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Chemistry and pharmacological effect of beta vulgaris: A systematic review

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ABSTRACT

Beta vulgaris is a plant native to Mediterranean, the Atlantic coast of Europe, the Near East, and India belong to Amaranthaceae, Genus Beta, and Subfamily Betoideae. The aim of this study is to overview Chemistry and pharmacological effect of beta vulgaris .This review article was carried out by searching studies in PubMed, Medline, Web of Science, and IranMedex databases up to 2016.Among 89 found articles, 54 articles were included. The search terms were "Beta vulgaris", "therapeutic", and "pharmacological", "Chemistry". Various studies have shown that Beta vulgaris possess anti-inflammatory effect, antioxidant Properties, anti-stress effect, anti-Anxiety and anti-depressive effect, anti-cancer, antihypertensive effect, hydrophobic properties, anti-sterility effects. The result of this study have found various constituents of Beta vulgaris exhibit a variety of therapeutic effects with little or no associated toxicity. These results are very encouraging and indicate this herb should be studied more extensively to confirm these results and reveal other potential therapeutic effects. Clinical trials using Beta vulgaris for a variety of conditions should also be conducted.

Keywords: beta vulgaris, therapeutic, pharmacological, pharmacognosy

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INTRODUCTION

It is proved that herbal medicine is effective in the treatment of many diseases [1-21]. *Beta vulgaris* [beet] is a plant native to Mediterranean, the Atlantic coast of Europe, the Near East, and India belong to Amaranthaceae, Genus *Beta* [22]. Beta *vulgaris* is an herbaceous biennial or, rarely, perennial plant with leafy stems growing to 1–2 m tall [23]. The leaves are heart-shaped, 5–20 cm long on wild plants[24]. The flowers are produced in dense spikes. The fruit is a cluster of hard nutlets. Beets are a food plant for the larvae of species. The roots and leaves of the beet have been used in folk medicine to treat a wide variety of ailments [25, 26]. It is used as a laxative, wounds healing, aphrodisiac, digestion and the blood disorders. 'garlic-breath nullifying effect', against oxidative stress[27] ,neuroprotective effect[26],antifungal [28],antihyperglycemic[29],anti-inflammatory[30],anticancer[31] activities.

Pharmacological Activities

Anti-inflammatory effect

The protective effect of (Beta vulgaris L.) beat root ethanolic extract (BVEE) on gentamicin-induced nephrotoxicity and to elucidate the potential mechanism was investigated. BVEE treatment significantly reduced the amount of cleaved caspase 3 and Bax, protein expression and increased the Bcl-2 protein expression. BVEE treatment also ameliorated the extent of histologic injury and reduced inflammatory infiltration in renal tubules. These findings suggest that BVEE treatment attenuates renal dysfunction and structural damage through the reduction of oxidative stress, inflammation, and apoptosis in the kidney [32].

The ribosome inactivating protein BE27 displays several biological activities in vitro that could result in a broad action against several types of pathogens. Beetin 27 [BE27], a ribosome-inactivating protein [RIP] from sugar beet [Beta vulgaris L.] leaves, is an antiviral protein induced by virus and signaling compounds such as hydrogen peroxide and salicylic acid. BE27 possesses superoxide dismutase activity, thus being able to produce the signal compound hydrogen peroxide. BE27 is also toxic to COLO 320 cells, inducing apoptosis in these cells by either activating the caspase pathways and/or inhibiting protein synthesis. The combined effect of these biological activities could result in a broad action against several types of pathogens such as virus, bacteria, fungi or insects [33].

Antioxidant Properties

The effects of home-processing on the antioxidant properties and in vitro bioaccessibility of red beetroot bioactives were investigated. The in vitro digestion method revealed the highest recovery for TP [16%] and TAC [1.3%] in jam. This study provides comparative data to evaluate the effects of various home-processing techniques on antioxidant potential of red beetroot products [34].

The plasma bioavailability of betanin and nitric oxide [NOx] after consuming beetroot juice [BTJ] and whole beetroot [BF] was evaluated. BTJ and BF were also analysed for antioxidant capacity, polyphenol content [TPC] and betalain content.These data reveal that BTJ and BF are rich in phytonutrients and may provide a useful means of increasing plasma NOx bioavailability. However, betanin, the major betalain in beetroot, showed poor bioavailability in plasma[35].

