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REVIEW OF CHEMO-PREVENTIVE ACTIVITIES OF COMMON VEGETABLES VOLATILE ORGANIC COMPOUNDS (VOCS)

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ABSTRACT:

Several research papers on the chemo-preventive properties of vegetables have been published in recent years.

Vegetables don't just appear to be a nutrient-dense food source; they're also high in volatile organic compounds with numerous bioactivities that are beneficial to human health.

A review of vegetable volatile components and their bioactivities is critical since it will provide an overview and statistics on their function in human health improvement.

Introduction:

All foods for humans can be said to be forced by vegetables, either directly or indirectly. They're factory-made edibles that can be tweaked. Stems, roots, leaves, flowers, and fruits form a vital corridor for them. They're commonly found in the bottom of the factory's food-processing section. Kohlrabi, celery, and asparagus are among the stem vegetables. Root veggies include things like radishes, turnips, carrots, and beets. cruciferous kale, endives, and lettuce are among the lush vegetables. Broccoli, cauliflower, leeks, artichokes, and the Allium rubrics make up the floral Corridor of vegetables. Fruits are structures that grow after fertilization or pollination and usually include seeds (1). This Order includes eggplants, cucumbers, sap, squash, bell peppers, sludge, and tomatoes.Vegetable are abundant sources of bioactive unpredictable organic composites, as well as nutrient-dense foods (VOCs). At room temperature, VOCs are organic composites with a high vapor pressure. VOCs are plentiful, and naturally occurring compounds. VOCs are the most powerful aromas or odors. A variety of bioactive compounds found in vegetables have been found to have anticarcinogenic properties, Unpredictable foods are nutrient-dense and bioactive, with the potential to protect against chronic and degenerative diseases such as diabetes and cardiovascular disease.

Material and Methods

Fruit part of vegetables

Capsicum annuum (bell pepper or sweet pepper): Capsicum annuum, often known as bell pepper or sweet pepper, is an American native whose fruits are produced for use as vegetables, spices, and topical remedies. Capsicums are primarily used in food due to their pungency and colour. Other changeable constituents include trans- beta- ocimene, limonene, methyl salicylate, and linalool (Table 1). In West Africa, whole dried pepper fruits have been employed as a traditional grain protectant. Adult C. maculates, a common pest of stored legumes, has been known to die from a combination of dry pepper cream and cowpea. Bell pepper ethanol extracts have been shown to cause 100 adult mortality in T. confusum.

Cucumber(Cucumissativus,L.) : Cucumber (Cucumissativus, L.): Cucumissativus is related to squash, muskmelon, and watermelon, and belongs to the Cucurbitaceae family. It's an India-native seasonal vegetable crop. The medicinal properties of this plant's entire pathway (flake, fruit, and seed) have been studied. Cucumber is widely used to treat a variety of skin conditions, and it is thought to have a cooling, healing, soothing, emollient, and anti-itching impact on irritated skin. Chinese people employ the leaves, stems, and roots as anti-diarrheal, detoxicant, and anti-gonorrheal substances. Cucumber's anti-wrinkle, anti-diabetic, and anti-hyperlipidemic properties have all been established. Cucurbitacin (a triterpenoid compound) has been linked to cytotoxicity and anti-cancer activity in cucumber seeds.Cucurbitacin, according to Guha and Sen, has a wide spectrum of pharmacological properties in vitro and in vivo, and is utilised as a purgative, anti-inflammatory, and anti-fertility drug.

Onions(Allium cepa L): Onions are a most vegetable crop farmed around the world. A number of sulphur composites have been blamed for onion's unique scent, flavour, and lachrymatory qualities. Allicin and its derivatives are the most important sulphur-containing chemical compounds found in Allium species such as onions, and Allicin is recognised to have restorative as well as implicit anti-carcinogenic, anti-mutagenic, and antibacterial properties (Table 1). Onions contain both oil painting- and water-responsive organo-sulphur composites (OSCs), some of which have been found to be chemopreventative against cancer in animal models.When given prior to carcinogen exposure, dially sulphide (DAS) has been shown to inhibit the development of colon lymphomas, oesophageal lymphomas, pulmonary adenomas, and fore- stomach tumours in rodents. However, Fukushima, Takada, Hori, and Wanibuchi discovered that water-responsive OSCs have an inhibitory effect on rat liver carcinogenesis in alternate stage growth. S-Allylcysteine, S- propylcysteine, S- ethylcysteine, S- methylcysteine, and cysteine all decreased GST- P-positive foci (Glutathione S- transferase placental form), especially SMC and cysteine, resulting the density of GST-P-positive foci has decreased significantly.

