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Review

Pro-Health Potential of Selected Uncommon Oilseed Plants

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Abstract: Oilseed plants are a valuable group of foods in human nutrition. Uncommon oilseed plants, such as safflower (*Carthamus tinctorius* L.), camelina (*Camelina sativa* L.), and black cumin (*Nigella sativa* L.), have been gaining increasing attention. The unique chemical compositions of these plants, which contribute to potential health benefits, underscore the importance of further exploration and study. The continuation of development of research in this field, resulting in the well-documented positive impact of these plants on human health, may lead to the possibility of them becoming new functional foods in the future. This review aims to present the potential health-promoting properties of the aforementioned uncommon oilseed plants based on recent literature reports and intends to inspire further exploration of their unique features. Among others, recent reports on the anticancer, antioxidant, and antibacterial potential, as well as the preventive potential in the case of metabolic diseases of these plants, were discussed. The importance of further development of these problems was also emphasized.

Keywords: safflower; camelina; black cumin; uncommon oilseed plants; pro-health potential

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1. Introduction

Plants play a crucial role in maintaining human health. The rich content of bioactive compounds, e.g., phenols, glucosinolates, carotenoids, alkaloids, and terpenes, in a variety of plant-based foods causes research interests in them to continue unabated. Scientific studies have demonstrated that incorporating these compounds into the diet can significantly influence various biological processes, thereby contributing to the prevention of chronic diseases such as cardiovascular disease, metabolic syndrome, and certain types of cancer [1,2]. Oilseed plants are a valuable group of foods in human nutrition as they provide high-quality oils used in various food products and supplements. They have been utilized for medical purposes by humanity since ancient times [3]. Recently, unconventional oilseed plants, such as safflower (*Carthamus tinctorius* L.), camelina (*Camelina sativa* L.), and black cumin (*Nigella sativa* L.), have been gaining increasing attention due to their potential not only as components of various products but also in the pharmaceutical industry.These rare plant species have unique chemical compositions that contribute to potential health benefits. A growing number of scientific studies confirm that the bioactive compounds present in these rare oilseed plants could significantly impact human health, making them an attractive subject of research in the context of developing natural therapeutic and prophylactic agents [4–6]. This review aims to present the potential health-promoting properties of safflower (*Carthamus tinctorius* L.), camelina (*Camelina sativa* L.), and black cumin (*Nigella sativa* L.) based on recent literature reports and intends to inspire further exploration of their unique features. Photographs of safflower, camelina, and black cumin are included in the Supplementary Materials.

2. Methods

All data were collected based on a search for articles in the following databases: Scopus, ScienceDirect, and PubMed. The following keywords were used: "Carthamus tinctorius",

"safflower", "Camelina sativa", "camelina", "Nigella sativa", and "black cumin". English-language scientific articles were taken into account. In the case of safflower and camelina, the literature from the years 2015–2024 was analyzed. Due to the great progress in research on the health-promoting properties of black cumin, in the case of this plant, the search was narrowed to the last five years (2019–2024).