Restricted irrigation provides a viable means to maintain leaf vitamin content after harvest in S. oleracea, an important finding for producers, retailers and consumers alike [36].

The effect of chard extract (Beta vulgaris L. var. cicla) on the antioxidant system and the expression of surfactant-associated proteins [SP] in the lungs of hyperglycemic rats were examined. All treatments have a positive effect on the surfactant and antioxidant systems of the lungs of hyperglycemic rats. The best therapeutic effect was provided by treatment with chard extract alone in the compensation of hyperglycemic symptoms [29].

Betalains, natural plant pigments, are beneficial compounds due to their antioxidant and possible chemoprotective properties. The results are crucial in the application of completely food-grade solvent systems in separation of food-grade compounds as well, and the systems can possibly be extended to other ionizable and polar compounds with potential health benefits[37].

The biochemical influence of broccoli and beet extracts on selected individual additives $NaNO_2$ or sunset yellow treated rats was investigated. The result demonstrated that Oral administration of $NaNO_2$ or sunset yellow caused a significant increase in serum levels of AST, ALT, ALP, urea, total lipids, and triglycerides, as well as a significant decrease in GSH, GSH-px, and SOD compared to the positive group. In conclusion, this study showed that broccoli and beet extracts have a protective effect against $NaNO_2$ or sunset yellow in rat treated groups[38].

The effects of TAP on antihyperglycemic, antioxidant, and pancreas-protective in streptozotozin [STZ]-diabetic rats was investigated. Triterpenic acid from Prunella vulgaris L. has an anti-diabetic effect, by controlling blood glucose and antioxidants, and has a protective effect on the pancreas[39].

It was found that betalain extracts obtained from hairy root cultures of the red beetroot B. vulgaris. The presence of 4-hydroxybenzoic acid, caffeic acid, catechin hydrate, and epicatechin were detected in both types of extract, but at different concentrations. Rutin was only present at high concentration [1.096 mg.g[-1] dry extract] in betalain extracts from the hairy root cultures, whereas chlorogenic acid was only detected at measurable concentrations in extracts from intact plants[40].

Crude aqueous and ethanolic extracts of root tissue of red [Rd] and high-pigment [HP] beet [Beta vulgaris L.] strains exhibited antioxidant and phase II enzyme-inducing activities. Lack of effect and diversity in response to diet may be related to the wide range in absorptive capacity of and/or insufficient level or enrichment of the active agents or to difficulties in assessing such activity in vivo. Subsequent to the animal studies, betanin was isolated in pure form, identified by MS analysis, and confirmed to be QR inducers in the bioassay [41].

The inhibitory ability of Beta vulgaris L.on proliferation both on human colon cancer [RKO] cells and normal human fibroblasts was tested. Xylosylvitexin is the main and more efficient chemopreventive compound in BV seeds, but the natural cocktail of molecules, represented by P4 fraction, showed a better compromise between the antiproliferative activity on RKO cells and the enhancement of HF proliferation [42].

Anti-stress effect, Anti-Anxiety and anti-Depressive effect

The protective effect of Beta vulgaris Linn. Ethanolic extract [BVEE] of leaves against acute restraint stress [ARS]-induced anxiety- and depressive-like behavior and oxidative stress in mice was investigated. BVEE exhibits anxiolytic and antidepressant activity in stressed mice along with good antioxidant property suggesting its therapeutic potential in the treatment of stress-related psychiatric disorders. ARS-induced oxidative stress was prevented by BVEE pretreatment in mice [43].

Anti-cancer

Table beet affects numerous biochemical reactions, enzymes and metabolic-synthesis.According to results, it seems that moderate and permanent consumption of table beet product affects the life expectancy of patients favorably; however, due to the increasing values of EGF, medical control is necessary for patients with prostate cancer treated by chemotherapy [44].

The cytotoxic effect of the red beetroot extract with anticancer drug, doxorubicin [adriamycin] in the androgen-independent human prostate cancer cells [PC-3] and in the well-established estrogen receptor-positive human breast cancer cells [MCF-7] was compared. The result showed that the beetroot extract had significantly lower cytotoxic effect than doxorubicin [8.6% vs. 100%, respectively, at 29 µg/ml concentration of each, three-day test period]. The results suggest that betanin, the major betacyanin constituent, may play an important role in the cytotoxicity exhibited by the red beetroot extract[45].