Fennel(Foeniculumvulgare):. Fennel is a yearly medicinal and delicious plant in the Apiaceae family (Umbelliferaceae). It's a sweet, flavorfulcondiment that can be used in both cooking and medicine. Fennel seeds have an anise-like flavour and are used in baked products, meat and fish meals, ice cream, alcoholic beverages, and condiment fusions. In animal tests, fennel seed extracts were found to be useful in the treatment of many diseases, as a diuretic, and as a medication for hypertension treatment. Fennel's chemopreventive effect is generally mainly ascribed to its crucial oil painting, according to extensive studies on F. vulgare. Although, some of the uncontrollable elements, such as estragole (methylchavicol), which has been linked to the formation of malignant tumours in rodents, should be avoided. According to Karlsen, Steen, Chingova, and Zolotovitch, the main constituents in sweet fennel (var. dulce) and bitter fennel (var. vulgare) are anethole, glycosides, and fenchone, and fresh 18 mixes were extracted from the monoterpene portion of the fruit vegetable.

Carrot(Daucuscarotasativus): Daucus is a rubric belonging to the Apiaceae family and correspond of over 500 species considerably spread around the world. For a long time, shops from this family have been used as spices or medicines. Carrot essential canvases have been reported to have several bioactive parcels similar as antibacterial, fungicidal, hepatocellular regenerator, general alcohol, and goad, lowering of high cholesterol, and cicatrisant. The serve to ease carotol and daucol, as well as the sesquiterpene beta-caryophyllene, are all derived from carota. Carotol, a significant sesquiterpene alcohol found in Daucuscarota seeds, is thought to have originated from cis, trans-farnesol. The canvases of some species of Daucuscarotahave been proven to retain antibacterial exertion. . Previous research has found that monoterpene hydrocarbons such as -pinene and sabinene dominate the chemical makeup of Daucus species. Jasicka- Misiak et al. isolated the terpenoidscarotol-caryophyllene, daucol from the variable elements of carrot and investigated their antifungal activity on fungi strains belonging to the strong inhibitory goods on Alternariaalternata mycelium radial growth. Sesquiterpene-caryophyllene, on the other hand, was found to have no effect. Carotol exerted nearly as much force as the commercially available miticideFunaben T.

Vegetable flowering portion

Globe Artichoke(CynarascolymusL.): Numerous mortal conditions, including accelerated ageing, cancer, cardiovascular conditions, neurodegenerative conditions and inflammations, are generally linked to increase the Quantum of free revolutionaries). Artichoke is an herbaceous factory native to the Mediterranean Basin. Globe artichoke is substantially used for food. still, colorful studies have demonstrated the health promoting parcels of its excerpts. Beta- selinene, one of the changeable ingredients SetUp in artichoke, has been reported to parade an antioxidant exertion Eugenol and fechone are also some of the changeable factors of artichoke with natural exertion(Table 1). Fenchonewhich is set up in fennel leaves retain acaricidal exertion againstD. farina and D. pteronyssinus when used as direct contact operation On the other hand, eugenol has been shown to thwart the production of reactive oxygen species (ROS), intracellular calcium buildup, and the eventual collapse of the posterior mitochondrial membrane.

Broccoli(Brassica oleraceaL., Italica group): Broccoli is classified in the Italica cultivar group of the species Brassica oleracea. It's a high source of vitamin C, and salutary fibre; it also contains multiple nutrients with potentanti-cancer parcels, similar as diindolylmethane and small Quantities of selenium. Epidemiological compliances suggested that high input of fruit and vegetables could be associated with a reduced threat of cancer(3), and cruciferous vegetables, including broccoli, cabbage, cauliflower, and Brussels sprouts, sounded particularly Salutary in precluding carcinogenesis Experimenters have shown that the unpredictable ingredients responsible for these conditioning were the sulphur containing composites, similar as isothiocyanates(R- NCS) and their glucosinolate precursors and indole- grounded ingredients, Similar as indole-3-carbinol, '- di- indolylmethane, and indole- 3- acetonitrile. These unpredictable ingredients were set up to induce medicine- metabolizing enzymes in cell culture and rodent towel, and their chemopreventive exertion was attributed to the increased detoxification of xenobiotic and carcinogens.