3. Pro-Health Potential of Selected Uncommon Oilseed Plants

3.1. Carthamus tinctorius L.

Carthamus tinctorius L., commonly known as safflower or false saffron, is an herbaceous annual plant that belongs to the *Asteraceae* family [7,8]. The safflower is a plant with extensive branching, growing up to a meter in height. Its leaves are lanceolate and stalkless, measuring between 4 and 10.5 cm in length and 1 and 2.8 cm in width. Its bright yellow-orange or red flowers are large and sit within a cluster of leafy bracts, forming an involucre around 3 cm across. The fruits comprise achenes, with four deformed ribs and a truncated top. The seeds, which may be hairy or hairless, are encased in a thick pericarp [7,9]. *C. tinctorius*, one of the earliest cultivated crops, has been documented in commercial use for over 2200 years. The flowers and seeds of *C. tinctorius* have been used in traditional herbal medicine throughout China, Korea, Japan, and other Asian countries to treat various health problems [9]. Table 1 presents a comparison of the potential pro-health properties of *Carthamus tinctorius* L., *Camelina sativa* L., and *Nigella sativa* L. based on the analyzed recent data. The phytochemistry of safflower has been extensively studied, with over 200 isolated compounds. They include, among others, flavonoids, alkaloids, organic acids, and polyacetylenes. Flavonoids, which have a wide range of biological activity, are considered the characteristic, active components of safflower. Substances such as quinochalcones, which comprise almost all yellow and red pigments in flowers, C-glycosides, O-glycosides, and kaempferol derivatives have been isolated from this plant. In recent years, a major component of the yellow pigment, hydroxysafflor yellow A (HSYA), has garnered significant attention from researchers owing to its promising therapeutic potential. Widely distributed in safflower seeds and leaves, alkaloids, which are serotonin derivatives, can be used as natural antioxidants. *C. tinctorius* seeds are rich in fatty acids, including linoleic acid (LA) (40–80%), oleic acid (20–50%), palmitic acid (6–10%), and stearic acid (2–3%). In flowers, roots, and immature seeds, polyacetylene compounds have been found. However, their phytochemistry and biological activity have not been given sufficient attention in the available literature [8–10].

Table 1. Comparison of the potential pro-health properties of *Carthamus tinctorius* L., *Camelina sativa* L., and *Nigella sativa* L. based on the analyzed data. The symbol "+" indicates specific properties noted for a given plant based on analyzed literature.

Potential Pro-Health Properties	*Carthamus tinctorius* L.	*Camelina sativa* L.	*Nigella sativa* L.
Anti-inflammatory	+	+	+
Antioxidant	+	+	+
Antibacterial	+	+	+
Antidiabetes	+	+	+
Antiobesity	+	+	+
Anticancer	+	+	+
Cardioprotective	+	+	+
Hepatoprotective	+	+	+
Immunomodulatory			+

3.1.1. Anti-Inflammatory Properties

Inflammation is associated with the pathogenesis of many diseases. According to the current literature, substances derived from safflower, such as hydroxysafflor yellow A, kaempferol, and hyperoside, exhibit anti-inflammatory effects in different organs and

tissues [8]. However, this issue is still intensively researched. In various studies regarding the anti-inflammatory properties of safflower, researchers' attention is attracted to various parts of the plant (flowers, leaves, and seeds). In a study by Kim et al., the ethanol extract of safflower leaves was used to test its anti-inflammatory potential. The results showed that the ethanol extract of *C. tinctorius* leaves protects the lipopolysaccharide (LPS)-induced HaCaT (human keratinocyte cell line) cells by inhibiting the expression of inducible nitric oxide synthase (iNOS), as well as nitric oxide (NO), interleukin-6 (IL-6), and interleukin-1 beta (IL-1β) production. These results indicate that safflower leaves are a potential candidate to prevent inflammation-related diseases [11]. The results of research conducted by Li et al. [12] showed that polyacetylene glucosides isolated from the florets of safflower significantly inhibited LPS-induced NO production in RAW 264.7 cells (macrophage cell line) in a dose-dependent manner. Four compounds derived from safflower seeds, acacetin, cosmosiin, N-feruloyl serotonin, and N-(p-coumaroyl) serotonin, restrained formation of LPS-stimulated NO and cytokines that cause or enhance inflammatory responses [13].