The preventive role of beetroot extracts against cancers and their cytotoxic activity on cancer cells was examined. The betanin-enriched extract had no obvious effect towards normal cell lines. The result showed the betanin/isobetanin mix as therapeutic anticancer compound, alone or in combination with classical chemotherapeutic drugs, especially in functional p53 tumors[46].

Inhibition of HepG2 cell proliferation by betanin and betaine was also tested. The results indicated that the contents of health-beneficial compounds in beetroots, betalains and betaine, could be increased by modifying the growing conditions and that betanin and betaine extracted from beetroots had some anticancer effects against HepG2 cells[47].

Cytotoxic investigation with B and D in several human cancer cell lines indicated their potential for synergistic activity. The results indicated that an overall positive reduction in drug concentration was achieved by D when combined with B in its cytotoxicity profile in the three human cancer cells tested. The results warrant further studies on the potential of red beetroot extract-doxorubicin combination in treating human cancers[48].

The level of antioxidants and metabolomic fingerprinting in both raw beetroots and naturally fermented beetroot juices from organic [ORG] versus conventional [CONV] production was determined. In addition, the anticancer properties of the fermented beetroot juices were evaluated.The obtained results indicate that ORG- and CONV-produced beetroots and fermented beetroot juices have different chemical properties and different impacts on cancer cells. It is necessary to continue research on this topic in order to confirm and understand the achieved results[49].

Two mixtures of decarboxylated and dehydrogenated betacyanins was tested for their anticancer activity. The results of this research are crucial in finding effective isolation methods of betacyanins and their derivatives which are meaningful compounds due their colorant properties and potential health benefits regarding antioxidant and cancer prevention. The pigments were detected by LC-DAD and LC-MS/MS techniques[50].

Sugar beet mud [SBM] and pulp [SBP] produced as a waste by-products of the sugar industry were mixed with cattle dung [CD] at different ratios on dry weight basis for vermicomposting with Eisenia fetida. Genotoxicity analysis of post-vermicomposted samples of SBM revealed 18-75% decline in the aberration frequencies. Scanning electron microscopy [SEM] was recorded to identify the changes in texture in the control and vermicomposted

samples. The vermicomposted mixtures in the presence of earthworms confirm more numerous surface irregularities that prove to be good manure[51].

Antihypertensive effect
Beta vulgaris cicla and Beta vulgaris rubra shows that BVc extracts possess antihypertensive and hypoglycaemic activity as well as excellent antioxidant activity. BVc contains apigenin flavonoids, namely vitexin, vitexin-2-O-rhamnoside and vitexin-2-O-xyloside, which show antiproliferative activity on cancer cell lines. BVr contains secondary metabolites, called betalains, which are used as natural dyes in food industry and show anticancer activity. In this light, BVc and BVr can be considered functional foods [52].

The effect of raw beet juice [RBJ] and cooked beet [CB] on BP of hypertensive subjects was investigated. Total antioxidant capacity was increased and non-high-density lipoprotein [HDL], low-density lipoprotein [LDL] and total cholesterol [TC] were decreased with RBJ but not with CB. Although both forms of beetroot were effective in improving BP, endothelial function and systemic inflammation, the raw beetroot juice had greater antihypertensive effects. Also more improvement was observed in endothelial function and systemic inflammation with RBJ compared with CB.

Hydrophobic properties
The effect of trimethyltin chloride [Met3SnCl] on the slow vacuolar [SV] channels in vacuoles from red beet [Beta vulgaris L.] taproots was investigated. It was also found that Met3SnCl significantly diminished the number of SV channel openings, whereas it did not change the opening times of the channels. It suggest that the suppression of SV currents observed in the presence of the organotin results probably from its hydrophobic properties allowing this compound to translocate near the selectivity filter of the channel[53].

Anti-sterility
The interaction of bvORF20, a non-PPR Rf from sugar beet [Beta vulgaris], with preSatp6, the S-orf from sugar beet was investigated. The result illustrated that Post-translational interaction between preSATP6 and bvORF20 appears to alter the higher order structure of preSATP6 that may lead to fertility restoration in sugar beet[54].

CONCLUSION

The result of this study have found various constituents of Beta vulgaris exhibit a variety of therapeutic effects with little or no associated toxicity. These results are very encouraging and indicate this herb should be studied more extensively to confirm these results and reveal other potential therapeutic effects. Clinical trials using Beta vulgaris for a variety of conditions should also be conducted.

