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Review

Nutritional and therapeutic importance of carrot pomace: a review article

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Abstract

The carrot pomace (Daucus carota) is a root vegetable known for its nutritional importance, health benefits, and a rich source of phytochemicals including carotenoids, ascorbic acid, phenolics, and polyacetylenes. These phenolic compounds exhibit different pharmacological properties. This review study aimed to evaluate the nutritional as well as medicinal importance of carrot pomace. This review is helpful for a researcher who conducts a study on carrot pomace. Electronic databases MEDLINE, Scopus, PMC, PubMed database, Web of science, whereas Google Scholar was used as a secondary search tool. The keywords used were carrot pomace, Chemopreventive, Antioxidant, Anticancer, Phytochemistry, Pharmacological potential, and nutritional potential. More than 200 researches were searched from 2008 to 2021 related to the Carrot pomace. The results of comparing the antioxidant activity of two Algerian orange carrot varieties showed that the Touchon variety was richer in phenolics, flavonoids, and carotenoids and presents higher antioxidant activity in comparison with the Super-muscade variety. The nutritional composition and antioxidant properties of three varieties of carrots, Kuroda, Pamela, and Amazonia showed that the antioxidant properties were high even at low concentrations of extract. The literature review concluded that carrot is a rich source of β-carotene, fiber, and many essential micronutrients and functional ingredients having antioxidant, anti-inflammatory, and anti-cancer properties. Carrot roots are used to prevent different cancers, free radical scavengers, anti-mutagenic and boost the immunity as it contains large amount of carotenoids specifically β-carotene.

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Introduction: The Botanical name of carrot is Daucus carota, family Apiaceae which is biennial herbaceous species. The carrot is cultivated all over the world and which one of the most widespread root vegetables and a rich source of dietary carotenoid [1]. The cultivated carrot is classified into the western carrot and eastern carrot built on the coloration in the carrot root. The eastern carrot originates from Afghanistan and the western carrot's origin is still undefined. Western carrots are red, white and orange in color. Western carrots have extremely dissected leaves and branchless roots whereas most of eastern carrots are purple in color but some are yellow having moderately divided leaves and branched roots.[2 3]. There are four kinds of phytochemicals that were present in the carrot specifically ascorbic acid, tetraterpenoids, phenolics, polyacetylenes. Numerous factors influence the phytochemicals in the carrot due to the genotype (color differences), high content of a and beta-carotene is existing in orange carrot, lutein in yellow color, lycopene in red color, anthocyanins in the root of purple carrot, and phenolics compound in black carrot. Based on these phytochemicals the carrot showed the reduction of many risks including cardiovascular diseases and cancer due to its antioxidant activity, plasma lipid modification, anti-inflammatory, and anti-tumor properties [4]. Secondary metabolites called phenolic components are made comprised of an aromatic ring with one or more hydroxyl groups[56]. Flavonoids, phenolic acids, lignans, tannins, stilbenoids, and curcuminoids are some of the subgroups of phenolic groups. According to the study, carrots are a good source of phenolic acids including caffeic, p-hydroxybenzoic, and chlorogenic as well as a type of flavonoids called anthocyanins[7]. Different parts of the carrot contain different concentrations of phenolic compounds like carrot roots containing hydroxycinnamic acid and derivatives which contain 42.2% to 61.8% of total phenolics [89]. The peel of carrot contains 54.1% of total phenolics and phloem 39.1% and xylem contains(6.4%) less amount of phenolic compounds [10]. The color of the carrot shows variation in the antioxidant activity. Different studies conducted for the detection of antioxidant activity of carrot results showed purple carrots exhibit the greatest antioxidant activity because of the greater phenolic compounds concentration [11],[12]. The phenolic compounds exhibit different activities, antioxidant, such as anti-aging, anti-inflammatory [13], anti-carcinogenic or antiproliferative [14], antihyperlipidemic, antidiabetic [15], antimicrobial[16], hepatoprotective,[17],[18] reduced body mass index, prevention of cardiovascular diseases, antihypertensive,[19] and maintain the normal function of the nervous system [20]. Carotenoids are acyclic, meaning that one or both ends of the molecule include five or six C rings [21]. Carotenoids in carrots are divided into two categories: carotenes and xanthophylls. Carrot roots include 75% of carotene. 23% of carotene, 1.9% of lutein as well as -cryptoxanthin, zeaxanthin, and lycopene [22]. Carotenoids are found in larger amounts in the phloem of orange and purple carrots than in the xylem [23]. Commonly, a carrot comprises 16-38 mg/100 g of carotenoid [24]. The health advantages of carotenoids, particularly vitamin A, include the preservation of DNA, proteins, and lipids against oxidative damage, as well as the maintenance of normal immune system function, skin, mucosal membranes, and eyesight [222425]. A digested carrot extract penetrates through the mucosal cells of the colon, reducing oxidative DNA damage by 20.7 % percent and protecting colon cells from reactive oxygen species stress [26]. Vitamin A is also necessary for immune system function, tissue development, organogenesis, and vision [27]. Polyacetylenes are a class of non-volatile bioactive phytochemicals with at least two triple C–C bonds. The Apiaceae family of plants (which includes the carrot) contains aliphatic C17-polyacetylenes of the falcarinol type [28]. 12 polyacetylenes were extracted from carrots out of around 1400 polyacetylenes found in plants. Falcarinol, falcarinol, and falcarinol-3-acetate are three important polyacetylenes found mostly in carrot roots. Falcarindiol, (E)-isofalcarinolone, falcarindiol-8-acetate, 1,2-dihydrofalcarindiol-3-acetate, falcarindiol-8-acetate, falcarindiol-9-acetate, 1,2-dihydrofalcarindiol-9-acetate, 1,2-dihydrofalcarindio [2930]. Recent research on polyacetylenes' biological activity has revealed that they have the potential to benefit human health through antibacterial, antifungal, anti-inflammatory, anticancer, and teratogenic properties [29]. The objective of this review research was to assess the nutritional and therapeutic benefits of *carrot pomace*. Due to its reputation as a significant source of natural antioxidants and the anticancer properties of -carotene, which is a precursor to vitamin A, carrot intake has gradually grown. A researcher who does a study on *carrot pomace* will find this review to be of great use.