3.1.2. Antioxidant Potential

Oxidative stress is recognized as a crucial contributor to the pathogenesis of numerous chronic diseases, including cardiovascular disease, type 2 diabetes, and cancer. The organism employs a variety of defense mechanisms to counteract oxidative stress, such as antioxidant enzymes and antioxidants like vitamins C and E, flavonoids, and carotenoids. Recent research on antioxidants has been focused on their potential in disease prevention and therapeutic interventions [14,15]. Safflower oil has been shown to possess strong antioxidant properties, which were confirmed using various methods, including DPPH (α, α-diphenyl-β-picrylhydrazyl free radical scavenging method), ABTS (2,2′-azino-bis-(3-ethylbenzothiazoline-6-sulfonic acid method), and FRAP (ferric reducing ability of plasma assay). Studies suggest that the phenolic content and antioxidant activity of safflower oil may vary with plant genotype and cultivation conditions. The antioxidant potential of safflower oil draws attention to its use, among others, as a natural agent in maintaining skin health and antiaging protection. *C. tinctorius* oil demonstrates anticollagenase and antielastase activity and possible management of skin wounds [16,17]. Available scientific studies indicate the high antioxidant activity of *Carthamus tinctorius* L. flower extracts. Extracts exhibited high antioxidant activity as assessed by methods such as ORAC (oxygen radical absorbance capacity) and DPPH. The most potent free radical scavenging effect was correlated with a higher total phenol content in the samples [18,19]. Bacchetti et al. [18], in their studies, draw attention to the biphasic effect on oxidative stress of both safflower flower extracts and flavonoid compounds, HSYA and safflor yellow A (SYA). Extracts, HSYA and SYA showed a protective effect against oxidative stress in human dermal fibroblasts (HuDes) oxidized by tert-butyl hydroperoxide (t-BOOH) at low concentrations, while at higher concentrations, they showed pro-oxidant activity [18]. The antioxidant properties of HSYA are strongly connected with the protective effect of safflower against various diseases. The administration of HSYA maintained kidney function in rats with diabetic nephropathy induced by a high-fat diet (HFD) and streptozotocin (STZ). The probable mechanism underlying the renal protective properties of HSYA could involve the suppression of oxidative stress, mitigation of inflammatory responses, and alleviation of renal cell apoptosis [20]. Furthermore, pretreatment with hydroxysafflor yellow A may prevent oxidative injury from occurring in the renal tissue of rats [21]. Research by Wang et al. suggested that due to its ability to modulate oxidative stress and enhance antioxidant defense, HSYA has potential as a neuroprotective agent in the treatment of traumatic brain injury. HSYA administration significantly increased the activity of antioxidant enzymes such as superoxide dismutase (SOD) and catalase (CAT) in the brains of rats with traumatic brain injury. HSYA decreased the level of malondialdehyde (MDA), a marker of oxidative stress, and reduced the ratio of oxidized to reduced glutathione, indicating improved antioxidant defense [22]. More recent studies seem to be focused on understanding the antioxidant activity of lesser-known compounds present in safflower. Lin et al. analyzed

two polysaccharides derived from safflower, CTLP-1 and CTLP-2. Both polysaccharides showed high capacity to neutralize free radicals, including hydroxyl, DPPH, and ABTS radicals, moderate activity in chelating Fe^{2+}, and superoxide anion scavenging. The results suggest that CTLP-1 and CTLP-2 may be useful as natural antioxidants [23].

3.1.3. Antibacterial Effect

Antimicrobial substances extracted from various plants can be a source of initial concepts for novel drug compounds that can improve human health. The literature data indicate the potential antibacterial properties of safflower extracts [24]. Ethanol extract of *Carthamus tinctorius* L. with a concentration of 1.0 mg/mL effectively inhibited the growth of *E. coli* isolated from laying hens [25]. An inhibitory effect against pathogenic bacteria *S. aureus* and *S. Typhi* was observed in the case of safflower petal methanolic extracts with a concentration of 240 mg/mL. The authors also noted that the inhibitory effect differed significantly between various safflower cultivars which were used to prepare the extracts [19]. *C. tinctorius* ethanolic leaf extracts exhibited varying degrees of antimicrobial effects against harmful pathogens such as *S. aureus*, *P. aeruginosa*, and *E.coli*. The concentration of 100 μg/mL was distinctly more effective than the lower concentrations of ethanolic leaf extracts (respectively, 20, 40, 60, and 80 μg /mL) [26].

