 2 diabetes have amyloid accumulation in their pancreatic islets. This deposit is mostly made up of a peptide called islet amyloid polypeptide (HIAPP). Pancreatic beta cells generate HIAPP, a 37-amino acid peptide hormone, in a 1:10 ratio to insulin. It rises simultaneously and is thought that the hIAPP is accumulated and the formation of amyloid plaques were the results of this concentration rise. Because pancreatic beta cells emit insulin and are poisoned by these deposits, which kill them, the disease progresses more quickly and has a detrimental effect on the patients' bodies. Molecular dynamics modeling was used to investigate the impacts of inhibitory saffron constituents on the formation of the human islet amyloid polypeptide. It was simulated that safranal, picrocrocin, crocin, and crocetin would adsorb onto amyloid fibrils. Perhaps this simulation will shed some light on their particular atomistic interaction mechanism. The amyloid fireball and saffron components and electrostatic potentials were evaluated. Using Amyloid's conformational alterations, including a radius of gyration and secondary structure fibrils were investigated.

These results could clarify how organic elements inhibit amyloid fibrils. Molecular dynamics modeling was employed in this work to assess the saffron components' ability to suppress the development of amyloid fibrils. Following adsorption, the structures of hIAPP in the aqueous medium and the saffron constituents (picrocrocin, crocin, crocetin, and safranal) were compared. The findings showed that the compounds with the greatest van der Waals and electrostatic interaction with human islet amyloid polypeptide (hIAPP) were crocin and crocetin. Additionally, there has been a decrease in the adsorption of crocin and crocetin (Azgomi et al., 2024; Candar et al., 2018; Kordzadeh et al., 2024).

The Side Effect of Saffron

Safranal is more hazardous than crocin or saffron in acute studies. In animal tests, crocin at pharmaceutical levels did not cause significant damage to major bodily organs. Nonetheless, a clinical experiment on crocin tablets has shown that this component is a safe herbal product at therapeutic levels. Similar investigations on saffron pills did not reveal any clinical harm in healthy participants. In terms of hematological and biochemical parameters, safranal is more poisonous than saffron or crocin (Bostan et al., 2017).

Disease Effect Saffron

Bacillus is recognized as a classic genus for biological disease control in plants (Magotra et al. 2021). Saffron stem rot induced by pathogens *Fusarium oxysporum* is the main pathogen affecting saffron production, especially corm rot infections caused by fungal and bacterial pathogens (Bhagat & Vakhlu, 2024; Ebrahimi et al., 2024). *Burkholderia gladioli pv. gladioli* are the cause of saffron leaf and corm rot disease. The bacteria persist in the ground and disperse over time via contaminated soil, agricultural implements, and corms ("Yu-Pps-V12n1p74-En.Pdf," n.d.). To combat diseases, corms are often chemically treated before planting (Gallo et al., 2024).

Conclusion

For ages, people were dried stigma of the Crocus sativus plant is used for food and medicine in Central Asia, Iran, China, India, Turkey, Algeria, and Europe. The biological chemicals that are particularly active in producing color, flavor, and scent include crocetin, crocin, picrocrocin, and safranal. These were connected to feelings of melancholy and anxiety and have a substantial effect on the central nervous system. Additionally, neuroprotective and anxiolytic, these bioactive substances have potential benefits for learning and memory deficits. The most prevalent anti-depressants recommended by physicians are tricyclic antidepressants (TCAs) and selective serotonin reuptake inhibitors. In a diabetic mouse, saffron, crocin, and safranal treatment have antidiabetic benefits via modulating oxidative stress and bolstering the antioxidant defense system.

These results further bolster the possibility that saffron and its active ingredients might help control diabetes and its complications. However, further research in human models is required to fully identify the preventive mechanisms of saffron, crocin, and safranal against diabetes and associated consequences. Terpenes and phenols are nutraceuticals with known pharmacological effects. The authors declare that there are no conflicts of interest regarding the publication of this paper. Their measurement is critical for assessing the saffron spice's quality for use in food and medicine, as well as determining the potential effectiveness of certain bio inoculants.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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