Nutritional importance of *carrot pomace*: *Carrot pomace* is a rich source of soluble and insoluble carbohydrates and serves as an excellent substrate for bioprocesses[31]. *Carrot pomace* is the main ingredient of many value-added nutritional food products. Carrots contain fiber and phytonutrients such as carotenoids and phenolic compounds as well as bioactive compounds and serve as an excellent source of basic nutrition. Pomace powders contain more fibers and less total carbohydrates than whole-vegetable powders as soluble solids with the juice are being removed. It is further processed and dried into pomace powders which are used in different snacks and increase their nutritional value[32].10% *carrot pomace* content, 145 °C die temperature, and 14% moisture content is being used to get a high expansion ratio for snacks[33]. *Carrot pomace* is an annoying source of β carotene and contains 50% of it and is best used for supplementation of different food products such as cakes, toffees, bread, biscuits, and many more. Although *carrot pomace* constituents of an excessive number of carotenoids, dietary fiber, uranic acids, and neutral sugars yet it is wasted as feed or manure. 30-50% of carrot is left as pomace and approximately 50% of the carotene is lost while commercial juice processing. *Carrot pomace* contains 17 percent and 31–35 percent of the total - and -carotenes, as well as total carotene concentration up to 2.0 g/kg dry matter. In dried pomace, there are the following microelement concentrations (mg/g): 18.60.10 K, 3.200.08 Na, 3.00.06 Ca, 1.80.04 P, 4.00.07 Cu, 1.10.05 Mg, 30.50.14 Fe, 10.80.12 Mn, and 29.40.16 Zn. On a dry weight basis, the composition of dietary fiber includes *carrot pomace* as cellulose (51.6%), lignin (32.1%), hemicellulose (12.3%), and pectin (3.88 %). *Carrot pomace* is made up of 37–48% of the recommended daily allowance of total dietary fiber, 9% of reducing sugar, 6% of minerals, and 4% of protein. Additionally, it contains 2.50.15% moisture, 1.30.01% fat, 5.50.10% ash, 20.90.15% crude fiber, 0.70.04% protein, 55.81.67% total dietary fiber, 71.60.23% total carbohydrate, and 3010.09 kcal/100 g calories. *Carrot pomace* is a nutritionally important residue containing a healthy amount of macro and micronutrients. Hence it is used to make various nutritionally rich recipes and snacks such as *carrot pomace* toffees, other sweets, and sweet and salty biscuits and make carrot products available throughout the year. These value-added products also satisfied the consumer by providing nutritious products at affordable prices as *carrot pomace* is effectively used in this way which otherwise gets wasted. The addition of *carrot pomace* to other foods such as bread or wheat flour enhances their nutritional quality and supplements the food with functional ingredients such as mineral components, carotenoids, and fiber. It overcomes the microelement deficiency found in wheat as dried *carrot pomace* carries 5.5% of mineral elements such as manganese iron, potassium, and zinc [9]. Dietary fiber is needed by the body as it helps in lowering the risk of many cancers, CVD, and other gastrointestinal problems. However, the production of high-quality fiber food is made possible by the utilization of *carrot pomace* in many bakery products. This is the best way to overcome fiber deficiency found in many food items[34]. Carrot is an excellent origin of carotenoids, minerals, vitamins, dietary fiber and has good potential as an antioxidant [35 36]. Vitamin C, also known as ascorbic acid, is a water-dissolvable antioxidant with little molecular weight present across the Plantae kingdom. It is well understood that it regulates the cellular redox potential in cells [37],[38]. [36] Significant differences were found in the effect of genetic variability on vitamin C in 20 different carrot genotypes. Dark orange (four times), yellow (3.7 times), and white (2.3 times) carrot cultivars had the highest vitamin C concentrations when compared to orange carrot cultivars. Boron deficiency during carrot growth increases ascorbic acid content from 45% percent to 70% percent, according to research. [39]. Vitamin C stability in carrots is influenced by ascorbic acid oxidase. It uses oxidation to transform l-ascorbic acid (vitamin C's active form) into dehydro-l-ascorbic acid. Scurvy, which is characterized by signs of connective tissue abnormalities, can be avoided by getting enough l-ascorbic acid. *Carrot pomace* comprises dry substance gratified, neutral cleansing agent soluble, hemicellulose, lignin and cellulose. These sections of *carrot pomace*s are commonly used in food and other productions such as cosmetics and pharmaceuticals. D-glucose is a linear polymer that produces microfibrils in cellulose. In low-calorie meals, it serves as a replacement of fat, texturizer, thickener, and extender. Hemicellulose is also a polymer of D-glucose and relies on the source. Sustaining, viscosity-enhancing and gelling agents in food products are some of the properties of hemicellulose. Lignin is a complicated cross-linked phenolic polymer comprising phenylpropane units with an amorphous structure. Pectin is also utilized for thickening, gelling agent, and texture ingredient in dairy and baking. Individual components such as hemicellulose, lignins, and cellulose were examined in the researched pomaces. The proportion of the components was estimated using the standard Raw fiber determination technique and is given in g/100 g of dry *carrot pomace* constitutes of hemicellulose (H percent), cellulose (C percent), and lignin (L percent). Carrots had the highest proportion of crude fiber NDF fraction (hemicelluloses, celluloses, and lignin) in the dry matter (18.23%) and the lowest lignin concentration (2.50 %)[40]. Carrots are a fantastic source of nutrients, but they may also include antioxidants. This study analyzed the nutritional value and antioxidant qualities of three Ghanaian carrot cultivars: Kuroda, Pamela, and Amazonia. The antioxidant activities of ethanolic extracts of carrot cultivars at various doses were determined using the peroxide scavenging technique. Even at low quantities of extract, the antioxidant capabilities were high, and their activity increased with time in the sequence of Amazonia at first followed by Kuroda and Pamela. Amazonia was the most desired type since it had the most fiber, protein, and carbohydrate content, as well as the lowest moisture level [41].