3.1.4. Antidiabetes Properties

Numerous studies have investigated the effects of *C. tinctorius* on diabetes. In a study involving rats with type 2 diabetes mellitus (T2DM) induced by an HFD and STZ, treatment with HSYA for 8 weeks led to a significant reduction in fasting blood glucose and insulin resistance. The authors concluded that the HSYA's effect on insulin resistance and glycolipid metabolism improvement in T2DM rats could be attributed to its phosphoinositide 3-kinase/protein kinase B (PI3K/Akt) pathway activation and pancreatic β-cell apoptosis inhibition, directly or indirectly [27]. The literature data indicate that the antidiabetic mechanisms of HSYA are related to several signals: the previously mentioned PI3K/Akt pathway, c-jun NH2-terminal kinases/c-jun (JNK/c-jun) pathway, NADPH oxidase 4 (NOX4) pathway, and macrophage polarization [28]. In a separate study investigating the antidiabetic properties of safflower, researchers utilized *C. tinctorius* oil. STZ-induced diabetic male rats received 4 mL/kg body weight safflower oil for 21 days via an intragastric catheter. This administration resulted in a highly significant decrease in blood glucose levels. The authors suggested that it could be related to antioxidants, which help in recovering from weak glucose metabolism. Furthermore, the improvement of antioxidants in diabetics may prompt the protection of pancreatic β cells. In addition, safflower oil is rich in polyunsaturated essential fatty acids. Researchers emphasized that there is evidence indicating that unsaturated fats play an essential role in insulin production and glucose homeostasis [29].

3.1.5. Antiobesity Potential

Obesity represents a multifaceted metabolic disorder with a complex origin, characterized by abnormal or excessive fat accumulation that poses a significant health risk. Fat accumulation has been noted to exhibit a strong association with indicators of systemic oxidative stress [30–32]. The bioactive compounds obtained from safflower, including HSYA and safflower yellow (SY), have been identified as having antiobesity properties. In a study involving diet-induced obese (DIO) mice, HSYA or SY were administered at a dosage of 200 mg/kg per day for 10 weeks. The findings indicated that both SY and HSYA led to significant reductions in body weight gain and fat mass in the DIO mice. Additionally, improvements were observed in glucose metabolism and liver function parameters. Yan et al. [33] postulated that the favorable impacts of these compounds may be linked to elevated expression of antioxidant enzymes in the liver and adipose tissue. Another experimental analysis of SY demonstrated notable effects, including significant reductions in body fat mass, lowered fasting blood glucose levels, and improved insulin sensitivity in high-fat diet-induced obese male mice. These findings were observed fol-

lowing an 8-week regimen of intraperitoneal injections of SY at a dosage of 120 mg/kg daily. The study suggested a potential mechanism involving the promotion of browning in subcutaneous white adipose tissue and the activation of the IRS1/AKT/GSK3β (insulin receptor substrate 1/protein kinase/glycogen synthase kinase 3β) pathway in visceral white adipose tissue [34]. According to Liu et al. [35], in mice with obesity induced by an HFD, oral administration of HSYA also led to decreased fat accumulation, improved insulin sensitivity, and reestablished normal glucose levels. HSYA effectively alleviated inflammation, fortified intestinal structures, boosted short-chain fatty acid production, and rectified gut microbiota imbalance triggered by an HFD [35]. Although HYSA and SY seem to be promising antiobesity drugs, it turns out that supplementation with safflower oil also could bring some advantages. Safflower oil supplementation reduced the abdominal fat in male rats fed with an HFD and undergoing swimming training. In this study, safflower oil had no significant effect on lipid biochemical parameters and blood glucose [36]. In a randomized, double-blind, placebo-controlled clinical trial, participants with metabolic syndrome, without lifestyle modification, who took 8 g of safflower oil for 12 weeks, experienced significant improvements in waist size, systolic and diastolic blood pressure, fasting blood sugar, insulin resistance, and increase in adiponectin level to placebo recipients. The lipid profiles, leptin levels, and serum creatinine were similar in the experimental and control groups [37].

