https://doi.org/10.33472/AFJBS.6.13.2024.1350-1358

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

A REVIEW ON THE VERSATILE BENEFITS OF CARROT AND CARROT SEED OIL: FROM NUTRITION TO THERAPEUTICS

Kumari Preeti[1], Shubham Pandey[2], Anju Singh[3*]

[1,2]Abhisekh Pharmacy College, Chandauli, U.P., India.
[3*]School of Pharmaceutical Sciences, CSJM University, Kanpur—208024, U.P., India.

Email: [1]preetiupadhyay1310@gmail.com, [2]sp6402430@gmail.com
Corresponding Email: [3*]anjutsingh@gmail.com

Article Info

Volume 6, Issue 13, July 2024

Received: 02 June 2024

Accepted: 30 June 2024

Published: 24 July 2024

doi: 10.33472/AFJBS.6.13.2024.1350-1358

ABSTRACT:

Carrot seed essential oil is commonly utilized in cosmetics, perfumes, and various food products as a fragrance and flavoring agent. It is sourced from specialized glandular structures called vittae within the plant. Chemical analyses have revealed that carrots contain various range of compounds like polyphenols, glycosides, alkaloids, saponins, sesquiterpenes, and essential oils. Researchers have extensively investigated the chemical constitution of carrot seed essential oil obtained through hydro-distillation, noting variations in composition across different plant parts. This essential oil exhibits diverse biological activities including antimicrobial, antibacterial, antifungal, herbicidal, antioxidant, and anticancer properties. Its health benefits are attributed to its antiseptic, disinfectant, detoxifying, antioxidant, anticarcinogenic, tonic, carminative, depurative, diuretic, and stomachic properties. This review comprehensively discusses the morphological characteristics of carrot plants, their essential oil constituents, chemical compositions, and biological functionalities.

Keywords: Essential oil, phytochemical studies, biological activities, components, health benefits.

1. INTRODUCTION

The genus Daucus encompasses approximately 60 weedy species that are widely distributed and often cultivated for their fleshy, edible roots. Derived from the word 'Carotos,' the species Carrot (*Daucus Carota L.*), a member of the *Apiaceae* family, is a popular root vegetable globally recognized for its crisp texture when fresh and predominantly orange color, though variations in purple, red, white, and yellow hues also exist. It ranks among the world's top ten economically significant vegetable crops. D. carota seeds are minute and encased in a fleshy mericarp, necessitating removal before sowing. These seeds originate from ovules within the carpels and are characterized by their small size and the presence of a spiny, hooked, and slightly curved mericarp, which contains an inhibitory oil hindering seed germination. Hence, the mericarp must be eliminated before planting. Botanically, carrot seeds aren't true seeds but rather dry fruits termed schizocarps. Contrary to common perception, carrots do not bear seeds within or on them, as they are not classified as fruits in the traditional sense.

Distribution

The natural habitat of the carrot plant extends from Western and Near East Asia to regions including the Mediterranean, Southwest Asia, Tropical Africa, Australia, and both North and South America. It is regarded as a significant weed in Afghanistan, Greece, Hungary, and Poland, and holds the status of a primary weed in Jordan, Mauritius, Puerto Rico, Sweden, and Tunisia. Additionally, it is commonly found in Austria, Canada, Egypt, England, Germany, Iran, Iraq, the USA, the former USSR, and West Polynesia. Carrots thrive in dry fields and uncultivated areas at low elevations across the northern United States, spanning from Vermont to Virginia and extending westward to Washington and California, with further distribution into Canada.

Habitat

Carrots exhibit adaptability to a wide spectrum of temperatures and are cultivated globally, except in regions with exceedingly high temperatures. Optimal root growth typically occurs within the temperature range of 15°C to 18°C. Despite this, carrot seeds can still germinate in cooler conditions. While carrots can endure extended periods of daylight, they require cooler temperatures to initiate the flowering process. Additionally, carrots are not typically found in recently abandoned fields due to the limited viability of their seeds, which typically last no more than two years.