Therapeutic/medicinal importance of *carrot pomace*: The extraction of phenolic components from black *carrot pomace* is examined in the current work using three extraction techniques: conventional solvent extraction (CSE), microwave-assisted extraction (MAE), and ultrasonic-assisted extraction (UAE) (BCP). BCP is a well-known industrial by-product that poses a serious disposal problem. Using a Box-Behnken design and a response surface technique, the MAE of phenolic, antioxidant activity, and color density from BCP were investigated and optimized. The ideal parameters for maximum polyphenolic recovery were 348.07W microwave, 9.8 min extraction duration, 19.3mL/g solvent-solid ratio, and 19.8% ethanol concentration. The extract's total phenolic content was 264.9 10.02 mg gallic acid equivalents (GAE)/100 mL when examined under these conditions, along with its antioxidant capacity (AOC) of 13.14 1.05 mol Trolox equivalents (TE)/mL and color density of 68.63 5.40 units. Under optimal conditions, there were 753.40 mg/L of anthocyanins overall, with a modest proportion polymeric color of 7.40 0.42. when everything functions properly [42]. The phosphorylated and carboxymethylated derivatives of *Daucus carota* polysaccharides were produced using hot water extraction and alcohol precipitation. FT-IR, NMR, and SEM were used to determine their structures. Phosphorylation increased the antioxidant activity of *Daucus carota* polysaccharides. However, the performance of carboxymethylated *Daucus carota* polysaccharide was worse to that of unaltered polysaccharide[43]. The most popular root vegetable in Algeria is the carrot (*Daucus carota* L.), which is high in bioactive compounds and has significant health-promoting effects. In this study, the stability of bioactive components and antioxidant activity of two varieties of orange carrots from Algeria (Super-muscade and Touchon) were assessed after storage (at 4°C for 12 days). To determine the entire phenolic constituent of the samples a technique was utilized called Folin–Ciocˆalteu. Built on the assessment of Free Radical Scavenging Activity (FRSA) utilizing DPPH radical and Ferric Reducing Power, antioxidant capacity was evaluated spectrophotometrically (FRP). In compared to the Super-muscade variety, the Touchon cultivar has greater levels of phenolics, flavonoids, and carotenoids, as well as stronger antioxidant activity. The content of bioactive compounds and their concentrations at the end of storage [44]. Because co-extracted antioxidants enhanced carrot remnants, they became pectin-enriched fractions (PEFs) beneficial for the formulation of useful meals (- and -carotenes, lutein, and -tocopherol). High-power ultrasound (US)-enzyme-assisted extraction was employed for effectiveness and long-term sustainability. The US pretreatment (12.27 W/cm2: 20 kHz, 80% amplitude, 20 min) and digestion (5 h-40 °C) of carrot powder (CP) in citrate buffer (pH 5.20) with or without hemicellulose or cellulose were performed. The greatest PEF yield (27.1%) was from US-hemicellulose, which removed practically the whole pectin content of CP. The presence of an extra beneficial impact of the next procedure was dependent on the enzyme employed. US-pretreatment enhanced the extraction yield of all PEFs, yet the presence of supplementary positive effect of the following step was dependent on the enzyme utilized. PEFs had a high UA content of 40–47 percent, a low DM content of 24–49.9%, and co-extracted antioxidants. US reduced antioxidant content, DM, and molecular weight, but enabled for the production of calcium crosslinked true gels with a greater elastic modulus than non-US-extracted PEFs, making them potentially useful as food additives [45]. In addition to their nutritional value, carrots may be a good source of antioxidants. The nutritional content and antioxidant activities of three carrot types grown in Ghana, namely Kuroda, Pamela, and Amazonia, were investigated in this study. The antioxidant activities of ethanolic extracts of carrot cultivars at various doses were determined using the peroxide scavenging technique. Even at low quantities of extract, the antioxidant capabilities were high, and their activity increased with time in the sequence Amazonia > Kuroda > Pamela. Amazonia was the most desired type since it had the most fiber, protein, and carbohydrate content, as well as the lowest moisture level [41]. Skin, gums, and blood vessel health are all maintained by vitamin C. Additionally, it helps to lower plasma cholesterol, strengthen the immunity, and get rid of reactive oxygen species. Leong and Oey [46] and Dias [47] also provided in-depth information on the health advantages of vitamin C, including how it protects against heart disease, cancer, and arteriosclerosis. *Carrot pomace* is distinguished by excessive water holding capacity (WHC) and thus capable of retaining the high moisture content of 88g/100g. The *carrot pomace* contains an appreciable amount of dietary fiber, 9.87 to 11.57 mg/100g of carotene, and 13.53 to 22.95 mg/100g of ascorbic acid. Dehydration is an effective way of increasing the shelf life of *carrot pomace*. *Carrot pomace* promotes healthful body weight and lowers the chance of many non-communicable diseases such as obesity, stroke, type 2 diabetes, CHD, and high blood pressure as well as the presence of pectin in carrots can lower cholesterol levels. It also increases the nutritional value and functional properties in different deficit diets. Preparation of *Carrot pomace* powder is done to increase the shelf life of *carrot pomace* and its best usage in different food products. Carrots were peeled in order to extract the juice, and the leftover pomace was dried for around 45 minutes at 60 C in a fluidized bed dryer. The pomace was next ground to form *carrot pomace* powder[48].