3.1.6. Anticancer Properties

Flavonoids in safflower can induce anticancer effects in many human organs. HSYA, one of the flavonoids derived and isolated from safflower, poses antitumor activity. HSYA may reduce the proliferation of the Skov3 ovarian cancer cell line and enhance its sensitivity to chemotherapeutic agents by downregulating WSB1 (WD repeat and SOCS box-containing protein 1) expression [38]. HSYA shows potential as a candidate for preventing and treating hepatocellular carcinoma. Research on H22 (hepatoma cell line) tumor-bearing mice demonstrated that HSYA can significantly inhibit tumor progress by lessening the secretion of angiogenesis factors. Yang et al. [39] suggest that HSYA can induce apoptosis in cancer cells without causing cytotoxic effects on normal liver cells. In the case of hepatocellular carcinoma, the anticancer effect of safflower yellow (SY) has also been tested. Safflower yellow presented a potent effect on the development of hepatocellular carcinoma by amplifying liver immune infiltration, promoting collagen degradation, and modulating the gut microbiota, which may contribute to the immune microenvironment [40]. The literature data suggest that safflower can be developed as a breast anticancer agent. The ethanol extract of safflower inhibits cell proliferation and induces apoptosis in breast cancer cell lines T47D [41]. Treatment with hydroxysafflor yellow B (HSYB), an isomer of HSYA, decreased survival and proliferation of human breast cancer MCF-7 cells in a dose-dependent manner. Moreover, HSYB restricted the MCF-7 cell cycle at the S phase [42]. Safflower polysaccharide (SPS) is an active fraction purified from *Carthamus tinctorius* L. petals. Safflower polysaccharide significantly inhibited the proliferation of the MCF-7 human breast cancer cell line. These inhibitory effects are enhanced in a dose- and time-dependent manner [43]. SPS demonstrates cytotoxic activity against diverse types of cancer cells. SPS could significantly inhibit azoxymethane (AOM)/dextran sodium sulfate (DSS)-induced mice colorectal cancer through the regulation of macrophage polarization [44]. Furthermore, SPS induces cervical cancer cell apoptosis via inhibition of the PI3K/AKT pathway [45], and inhibits the growth of tongue squamous cell carcinoma [46].

3.1.7. Cardioprotective Effect

Studies suggest that HSYA may be an effective protective agent against cardiac injury caused by ischemia/reperfusion (MI/R) and hypoxia/reoxygenation (H/R). The mechanism of action of HSYA includes inhibition of NLRP3 inflammasome, a reduction in myocardial apoptosis and inflammation, and the induction of autophagy [47,48]. In Li et al.'s study [49], HSYA ameliorated isoproterenol (ISO)-induced myocardial fibrosis in rats,

probably by reducing oxidative stress. In a rat model with two kidneys and one clip (2K-1C) exhibiting hypertension, administration of safflower extract at a dose of 500 mg/kg/day for 4 weeks improved hemodynamics. The researchers observed a decrease in blood pressure, reduced vascular resistance, and increased blood flow in the hind limbs. Additionally, they noted effects on vascular remodeling, including a decrease in aortic wall thickness, cross-sectional area, and collagen deposition. The researchers suggest that these effects may be due to the inhibitory actions of safflower extract on the renin–angiotensin system (RAS) and the strong antioxidant potential [50].

3.1.8. Hepatoprotective Effect

Total flavonoids from safflower leaves (TFCTLL) exhibited a protective effect against carbon tetrachloride (CCl4)-induced chronic liver injury (CLI) in a mouse model. The mechanism of action may be linked, for example, to anti-inflammation and antioxidation [51]. Hepatoprotective effects in the case of CCl4-induced oxidative liver injury in mice are demonstrated also by kaempferol 3-O-rutinoside (K-3-R) and kaempferol 3-O-glucoside (K-3-G). Treatment with these two kaempferol glycosides isolated from safflower increased the level of total protein (TP), as well as prevented the CCl4-induced increases in serum aspartate aminotransferase (AST), alkaline phosphatase (ALP), and hepatic MDA levels. Animals treated with 3-O-rutinoside and kaempferol 3-O-glucoside had significantly reinstated glutathione levels and presented normal catalase and superoxide dismutase activities. K-3-R and K-3-G also moderated the CCl4-induced liver histological modification [52]. The literature data indicate that HSYA has been shown to effectively safeguard the liver of rats from long-term alcohol-induced damage. This action is associated with the increased antioxidant capacity of liver tissues and the suppression of TGF-β1 (transforming growth factor β1) expression [53].