Morphology

The carrot plant is classified as a herbaceous biennial, typically reaching heights between 0.3 to 0.6 meters, and featuring a densely hairy, solid stem. During its initial growth phase, it forms a leafy rosette throughout the spring and summer seasons, while concurrently developing a robust taproot. This taproot serves as a storage organ for accumulating significant quantities of sugars and nutrients, essential for flowering and seed production in the subsequent year. The taproot itself varies in morphology, appearing either thick, swollen, and red-orange, or slender and light-colored, with shapes ranging from conical to cylindrical or spherical, depending on the cultivar. The stem exhibits furrows and may be covered in bristly hairs or compressed, with indistinct internodes. Leaves are characterized by their tri-pinnate, finely divided, stalked, lace-like appearance, forming a triangular outline. At the apex of the plant, a sizable primary umbel emerges, comprising up to 50 smaller umbellets, each potentially bearing as many as 50 flowers. These flowers, typically white but occasionally tinged with light green or yellow, are arranged in a flat, umbrella-like configuration known as an umbel, composed of five petals, five stamens, and a calyx. Carrot fruits are oval-shaped, flattened laterally, measuring 2-4mm in size, featuring short styles and distinctive hooked spines [2,3]

Extraction of Oil from Carrot Fruits and Seeds

Carrot seeds underwent extraction employing various solvents including 1, 1, 2-trichloro-1, 2, 2-trifluoroethane, methylfuran, ethanol, chloroform, petroleum ether, and dichloromethane. Quantitatively, the most substantial yields of concrete and essential oil were achieved through sylvan (4.89% and 0.44%, respectively) and ethanol (3.31% and 0.88%, respectively). These yields of essential oil surpassed those acquired via hydro-distillation (0.42%**)** [4]**.** the investigation also explored the extraction of essential oil from carrot fruits using the supercritical carbon dioxide method, starting from the pretreatment of the herbaceous matrix.

Chemical Composition of Oil Extracted From Carrot

Fresh carrots contain approximately 0.58% of essential oil. In Iran, hydro distillation of carrot leaves yielded 0.2% (v/w) of essential oil. Upon harvest, fully matured carrot plants displayed varying essential oil yields across different plant parts: roots yielded 0.2%, leaves ranged from 0.1% to 0.3%, and fruits exhibited yields between 0.8% and 1.6% (v/w). Throughout the ontogeny of the umbels, essential oil yields fluctuated between 0.5% and 1.7% (v/w). Carrot seed oil is predominantly composed of petroselinic acid (70%). Analysis of hydrodistilled essential oil from aerial parts (stems, leaves, and umbels) of D. carota cultivated in Algeria revealed a higher abundance of monoterpenes (91.7% and 63.2%) compared to phenylpropanoids (0.2% and 13.9%). The composition of essential and edible oil from carrot seeds was investigated using GC and GC-MS, with essential oil yields at 0.82% and edible oil yields at 7.83%. Major constituents of seed essential oil included carotol (66.79%), daucene (8.75%), (Z, Z)-α-farnesene (5.80%), germacrene D (2.33%), trans-α-bergamotene (2.42%), and β-selinene (2.21%), whereas carotol (31.55%), daucol (12.61%), and copaenol (0.60%) were prominent in edible carrot seed oil. Notably, carotol emerged as the predominant component in both oils. [6,7]

Different Benefits of Carrot

Table no.1- Various benefits provided by Carrot

NUTRITIONAL BENEFITS	SKIN- RELATED BENEFITS
Carrots comprises of pro-vitamin A carotenes and helps to maintain good eye health.	slows down ageing due to presence of rich antioxidants and soothes the skin.
Carrot is a decent source of dietary fiber and the trace mineral molybdenum, which is rare to be found in many vegetables.	Inhibits the growth of bacteria and regulates the production of sebum.
It is also a potent source of magnesium and manganese. Magnesium is necessary for bone, protein, synthesizing new cells, relaxing nerves and muscles, clotting blood, and for providing energy.	protects the skin from sun damage and help to treat various skin conditions. It has vitamin C which boosts collagen and vitamin E which rejuvenates skin.
Secretion as well as proper functioning of insulin also demands magnesium.	It also possesses anti-inflammatory properties and keeps the skin calm and clear.

Biological Potential of Carrot Seed Essential Oil

Carrots are extensively cultivated worldwide as a valuable vegetable and have been the subject of research for numerous decades due to their biological properties. Phytochemical investigations have yielded a plethora of active compounds from this plant, encompassing volatile oils, steroids, triterpenes, carbohydrates, glycerides, tannins, flavonoids, amino acids, carotene, and hydrocarotene.