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REFERENCES

[1]Miraj S Azizi N, Kiani S. *Der Pharmacia Lettre*. **2016**;8 [6]:229-237.
[2]Miraj S Kiani S. *Der Pharmacia Lettre*. 2016;**2016**, 8 [9]:276-280.
[3]Miraj S Kiani S. *Der Pharmacia Lettre*. **2016**;8 [6]:59-65.
[4]Miraj S , Kiani S. *Der Pharmacia Lettre*. **2016**;8 [9]:137-140.
[5]Miraj S , Kiani S. *Der Pharmacia Lettre*. **2016**;8[9]:160-168.
[6]Masoudi M ,Miraj S, Rafieian-Kopaei M. *Journal of clinical and diagnostic research: JCDR*. **2016**;10[3]:QC04.
[7]Miraj S , Kiani S. *Der Pharmacia Lettre*. **2016**:;8[6]:78-82.
[8]Miraj S , keivani Z. *Der Pharmacia Lettre* **2016**;8[6]102-6.
[9]Miraj S, Kiani S. *Der Pharmacia Lettre*. **2016**;59-65.
[10]Miraj S kiani S. *Der Pharmacia Lettre*. **2016**;8[9]:168-173
[11]Miraj S, Kiani S. *Der Pharmacia Lettre*. **2016**;8[6]:102-109
[12]Miraj S, Kiani S. *Der Pharmacia Lettre* **2016**; 8[6]:299-303.
[13]Miraj S. *Cell journal*. **2016**;16[2]:225.[9]:137-140.