3.2. Camelina sativa L.

False flax, gold of pleasure, or camelina are commonly used names to refer to *Camelina sativa* L., an oily, annual plant from the *Brassicaceae* family [54,55]. This plant originates from the areas of Southeast Europe and Southwest Asia. Archeological discoveries suggest that camelina was grown in central Europe as early as 4000 BCE [56]. Camelina leaves are lance-shaped, typically 5 to 8 cm long. A single stem may be smooth or hairy and branched above. The small flowers may be white-yellow or greenish-yellow. The pear-shaped silicles contain very small yellow-to-brown seeds [56]. Camelina seeds contain up to 47% fat. The increasing interest in camelina is related to the high nourishing value of the oil obtained from its seeds [54,55]. This is mainly related to the polyunsaturated fatty acid (PUFA) content, which reaches up to 60% in camelina oil. Worth attention is the information about the content of α-linolenic acid (ALA) (18:3), an n-3 essential fatty acid, whose amounts are estimated to be up to 40 percent. What is more, camelina oil contains large amounts of oleic, (18:1), linoleic, (18:2), and eicosenoic (20:1) acids, whose values, respectively, range from 14 to 16%, 15 to 23%, and 12 to 15%. Saturated fatty acids constitute only about 10% of all fatty acids and are formed mainly of palmitic (16:0) and stearic (18:0) acid [54–57]. Oil derived from camelina also contains a high content of tocopherols, which may have a positive effect on its durability [56].

3.2.1. Antioxidant Activity

Many studies have confirmed the antioxidant potential of *Camelina sativa* L. Both camelina oil and its seeds are being evaluated. In addition, reports suggest the great antioxidant potential of camelina as a plant to be consumed after germination [58–61]. Pathak et al. [62] conducted a study to evaluate the antioxidant potential of camelina oil. Researchers used H_2O_2 (hydrogen peroxide), DPPH, and ABTS tests to measure the oil's ability to neutralize free radicals. The results confirmed that *Camelina sativa* L. seed oil has a high antioxidant potential. Additionally, researchers assessed the α-tocopherol content using the HPTLC (high-performance liquid chromatography) method, finding that the

oil contained 59.34 mg/100 g of tocopherol. The researchers emphasized that this high content contributes to the oxidative stability of the oil, making it a promising raw material for the biodiesel, cosmetic, and food industries [62]. Camelina seeds are characterized by high content of phenolic compounds and glucosinolates, as well as their strong antioxidant activity. Research by Bravi et al. [63] has shown that germination significantly increases antioxidant activity and the levels of bioactive compounds, and enhances the nutritional value of camelina. Comprehensive studies on the properties of camelina after germination were also conducted by Kapusta-Duch et al. [59]. The researchers took into account the plant in the microgreens stage. The studies were conducted with the use of plants after two different collection times. The first harvest was 11 days after sowing when the plant had a cotyledon and a true leaf. The second was 18 days after sowing, i.e., when the plant had 1–2 true leaves. The content of various substances with antioxidant effects, such as vitamin C, carotenoids, and polyphenols, as well as antioxidant activity, increased with the maturity of camelina microgreens. This indicates the possibility of using camelina at this stage of development as a valuable addition to the human diet [59].

3.2.2. Antimicrobial Properties

Camelina seeds possess significant value, not only owing to their unique fatty acid profile but also due to the presence of phenolic compounds exhibiting a wide spectrum of activities [63,64]. One of the potential properties may be antibacterial activity. There are several scientific studies available in this area. Scientific reports include information on the antibacterial effect of methanolic and ethanolic camelina seed extracts [65]. The inhibiting effect on selected strains was also demonstrated in the case of petroleum ether, chloroform, and toluene seed extracts [66]. One of the more recent studies appeared in 2021, where researchers examined the antimicrobial properties of camelina oil and hydroalcoholic seed extracts. They tested these using three different extraction methods (using ethanol, i-propanol, and methanol) and 13 microbial strains, building on previous reports of camelina's antimicrobial effects. It has been proven that camelina oil and i-propanolic and ethanolic extracts showed medium and high antimicrobial activity in several strains of human and animal pathogens (e.g., *Bacillus cereus*, *Staphylococcus Aureus*, and *Candida albicans*). The best results were achieved in the case of *Salmonella typhimurium* and *Enterococcus faecalis* strains, using propanolic extracts obtained by suspending ground camelina seeds in a 90% solvent solution in a weight-to-volume ratio of 1:4 [64].