Cauliflower (Brassica oleracea Botrytis):

Cauliflower, like other Brassica family members, has the ability to improve cardiovascular health as well as fight cancer (52). Significant antioxidant parcels have been discovered in violet cauliflower extracts. Pedras, Sarwar, Suchy, and Adio used three different phytoalexins (secondary metabolites) to isolate indolyldisulfide and non-sulphur containing indolylphytoalexins from cauliflower. The antifungal activity of caulilexin A, an illustration of indolyldisulfide, was highest against S. sclerotiorum. The enzymatic hydrolysis item of glucosinolate, isothiocyanate (ITCs), is notably effective in blocking the sprouting of fungal pathogens B.cinerea, R. stolonifer, M. lazea, M. piriformis, and P. expansum(64). Sisti, Amagliani, and Brandi also demonstrated that B. oleraceae waterless juice inhibited C. albicans growth in a remedy manner . After 4 days of observation with 15 juice, there was over 95 inhibition. Sulphur-containing volatiles and ITCs can be found in abundance in cauliflower.

	Phytochemical/ volatile constituent	**Bioactivity potential**	**Kind of veggies**	**Reference**
1	Lactones	Exhibits anti-microbial activity against *B. subtilis, P. vulgaris*		Siapailene, et al. [85]
2	Trans-Ocimene	Exhibits anti-microbial activity against *B. cereus*		
3	3-Methyl-4-ethylhexane	Exhibits anti-microbial activity against *E. faecalis*		
4	β-Pinene	*-ditto-*		
5	9 (Z)-Octadecenamide	Anti-oxidative and hypolipidemic activity	Celery	Cheng et al., [92]

6 7 8 9 10 11	β-Selinene Fenchone Eugenol Thymol Carvarol Xanthorrihzol (sesquiterpene)	Anti-oxidant properties Possess acaricidal activity against *D. farina & D. pteronyssinus* Inhibits reactive oxygen species Good scavengers of peroxyl radicals -ditto- Neuroprotective effect against cisplatin-induced nephrotoxicity	 Artichoke	Ou et al., [49] Kim et al., [25]
12 13 14 15 16 17 18 19 20	Carotol Daucol Undecan-2-one SabineneAneth ole p-anisaldehyde (+)-Fenchone Estragol Kaempferol-3-0-rutinoside	Antifungal, herbicidal and anti-microbial -ditto- Anti-microbial &nematocidal Anti-microbial against *B. subtilis* Anti-microbial, estrogenic agent and anti-thrombotic agent. Increases milk secretion/promote menstrual flow Acaricidal activity -ditto- -ditto- Anti-radical scavenging activities	 Carrot  Fennel	Jasicka-Misiak, et al., [43]; Glisic et al., [46] Ntalli et al., [45] Dorman & Deans [47] Kubo et al., [32] Lee, [35] Parejo et al., 2004b
21	Hydrocycinnamates	Neuroprotective effect such as Alzheimer's disease	 lettuce	Commenges et al., 2000
22 23 24 25	3-Butenylisothiocyanate 4-Pentenylethylisothiocyanate Benzene propane nitrile 1H-Indole-3-acetonitrile	Inhibits the growth of pathogenic bacteria -ditto- Anti-carcinogenic -ditto-	 Broccoli raab	Jang et al., [25]
26 27	Lycopene Limonene	Anti-oxidant activity, reduction of cardiovascular disease (CVD) Antibacterial	 Tomato water melon	Kardinaal et al., 1993; Erdman et al., 2005

28 29 30	Capsidiol Limonene Trans-β-ocimene	Bacteriostatic properties Antibacterial -ditto-	 pepper	Buttery et al. [9]
31 32	Allicin Dially sulphide	Anti-carcinogen, anti-mutagen and anti-oxidant Inhibition of colon and oesophageal carcinomas	 Onion Garlic	Xiao, & Parkin [19] Wargovich, [20]
33 34	4-Methyliobutyl isothiocyanate Phenylethylisothiocyanate	Anti-oxidant action Chemopreventive properties	 Arugula	Lamy et al., [72]
35 36	Incensole, α-Copaene	Anti-inflammatory Antioxidant &Anticarcinogenic	 water dropwort	Moussaieff et al. [77]
37	Anthraquinone	Laxative, antimalarial, antineoplastic & in treatment of cancers	 Rhubarb	Huang, et al.,
38	Dihydroquercetin	Antioxidant activity	 Peanut	Pratt, & Miller