Carotenoids: Carotenoids are naturally occurring isoprenoid compounds with antioxidant characteristics in the human body that are found in all photosynthetic plants, certain non-photosynthetic fungus and bacteria, and other organisms [9]. They are known for their various beneficial effects on human health and protect the body against many diseases. Carotenoids have antioxidant properties and reduce the risk of developing cancer, human immunodeficiency virus (HIV), anti-inflammatory, anti-tumor properties, cardiovascular diseases[49], and blindness[4],[1]. According to Krinsky's research, consuming carotenoids-rich fruits and vegetables prevent various disorders, including eye disorders[50]. The roots of the carrot (Daucus carota) are a rich source of carotenoids. According to Perrin et al., the accumulation of carotenoids in different carrots with varying root colors and root tissues[23]. The amounts of carotenoids in phloem and xylem were equivalent in the red genotype carrot, while the concentration of carotenoids was higher in the phloem of orange and purple carrots[23]. The different accumulation pattern in the root tissues of carrots was thought to be due to the different expression of carotenoid biosynthesis genes[23]. Around 600 carotenoids have been identified in carrots, classified into carotenes and xanthophylls. The Carrot roots include the following percentages from the carotenoids category i-e β-carotene (75%) higher among all, α- carotene (23%), lutein (1.9%) while the xanthophylls included β-cryptoxanthin, lycopene, and zeaxanthin[22]. The number of carotenoids in