3.2.3. Prevention in Metabolic Diseases and Others

Researchers see great potential for the health properties of camelina oil. Ratusz et al. [55] conducted a complex analysis of the quality and nutritional value of 29 cold-pressed camelina oils from seeds grown in Poland. The results confirmed that cold-pressed camelina oils are characterized by high nutritional value, which results from the favorable composition of fatty acids (n-3 to n-6; 1.79–2.17), as well as optimal nutritional quality indicators: low atherogenic index (AI: 0.05–0.07) and thrombogenic index (TI: 0.1–0.2). In addition, high content of tocopherols was noted (55.8–76.1 mg/100 g). In cold-pressed camelina oils, the content of phytosterols (331–442 mg/100 g) as well as carotenoids (103–198 mg β-carotene/kg) was assessed [55]. Camelina oil is a rich source of PUFAs, including ALA, an n-3 essential fatty acid [54–57]. Some reports confirm that ALA supplementation in the diet is associated with amelioration of the lipid profile, lowering C-reactive protein (CRP) levels, and diminishing the risk of cardiovascular diseases [67,68]. For this reason, researchers are working to understand camelina oil's role in the improvement of health parameters. Regrettably, there are only a few reports available in these areas. Nevertheless, the access reports indicate several potential research directions regarding camelina. In the studies of Kavyani et al. [69], it was shown that supplementation of camelina oil and prebiotic (resistant dextrin) in combination with a low-calorie diet showed promising results in improving various health parameters in patients with non-alcoholic fatty liver disease (NAFLD), suggesting the possibility of using such therapy as a complement to

treatment. Among others, a significant reduction in insulin levels, homeostatic model assessment for insulin resistance (HOMA-IR), a decrease in body weight and body mass index (BMI), a considerable reduction in high-sensitivity C-reactive protein (hs-CRP) level, and an improvement in scores on the depression, anxiety, and stress scale were noted [69]. In a study aiming to determine the metabolic effects of consuming lean fish, oily fish, and camelina oil in people with glucose metabolism disorders, the results showed that a diet enriched with camelina oil improved the serum lipid profile compared to a diet enriched with oily or lean fish in the study participants. However, no differences were noted in glucose metabolism or concentrations of inflammatory markers [70]. Studies using an animal model have shown that alcoholic extracts from camelina seeds can improve cognitive function and mood, as well as exhibit antioxidant properties in the brain and gut in animal models of stress-induced irritable bowel syndrome (IBS) [71].

3.2.4. Anticancer Activity

Glucosinolates are compounds found mainly in plants of the *Brassicaceae* family. They are secondary metabolites of the plants, which are considered to have several beneficial effects on health. The literature lists, among others, the potential antioxidant and anti-inflammatory effects of glucosinolates. Despite this, the greatest attention is given to the potential anticancer effects of glucosinolates [72,73]. Glucosinolates were detected in camelina seeds as well as in the germinated plant. The glucosinolates present in the various camelina varieties studied are compounds derived from methionine, which are recognized for their anticancer effects [63]. Research on the anticancer effect of camelina seems to be an interesting direction, but there is still a lack of information on this subject in the literature. Pagliari et al. [74] in their study showed that a purified extract of glucosinolates, rich in glucoarabinin, glucocameline, and homoglucocameline, obtained from camelina seed by-products showed interesting chemopreventive activity against various colon cancer cell lines without affecting healthy cells. Further studies in this field are necessary, including efforts to determine the exact mechanism of action of the extract [74].