[14]Miraj S, Kiani S. Melissa officinalis LA *Journal of Evidence-Based Complementary & Alternative Medicine*. **2016**:2156587216663433.
[15]Miraj S , Kiani S. *Der Pharmacia Lettre*.**2016**:135-8.
[16]Miraj S. *Der Pharmacia Lettre*. **2016**;108-110.
[17]Eftekhar M, Miraj S, Mortazavifar Z. *International journal of reproductive biomedicine* [Yazd, Iran]. **2016**;14[8]:507-10.
[18]Davar R, Miraj S, Farid Mojtahedi M. *International journal of reproductive biomedicine* [Yazd, Iran]. **2016**;14[1]:53-6.
[19]Taghizade Mortezaee F, Tabatabaiefar MA, Hashemzadeh Chaleshtori M, Miraj S. Descent. *Cell journal*. **2014**;16[2]:225-30.
[20]Seyyedi F, Rafiean-Kopaei M, Miraj S. *Journal of clinical and diagnostic research* : JCDR. **2016**;10[5]:Qc01-5.
[21]Miraj S,kiani S. *Der Pharmacia Lettre*. **2016** 8[6]:328-334.
[22]Ul Kabir A, Samad MB, Ahmed A, Jahan MR, Akhter F, Tasnim J, et al. *PloS one*. **2015**;10[2]:e0116546.
[23]Hashem AN, Soliman MS, Hamed MA, Swilam NF, Lindequist U, Nawwar MA. *Die Pharmazie*. **2016**;71[4]:227-32.
[24]Iglesias R, Citores L, Di Maro A, Ferreras JM. *Planta*. **2015**;241[2]:421-33.
[25]Nowacki L, Vigneron P, Rotellini L, Cazzola H, Merlier F, Prost E, et al. *Phytotherapy research* : PTR. **2015**;29[12]:1964-73.
[26]Nade VS, Kawale LA, Zambre SS, Kapure AB. *Indian journal of pharmacology*. **2015**;47[4]:403-8.
[27]Kazimierczak R, Hallmann E, Lipowski J, Drela N, Kowalik A, Pussa T, et al. *Journal of the science of food and agriculture*. **2014**;94[13]:2618-29.
[28]Citores L, Iglesias R, Gay C, Ferreras JM. *Molecular plant pathology*. **2016**;17[2]:261-71.
[29]Oztay F, Sacan O, Kayalar O, Bolkent S, Ipci Y, Kabasakal L, et al. *Pharmaceutical biology*. **2015**;53[11]:1639-46.
[30]Martinez RM, Longhi-Balbinot DT, Zarpelon AC, Staurengo-Ferrari L, Baracat MM, Georgetti SR, et al. *Archives of pharmacal research*. **2015**;38[4]:494-504.
[31]Kapadia GJ, Rao GS, Ramachandran C, Iida A, Suzuki N, Tokuda H. Jou*rnal of complementary & integrative medicine*. **2013**;10.
[32]El Gamal AA, AlSaid MS, Raish M, Al-Sohaibani M, Al-Massarani SM, Ahmad A, et al. Beetroot [Beta vulgaris L.] extract ameliorates gentamicin-induced nephrotoxicity associated oxidative stress, inflammation, and apoptosis in rodent model. *Mediators of inflammation*. **2014**;2014.
[33]Iglesias R, Citores L, Di Maro A, Ferreras JM. *Planta*. **2015**;241[2]:421-33.
[34]Guldiken B, Toydemir G, Nur Memis K, Okur S, Boyacioglu D, Capanoglu E. *International journal of molecular sciences*. **2016**;17[6]:858.
[35]Clifford T, Constantinou CM, Keane KM, West DJ, Howatson G, Stevenson EJ. *European journal of nutrition*. **2016**:1-10.
[36]Mogren LM, Beacham AM, Reade JP, Monaghan JM. *Journal of the Science of Food and Agriculture*. **2015**.
[37]Spórna-Kucab A, Garrard I, Ignatova S, Wybraniec S. *Journal of Chromatography* A. **2015**;1380:29-37.
[38]Sarhan MA, Shati AA, Elsaid FG. *Saudi journal of biological sciences*. **2014**;21[4]:342-54.
[39]Zhou Q, Liu F, Zhang J, Lu J, Gu Z, Gu G. *Chinese medical journal*. **2012**;126[9]:1647-53.
[40]Georgiev VG, Weber J, Kneschke E-M, Denev PN, Bley T, Pavlov AI. *Plant foods for human nutrition*. **2010**;65[2]:105-11.
[41]Lee C-H, Wettasinghe M, Bolling BW, Ji L-L, Parkin KL. *Nutrition and cancer*. **2005**;53[1]:91-103.
[42]Gennari L, Felletti M, Blasa M, Angelino D, Celeghini C, Corallini A, et al. *Phytochemical Analysis*. **2011**;22[3]:272-9.
[43]Sulakhiya K, Patel VK, Saxena R, Dashore J, Srivastava AK, Rathore M. *Pharmacognosy research*. **2016**;8[1]:1.
[44]Nyirády P, Sárdi É, Bekő G, Szűcs M, Horváth A, Székely E, et al. *Orvosi hetilap*. **2010**;151[37]:1495-503.
[45]J Kapadia G, A Azuine M, Subba Rao G, Arai T, Iida A, Tokuda H. Cytotoxic effect of the red beetroot [Beta vulgaris L.] extract compared to doxorubicin [Adriamycin] in the human prostate [PC-3] and breast [MCF-7] cancer cell lines. Anti-Cancer Agents in Medicinal Chemistry [Formerly Current Medicinal Chemistry-Anti-Cancer Agents]. **2011**;11[3]:280-4.
[46]Nowacki L, Vigneron P, Rotellini L, Cazzola H, Merlier F, Prost E, et al. *Phytotherapy Research*. **2015**;29[12]:1964-73.
[47]Lee EJ, An D, Nguyen CT, Patil BS, Kim J, Yoo KS. *Journal of agricultural and food chemistry*. **2014**;62[6]:1324-31.

[48]Kapadia GJ, Rao GS, Ramachandran C, Iida A, Suzuki N, Tokuda H. *Journal of Complementary and Integrative* Medicine. **2013**;10[1]:113-22.
[49]Kazimierczak R, Hallmann E, Lipowski J, Drela N, Kowalik A, Püssa T, et al. *Journal of the Science of Food and Agriculture*. **2014**;94[13]:2618-29.
[50]Spórna-Kucab A, Ignatova S, Garrard I, Wybraniec S. *Journal of Chromatography* B. **2013**;941:54-61.
[51]Bhat SA, Singh J, Vig AP. *Environmental Science and Pollution Research*. **2015**;22[15]:11236-54.
[52]Ninfali P, Angelino D. *Fitoterapia*. **2013**;89:188-99.
[53]Trela Z, Burdach Z, Siemieniuk A, Przestalski S, Karcz W. *PloS one*. **2015**;10[8]:e0136346.
[54]Kitazaki K, Arakawa T, Matsunaga M, Yui-Kurino R, Matsuhira H, Mikami T, et al. *The Plant Journal*. **2015**;83[2]:290-9.