Health Benefits of Carrot

1. **Antioxidant activity-** Carrots, among various other colorful vegetables, represent a rich source of antioxidants. The notable abundance of antioxidant carotenoids, particularly β-carotene, is believed to underlie the physiological and therapeutic attributes associated with carrots. Carotenoids, along with polyphenols and vitamins found in carrots, function as antioxidants [10]. Specifically, the carotenoids prevalent in orange carrots exhibit robust antioxidant properties, capable of counteracting the deleterious effects of free radicals. Furthermore, flavonoids and phenolic compounds present in carrot roots contribute significantly to its antioxidant capacity.
2. **Anticarcinogen and immune enhancer activity-** Various dietary carotenoids have demonstrated anticancer effects owing to their potent antioxidant activity, which scavenges free radicals within the organism. Research indicates a potential correlation between diets abundant in carotenoids and a decreased susceptibility to prostate cancer. A comprehensive meta-analysis from 2008 revealed a 21 percent reduction in the risk of lung cancer among individuals with high intakes of diverse carotenoids. Moreover, empirical evidence suggests that integrating carrots into one's diet may diminish the likelihood of developing lung, breast, and colon cancers. This phenomenon is attributed to carrots' richness in the polyacetylene antioxidant, falcarinol, which combats cancer by eradicating precancerous cells within tumors. Consequently, carrots exhibit anticarcinogenic properties that impede the proliferation of cancer cells in the colon, thereby promoting gastrointestinal health. This underscores one of the foremost health advantages of carrot consumption. Additionally, carrots boast an array of nutrients and antioxidants, including vitamin C, which bolsters the immune system. Regular incorporation of carrots into the diet establishes a protective barrier, fortifying the body against various threats [8,9]

In addition to β-carotene and various carotenoids, carrots encompass a spectrum of essential vitamins such as vitamin C and vitamin K, alongside thiamin (B1), riboflavin (B2), pyridoxine (B6), and folates (B9), crucial for carbohydrate and protein metabolism, as well as facilitating healthy growth. Vitamin C plays a pivotal role in enhancing the absorption of non-heme iron and is indispensable for immune function, whereas vitamin K is integral for clotting regulation. Thiamin (B1) exerts significant positive effects on neurological function and mental well-being; riboflavin is indispensable for cellular respiration and erythrocyte production; pyridoxine mitigates homocysteine accumulation, thereby reducing the risk of cardiovascular ailments; and folates contribute to heart health by lowering homocysteine levels, potentially diminishing the likelihood of myocardial infarction.

3. **Anti-diabetic activity-** Carrots' antioxidants and phytochemical compounds potentially regulate blood sugar levels. Dietary recommendations from the American Heart Association (AHA) emphasize the importance of consuming a fiber-rich diet, increasing potassium intake, and reducing sodium consumption to mitigate the risk of hypertension and cardiovascular ailments. Carrots offer a favorable combination of these nutrients. Recent investigations have indicated that individuals with lower levels of carotenoids exhibited elevated blood glucose levels and increased fasting insulin levels. Furthermore, as the severity of glucose intolerance intensified, carotenoid levels declined. These observations suggest the potential utility of carrots and vitamin A-rich carotenoids in assisting individuals with diabetes in managing their condition. [11]
4. **Cardio and Hepato-protective activities-** Carrots are enriched with an array of antioxidants and polyacetylenes, collectively conferring a shield of protection to the cardiovascular system. Scientific studies have evidenced that consuming foods abundant in carotenoids correlates with a diminished risk of heart disease. In addition to their substantial β-carotene content, carrots also harbour alpha-carotene and lutein. Regular incorporation

of carrots into one's diet serves to safeguard the heart against oxidative stress, atherosclerotic plaque deposition, and elevation of detrimental cholesterol levels. This protective mechanism is attributed to the presence of soluble fibers in carrots, which interact with bile acids. Notably, carrot seed extract has demonstrated cardio-protective properties and regulation of myocardial contractility in rats with isoproterenol-induced myocardial infarction, attributed to the maintenance of membrane-bound enzymes. Furthermore, findings suggest a potential inotropic effect of carrot seed extract, as evidenced by significantly lower levels of serum aspartate transaminase, alanine transaminase, and lactate dehydrogenase in rats administered with carrot seed extract. Moreover, the hypolipidemic activity of carrot seeds in rats is noteworthy, as evidenced by reductions in total cholesterol, triglycerides, high-density lipoprotein (HDL), and very low-density lipoprotein (VLDL) levels compared to control groups. [12,14]