carrots ranges from 16-38 mg/100 g[24]. Provitamin-A carotenoids and non-provitamin-A carotenoids are the two different categories of carotenoids. Provitamin-A carotenoids can be converted to retinol, such as mutatochrome, β-carotene, and β-cryptoxanthin. The β-carotene yields the active Vitamin-A molecule by the activity of the carotene dioxygenase enzyme[51]. The non-provitamin-A carotenoids, such as lutein and lycopene, cannot be transformed into retinal carotenoids[52]. Other xanthophyll carotenoids, including the lutein/zeaxanthin and -cryptoxanthin, are important for bones health and eye care. These xanthophylls are identified in the macular of the retina and are thoroughly investigated because of their ability to reduce the onset of cataracts and macular degeneration in the human eye[51]. Lutein is the most abundant carotenoid in the central nervous system and is involved in the primate's brain and retina development. The presence of lutein is twice higher among children's brains, which plays an essential role in a child's neurological development. Moreover, it also protects the neural tissues, which is particularly important throughout childhood, when the retina and brain are constantly changing after birth. The actual lutein consumption fluctuates between 1 and 2 mg/day, but high lutein consumption (6 mg/day) reduces the risk of muscle deterioration in old age[53].The Vitamin A carotenoid's antioxidant qualities make it therapeutically important. It protects the DNA, Proteins, and lipids and defends the body from oxidative cellular damage, which leads to the malignant tumor by causing aberrant cells to proliferate and replicate. The antioxidant properties of Vitamin A maintain the normal functioning of the body's immune system, healthy skin, and strong eyesight[4]. The deficiency of Vitamin A has a substantial effect on the body's immune system and may cause serious damage to eyes photoreceptors, leading to blurred and weak vision[54].