Vegetable splint's portion

Arugula(Erucavesicaria subsp. Sativa) :

Arugula (Erucavesicaria subsp. Sativa), popularly known as salad rocket, belongs to the Brassiceae family, which also includes cabbage, broccoli, and cauliflower. Several investigations have been carried out in order to determine the primary unpredictable elements accountable for these Brassiceae vegetable defence products. The impact of 4- mercaptobutylglucosinolate(glucosativin) was linked in one study, while the presence of 4-methylthiobutylglucosinolate(glucoerucin) was linked in another. (The major unpredictable mixtures in Baby spinach include sulphur/ nitrogen bearing composites (4- methyliobutylisothiocyanate and 5- methylthiopentanenitrile), a Villatoro- Pulido, Font, Saha, Obregón- Cano, Anter, Muoz- Serrano also discovered that Arugula extracts and its sulforaphane were effective in detoxifying hydrogen peroxide's genotoxic effects, with inhibition rates ranging from 0.13-0.93.

Veggie stems

Celery (Apiumgraveolens): Celery is a plant that grows wild throughout Europe, the Mediterranean, and Asia west of the Himalayas. Celery seeds have been employed in Ayurvedic medicine for thousands of years. Celery seeds are utilised in incense and medicinal diligence due to their unexpected nature. This vegetable's entire corridor is thought to be a cure-all for one or more ailments. Insecticidal, bactericidal, and chemostatic properties have all been described. limonene, - selinene, - caryophyllene, sedanolde, cis- ocimene, apiole, 3- butylphthalide, myrcene, and 3- butyl— dihydrophthalide are some of the most unexpected components in celery. Sesquiterpene lactones from Jawad, Suvarnalatha, Sankar, and Suresh A graveolens showed antimicrobial activity against Bacillus subtilis, Proteus vulgaris, & evaluated fungi, whereas Siapailene, Venskutonis, Sarkinas, and Cypiene reveals that root extracts containing trans- ocimene, 3- methyl-4-ethylhexane, and - pinene exerted strong antimicrobial activity against and Enterococcus faecalis. Celery has long been used to cure a variety of ailments, including rheumatism, rheumatoid arthritis, diuresis, and indigestion. Celery root extracts soaked in alcohol have been used to treat urinary ailments, as well as as an order goad and cleanser. Similarly, celery seed was already found to be effective in the intervention of urinary calculi, gastrointestinal problems, flatulence and grip pains, decrease of visceral spasm, and activation of the womb's smooth muscle in various investigations.

Asparagus (Asparagus officinalis): Asparagus is a green vegetable that is widely used in salads, vegetable dishes, and soups throughout the world. In traditional Chinese medicine, it has been used as an alcohol, antifebrile, antitussive, hair growth booster, and diuretic. Natural conditions, such as antifungal, anti-mutagenic, diuretic, cytotoxic, antiviral, and molluscicide components, have been demonstrated to be retained in factory extracts. Flavonoids, oligosaccharides, amino acid derivations, sulphur bearing acids, and steroidal saponins are the top composites linked with these natural goods, with saponin being the principal active emulsion accountable for these goods in asparagus. Saponins are one of the many secondary metabolites produced by factory species, which have hydrophilic glycoside halves and lipophilic triterpene denotations in their structure. Shao et al. discovered that it had anticancer properties crude saponin retrieved from asparagus.

Conclusion and a Yet-to-Be-Discovered Trend :

Understanding the chemopreventative nature of greens can pique interest in increasing their use in the human diet. The current state of research into various unanticipated organic composites found in common vegetables, as well as their implied roles in the prevention of coloured disorders, is discussed. Benzene propane nitrile, 1H- Indole-3-acetonitrile, Xanthorrihzol, Thymol, Carvarol, terpenoids, capsaicin, and glucosinolates are some of the unpredictable organic compounds found under health-promoting conditions in plants. Although the vehicle of act of some goods of the composites listed below can be logically explained based on epidemiological studies, the channel of effect of some goods of the composites listed below is not totally understood. The design of comparable research will be aided by a better understanding of some aspects of VOC bioavailability, such as the dynamics of immersion, accumulation, and removal. The role of unexpected organic composites in human health is still a hot topic of debate.

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