5. **Antimicrobial activity**- The antimicrobial efficacy observed in the essential oil of D. carota stems from the combined lipophilic nature of its hydrocarbon skeleton and the hydrophilic properties of its functional group. In comparative assessments, the essential oil derived from D. carota subsp. gummifer exhibited greater activity in comparison to that of D. carota subsp. carota against six bacterial strains, as evidenced by minimum inhibitory concentration (MIC) values ranging between 2.4 to 5 mg/ml. [13] Notably, this heightened activity primarily targeted three gram-positive bacteria (L. monocytogenes, B. cereus, and S. aureus) and one gram-negative bacterium (E. coli) at a concentration of 2.4 mg/ml.
6. **Anti-fungal activity-** The antimicrobial efficacy observed in the essential oil of D. carota stems from the combined lipophilic nature of its hydrocarbon skeleton and the hydrophilic properties of its functional group. In comparative assessments, the essential oil derived from D. carota subsp. gummifer exhibited greater activity in comparison to that of D. carota subsp. carota against six bacterial strains, as evidenced by minimum inhibitory concentration (MIC) values ranging between 2.4 to 5 mg/ml. Notably, this heightened activity primarily targeted three gram-positive bacteria (L. monocytogenes, B. cereus, and S. aureus) and one gram-negative bacterium (E. coli) at a concentration of 2.4 mg/ml. Carotol exhibited notable growth inhibition of the fungi and led to a reduction in colony radial size. In contrast, daucol demonstrated a lesser inhibitory effect compared to carotol, while β-caryophyllene showed no discernible effect. These findings imply that carotol serves as the primary component responsible for the antifungal activity observed in carrot seed oil extracts. [14,15]
7. **Anti-inflammatory activity-** Polyacetylene compounds such as falcarindiol, falcarindiol 3-acetate, and falcarinol were found to reduce nitric oxide production in macrophage cells by approximately 65% without inducing cytotoxic effects. It was determined that the anti-inflammatory bioactivity observed in purple carrots could be attributed to these polyacetylenes rather than anthocyanins. Additionally, polyacetylenes exhibit cytotoxic effects on certain fungi and microorganisms, while demonstrating protective effects against various cancer cells both in vitro and in vivo. These compounds possess a spectrum of bioactive properties, including the inhibition of lipid transport enzymes, the induction of liver phase II detoxification enzymes, and anti-inflammatory activity. [15] Evaluation of essential oils derived from the flowers, roots, and stems of carrots was conducted based on yield, color, chemical structure, and multi-fragrance components. These oils displayed antibiosis and anti-inflammatory activities, with significant inhibition of nitric oxide (NO) production observed in lipopolysaccharide (LPS)-stimulated macrophages and microglia cells, indicating robust anti-inflammatory potential.
8. **Sun Protection**- Beta-carotene, present in carrots, serves as a beneficial nutrient for skin health, undergoing conversion to vitamin A upon ingestion. This conversion facilitates the repair of skin tissues and offers protection against the damaging effects of solar radiation.

The antioxidants and carotenoids present in carrots play a vital role in shielding and nurturing the skin, thereby enhancing its resilience against sun exposure and aiding in the healing of sunburns. Notably, consuming carrot juice during the summer months serves as a natural means of sun protection. [16,17]

9. **Anti-ageing Effects**- Carrots additionally contain Vitamin C, which plays a crucial role in stimulating collagen synthesis within the body. Collagen, a pivotal protein, is essential for preserving skin elasticity, thereby mitigating the formation of wrinkles and slowing the aging process. Furthermore, Vitamin A, possessing antioxidant properties, actively combats free radicals to forestall age-related manifestations such as wrinkles, pigmentation irregularities, and uneven skin tone. [18]
10. **Muscle relaxant and reducing blood Pressure-** The ethanolic extract derived from D. carota demonstrated a direct relaxant effect akin to calcium channel blockade on both cardiac and smooth muscle preparations, consequently lowering blood pressure. This effect was attributed to the presence of two coumarin glycosides in the aerial parts of the plant. Furthermore, seed oil extracted from D. carota var. sativa was found to induce central nervous system (CNS) hypnotic effects in rats, along with hypotensive effects and direct depressant actions on cardiac muscle in dogs. These effects were noted to lead to respiratory depression at higher doses. Additionally, the seed oil exhibited anticonvulsant activity in frogs and in vitro smooth muscle relaxant activity.