Antioxidant effect: The study was conducted under the lead stress with the effect of magnesium oxide nanoparticles observed. The magnesium oxide nanoparticles of carrots under lead stress exhibit antioxidant activity [55]. The study was conducted to assess the antioxidant activity and health benefits of black carrots. Results suggested that the black carrot showed good health benefits and antioxidant activity[56]The antioxidant and antihyperlipidemic effects of aqueous seed extract of D. carota aqueous extract (AQEDCS) were studied in mice with hyperlipidemia brought on by triton 100.The in vitro antioxidant activities of the extract (0.2-1.0 mg/ml) were evaluated using total antioxidant capacity, 2,2-diphenyl-1-picrylhydrazyl, nitric oxide, and ferric ion scavenging. Triton 100-induced oxidative stress and hyperlipidemia in mice were used to test the antioxidant and antihyperlipidemic properties of AQEDCS extract in vivo. Figure 1 depicts the therapeutic value of *carrot pomace*. The findings showed that AQEDCS has antioxidant and antihyperlipidemic actions, and that it might support the antioxidant defense system in vivo during oxidative stress as well as stop future consequences from hyperlipidemia when used to treat diabetes mellitus[57],[58].

Carotenoids increase vitamin A: Carotenoids are fascinating compounds that can be converted into a variety of other compounds, including retinoids, which are important in a variety of processes. Carotenoids are well-known in the fields of food science, nutrition, and health as natural colorants and vitamin A precursors [59]. Carotenoids are the Provitamin A and a good precursor of vitamin A showed in figure 2. Carotenoids increase the vitamin A level in the body and activate the vitamin A [60]. Our vitamin A requirements are mostly met by plant-based carotenoids, and in industrialized nations, bioconversion to retinol may account for one-third of total retinol consumption[61].

Enhance immunity: The study focused to explore the allergenic outcome of Daucus carotte on the change in the number of leukocytes, lymphocytes, monocytes, granulocytes, basophils, and immunoglobulins as important components of the immune system. we concluded that the higher concentration of *Daucus carota* causes a higher elevation in blood parameters and concentrations of immunoglobulins, compared to the smaller concentration of the same allergen [62].

Effects on liver enzymes: The impact of carrot extract on acute liver damage caused by carbon tetrachloride (CCl4) was investigated. Due to CCl4 treatment, the extract also reduced increased blood bilirubin and urea levels. The extract reversed increased activity of hepatic 5′-nucleotidase, acid phosphatase, and acid ribonuclease, as well as lower levels of succinic dehydrogenase, glucose-6-phosphatase, and cytochrome P-450 generated by CCl4. The findings of this investigation demonstrated that carrots had a strong protective effect against CCl4-induced hepatocellular damage [63]. These findings show that pre-treatment with *Daucus carota* root extract prevented CCl4-induced liver damage in mice, confirming its protective benefits against hepatic damage caused by both non-oxidative and oxidative pathways. Pretreatment with *Daucus carota* extract eliminated CCl4-induced changes in enzyme activity [64].

Effects on lipids and cholesterol profile: The effectiveness of carrots in reducing hyperlipidemia was investigated. The results showed a rise in high-density lipoproteins and a fall in total cholesterol, very low-density lipoprotein, and low-density lipoprotein [57]. *Daucus carota* Compared to untreated hyperlipidemic mice, there were lower levels of plasma cholesterol, triacylglycerol, low-density lipoprotein, coronary artery, cardiac, and atherogenic indices and higher levels of circulating HDL[65].

Antibacterial effect: The carrot's aerial sections have inhibitory efficacy against several enteropathogenic Campylobacter jejune strains. Additionally, against strains of Campylobacter coli and C. lari, phenylpropanoids such as methyl isoeugenol and elemicin, as well as the extracts and essential oil, all worked as antibacterial agents[66]. *Carrot pomace* oils and extracts also showed inhibitory effectiveness against two gram-positive Methicillin-resistant Staphylococcus aureus strains and the Enterococcus (HLARVRE) strain [67].Antibacterial study of *carrot pomace* reported that the extract and essential oil obtained.

Anti-carcinogenic effect: Because of the presence of poly-acetylene, falcarinol, which fights against cancer by eradicating the pre-cancerous cells in tumors, carrot consumption can lower the risk of colon, breast, and lung cancer, which is one of the finest properties and activities of *carrot pomace*. Because it prevents the development of cancer cells in the colon and promotes the health of the lower digestive tract, it has anticarcinogenic characteristics [66]. Several animal experiments and epidemiological studies have showed that due to the carotenoids (Fig-2) and phenols *carrot pomace* has anti-carcinogenic, antioxidant, anti-mutagenic and anti-tumor effect in mice, rats and also in humans [9].

Anti-ageing effect: Due to the presence of Vitamin-C and A, *carrot pomace* prevents signs of aging like wrinkles, pigmentation and uneven skin tone wrinkles by locking the process of aging (sing M. n., 2020). Carotenoids (Fig. 2) have been associated with improved immunity and a lower incidence of degenerative illnesses such cancer, cardiovascular disease, age-related muscle degeneration, and cataract development [9]. it also help in improving muscles, flesh and skin health [68].

Conclusion: Carrots are a biochemically abundant source of beta-carotene, fiber, and several necessary micronutrients and useful components. Carrot roots' high levels of carotenoids, particularly -carotene, make them potent inhibitors of cancer, free radical scavengers, anti-mutagenic, and immunological boosters. Daily consumption of carrot makes you safe and healthy from different diseases. Polyacetylenes have their role in the improvement of human health as it is anticancerous, antifungal, antibacterial, anti-inflammatory and have tetrogenic effects. Normal functioning of the nervous system and prevention from cardiovascular diseases is made possible due to the presence of phenolic compounds in carrot. *Carrot pomace* is nutritionally and medicinal rich substance which increased their consumption. *Carrot pomace* and pomace powders used to make different nutrient dense food products such as *carrot pomace* toffees, cakes, sweet and salty biscuits. Moreover, it overcomes the micronutrient deficiency present in wheat flour or bread by supplementing the food with ingredients like carotenoids, fiber and mineral components. In this study, the nutritional makeup and anti-oxidant qualities of three carrot cultivars grown in Ghana—Kuroda, Pamela, and Amazonia—were identified. In this work, three different extraction techniques—microwave-assisted extraction (MAE), ultrasonic-assisted extraction (UAE), and conventional solvent extraction (CSE)—are used to recover phenolic components from black *carrot pomace* (BCP). To explore and maximize the MAE of phenolics, antioxidant activity, and color density from BCP, a Box-Behnken design was employed. In the present study, the impact of storage (at 4 °C for 12 days) on the antioxidant activity and bioactive component stability of two Algerian orange carrot types, Super-muscade and Touchon, was examined. To determine the materials' total phenolic content, the Folin-Ciocalteu technique was utilized. Build on the assessment of Free Radical Scavenging Activity (FRSA) utilizing DPPH radical and Ferric Reducing Power, Spectrophotometric Analysis (SA) indicated the antioxidant capacity (FRP). The study's findings expressed that the Touchon variety has more phenolics, flavonoids, and carotenoids than the Super-muscade variety does. High water holding capacity (WHC) is one of the main characteristics of *carrot pomace* hence, capable of retaining the high moisture content of 88g/100g. To increase the shelf life of *carrot pomace* dehydration method is used. The *carrot pomace* contains an appreciable amount of dietary fiber, 9.87 to 11.57 mg/100g of carotene, and 13.53 to 22.95 mg/100g of ascorbic acid. 600 carotenoids in the form of carotenes and xanthophylls found in carrot root promotes primate's brain and retina development along with their antioxidant properties. Some of the therapeutic properties of *carrot pomace* include; possesses antioxidant and antihyperlipidemic effects, increases vitamin A, enhances immunity, effective against protective action in the alleviation of CCl_4-induced hepatocellular injury. Moreover, vitamin A carotenoids antioxidants properties protect the eyes photoreceptors from serious damage and defends the body from oxidative cellular damage.