Risks Associated With Carrot Seed Oil

- The application of substantial quantities of carrot seed oil has the potential to provoke adverse reactions in individuals with sensitive skin. Therefore, those with sensitive skin should exercise caution and judiciously regulate the usage of this oil to mitigate any potential adverse effects.
- When employing topically, use carrot seed oil for the skin with a carrier oil such as coconut oil.
- The use of carrot seed oil must be prevented during pregnancy.
- If a person is suffering from asthma or epilepsy or consumes medicines for any liver condition, they must consult with their doctor about whether you can use carrot seed oil or not.
- It is recommended to use carrot seed oil in the evenings, as it has beta-carotene which can oxidize in the presence of sunlight and heat, initiating irritation and discoloration on the skin**.**

Various Formulations of Carrot Seed Oil

There are various formulations available in the market containing carrot seed essential as well as its fixed oil. Many pharmaceutical preparations are formulated in conventional as well as in novel dosage forms. Some of them are-

Table no. 2- Various formulations of carrot seed oil

Typeof formulation	Excipients used	Benefits	References

Nanoemulgels	Tween-80 Sorbitol Carbopol-940 Propylene glycol	Sunscreen Anti-aging	Arianto Anayanti, et.al (2021),” The use of carrot seed oil (daucus carota l.) to formulate nano emulgels as an effective natural sunscreen and skin anti-aging” " International journal of Applied Pharmaceutics,14(1),124-129
Medicated Soaps	Palm kernel oil Sodium hydroxide Sodium chloride glycerin	Anti-fungal activity	Abdulrasheed (2015),” Parametric studies of carrot seed oil extract for production of medicated soaps”, IJRDET,4(1), ISSN-2347-6435

2. CONCLUSION

Numerous investigations have been conducted concerning carrot essential oil, with notable attention paid to its biological properties. Clinical studies have substantiated its therapeutic potential in pharmaceutical aromatherapy, exhibiting efficacy in addressing various pathological conditions. This inquiry delved into the promising medicinal utility of carrot essential oil, noting a dearth of comprehensive reviews on the chemistry and biological functions of both carrot plants and carrot seed essential oils. Notably, the hydro distillation method emerged as a prevalent technique for isolating essential oils from carrots. Carrot essential oil is distinguished by its abundance of sesquiterpenes, predominantly Carotol, alongside minor compounds such as Daucol and Daucene. Despite advancements, the precise isolation, quantification, derivatization, and structural elucidation of these constituents remain paramount due to their diverse biological activities. Carrot seed oil and its components exhibit a wide array of biological effects, encompassing antifungal, antimicrobial, insecticidal, anti-inflammatory, anticancer, antifertility, antiulcer, antioxidant, herbicidal, diuretic, and muscle relaxant properties. Thus, the therapeutic potential of carrot essential oil warrants further exploration, particularly in elucidating its underlying chemistry and diverse biological activities.

3. REFERENCES

1. Acharya U R, Mishra M, Patro J and Panda M K (2008) “Effect of vitamins C and E on spermatogenesis in mice exposed to cadmium”, Repro Toxicol ,25, 84-88.
2. Simon PW. (2000), “Domestication, Historical Development and Modern Breeding of Carrot”, Plant Breeding Reviews; 19; 157-190.
3. Ahmed A, Ahmed A, Mohktar M, Bishr B, Mohamed A, El-Shanawany C, Eman Z, Attia B, Samir A, Ross D and Paul W (2004) “Rare trisubstituted sesquiterpenes daucanes from the wild Daucus carota”, Phytochem,66,1680-1684.
4. Ashraf M, Sandra P J, Saeed T and Bhatty M K (1979) “Studies on the essential oils of the Pakistani species of the family Umbelliferae” Pak J Sci Ind Res, 22, 202-204