Conflicts of Interest: The authors declare no conflicts of interest.

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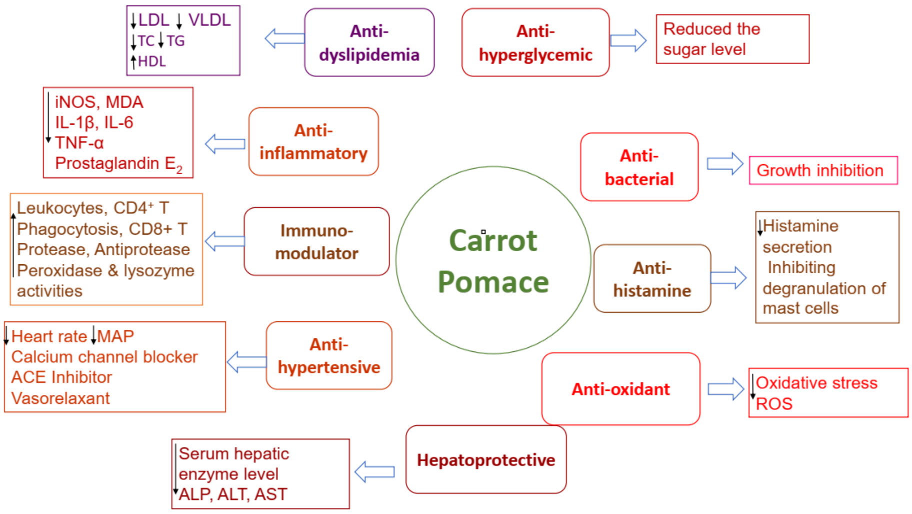

Fig 1. Therapeutic and Medicinal effect of *Carrot pomace*.

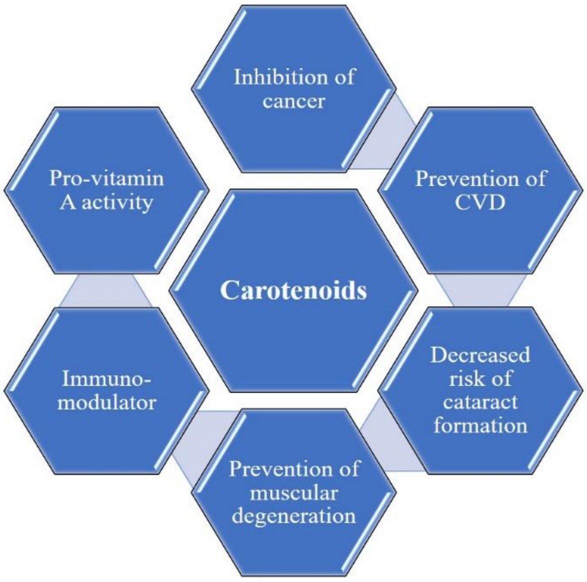

Fig 2. Health Promoting functions attributed to carotenoids