5. Azad A K, Sardar A, Yesmin N, Rahman M, Islam S (2006), "Eco-friendly pest control in cucumber (Cucumis sativa L.) field with botanical pesticides" Natural Resources, 4, 404- 409.
6. Bhargava A K (1967) "Pharmacological investigation of the essential oil of Daucus carota Linn. var. sativa" D C Indian J Pharm, 29, 127-129
7. Bhatnagar U (1995) "Postcoital contraceptive effects of an alcoholic extract of Daucus carota Linn. seed in rats" Clinical Drug Invest,9, 30-36
8. Garg S K, Mathur V S and Chaudhury R R (1978) "Screening of Indian plants for antifertility activity "Indian J Exp Biol, 16, 1077-1079.
9. Khanna K R, Sharma S O and Singh A (1989) "The essential oil from the leaves of Daucus carota L. var. sativa.", Acta 11th International Congress on Essential Oils, Fragrance and Flavanoids
10. Nayeem K, Godad A, Hashilkar N and Joshi R (2010) "Gastroprotective activity of the aqueous extract from the roots of Daucus carota L in rats" IJRAP, 1, 112-119
11. Ram S, Verma R, Padalia and Chauhan A (2013) "Chemical composition variability of essential oil during ontogenesis of Daucus carota L. subsp. sativus (Hoffm.)" Arcang Ind Crop Prod ,52, 809-814
12. Radulovic N, Dord-Evic N and Stojanovic Z (2011) "Volatiles of the Balkan endemic Daucus guttatus ssp. zahariadii and cultivated and wild growing D. carota – A comparison study" ,Food Chem ,125, 35-43
13. Ranjbar B (2010) "Effect of the methanolic extract of Daucus carota seeds on the carbohydrate metabolism and morphology of pancreas in type I diabetic male rats" Physiol Pharmacol, 14,84-93
14. Sandra B, Glis D, Marko D, Stamenic R, Irena T Z and Ruz M (2007) "Supercritical carbon dioxide extraction of carrot fruit essential oil: Chemical composition and antimicrobial activity Food Chem" ,105, 346-352
15. Smigielski K, Majewska M, Kunicka-Styczyn R and Gruska A (2014) "The effect of commercial enzyme preparation- assisted maceration on the yield, quality and bioactivity of essential oil from waste carrot seeds (Daucus carota L.)", Grasasy Aceites, 65 ,47
16. Zaini R G, Brandt K, Clench M R and Le Maitre C L (2012) "Effects of bioactive compounds from carrots (Daucus carota L.), polyacetylenes, beta-carotene and lutein on human lymphoid leukemia cells" Anticancer Agents Med Chem, 12 , 640-652
17. Saad H E A, El-Sharkawy S H and Halim A F (1995) "Essential oils of Daucus carota L. spp.", Max Pharma Acta Helvetiae, 70, 79-84
18. Park M and Park K (2012)" Larvicidal activity of Amyris balsamifera, Daucus carota, and Pogostemon cablin essential oils and their components against Culex pipiens pallens "J Asia Pacific Entomolo ,15, 631-634
19. Sing K, Dhongade H, Sing N, Kashyap P. (2010) "Hypolipidemic Activity of Ethanolic Extract of Daucus carota Seeds in Normal Rats" International Journal of Biomedical and Advance Research,2010;1,73-80.
20. Vasudevan M, Gunnam KK, Parle M. (2006) "Anticonceptive and Anti-Inflammatory Properties of Daucus carota Seeds Extract" Journal of Health Science;52,598- 606.
21. Nigam S S and Radhakrishnan C (1963) "Chemical examination of the essential oil from the seeds of Daucus carota "Perf Essent Oil Rec ,54, 87-92
22. Nayeem K, Godad A, Hashilkar N and Joshi R (2010) "Gastroprotective activity of the aqueous extract from the roots of Daucus carota L in rats", IJRAP ,1, 112-119
23. Miladi S, Abib N, Debarnot C and Damak B (2012) "In vitro antiviral activities of extracts derived from Daucus maritimus seeds" Nat Prod Lett ,26, 1027-1032.
24. Mockute D and Nivinskiene O (2004) "The sabinene chemotype of essential oil of seeds of Daucus carota L. ssp. carota growing wild in Lithuania" J Essent Oil Res, 16, 277-281

25. Pigulevskii G V, Kovaleva V I and Motskus D V (1965) “Essential oils obtained from the fruit of the wild carrot Daucus carota L.”, collected in different regions Rastitel’nye Resurs,1 ,227-230.