3.3. Nigella sativa L.

Nigella sativa L., also known as black cumin, black caraway, or kalonji, and less commonly as funnel flower or devil in the bush, holds a significant place as one of the most important medicinal plants in history. It has been referenced in various historical and religious texts [75,76]. Black cumin, an annual flowering plant of the *Ranunculaceae* family, typically attains a height ranging from 20 to 45 cm. The plant is characterized by its narrow, lanceolate leaves, measuring 2.5 to 5 cm in length. The delicate flowers of the black cumin plant consist of 5 to 10 petals, and their coloration may vary, exhibiting shades of yellow, white, pink, pale blue, or pale purple. The fruit manifests as a substantial, swollen capsule, comprising three to seven fused follicles, within which numerous seeds are contained. Measuring approximately 0.2 cm in length and 0.1 cm in width, the small, black, flattened, oblong, and angular seeds feature a funnel-like shape, with a black outer part and a white inner part. Seeds possess a discernible bitter taste and an astringent aroma [75–77]. The precise origin of black cumin is not extensively documented; however, it is widely believed to have originated in the Mediterranean region. Black cumin is a medicinal plant that has been used since ancient times. It has been used to treat fever, headache, diarrhea, indigestion, and asthma, among many other conditions. Currently, extensive research is underway regarding the pharmacological effects of *Nigella sativa* L. in treating a wide range of diseases and ailments. Its health-promoting properties are attributed to the abundance of various phytochemicals [75,77]. The seeds and oil of black cumin are rich in a variety of bioactive compounds. Terpenes and terpenoids form the largest group of chemical compounds present in black cumin. Among these, thymoquinone (TQ) and its derivatives, including carvacrol, 4-terpineol, α-pinene, thymol, and p-cymene, are particularly noteworthy. Thymoquinone, the most extensively studied compound, accounts for many of the pharmacological properties associated with black

cumin, such as its anti-inflammatory, antibacterial, and anticancer effects [77–79]. Black cumin oil also contains a significant quantity of phytosterols, with β-sitosterol constituting a substantial portion [77–79]. Several alkaloids with potential pharmacological activity have been identified in black cumin, including nigellicimine, nigellicimine-N-oxide, and indazole alkaloids like nigellidine and nigellicine. Tocopherols, with γ-tocopherol being the most predominant, are also present in black cumin. Polyphenols such as quercetin, kaempferol, ferulic acid, and chlorogenic acid exhibit robust antioxidant activity [75–79]. Black cumin seeds are abundant in fatty acids, including linoleic (55.6%) and oleic (23.4%) acids [75,77–79]. Table 2 shows a summary of the chemical composition of the selected uncommon oilseed plants based on the collected data.

Table 2. Summary of the chemical composition of *Carthamus tinctorius* L., *Camelina sativa* L., and *Nigella sativa* L. based on the collected data.

Plant	Fatty Acids	Other Biological Active Compounds	References
Carthamus tinctorius L.	- Linoleic acid (40–80%) - Oleic acid (20–50%) - Palmitic acid (6–10%) - Stearic acid (2–3%)	- Flavonoids (quinochalcones, C-glycosides, O-glycosides, kaempferol derivatives) - Alkaloids - Organic acids - Polyacetylenes - Polysaccharides	[8–10,23]
Camelina sativa L.	- Alpha-linolenic acid (40%) - Oleic acid (14–16%) - Linoleic acid (15–23%) - Eicosenoic acid (12–15%) - Palmitic acid, stearic acid (approx. 10%)	- Tocopherols - Phytosterols - Carotenoids - Polyphenols - Vitamin C - Glucosinolates (glucoarabinin, glucocameline, homoglucocameline)	[54–57,59,63]
Nigella sativa L.	- Linoleic acid (55.6%) - Oleic acid (23.4%)	- Terpenes and terpenoids (thymoquinone, carvacrol, 4-terpineol, α-pinene, thymol, p-cymene) - Phytosterols (β-sitosterol) - Polyphenols (quercetin, kaempferol, ferulic acid, chlorogenic acid) - Alkaloids (nigellicimine, nigellicimine-N-oxide, nigellidine, nigellicine) - Tocopherols	[75,77–79]

3.3.1. Anti-Inflammatory Activity

The properties of black cumin connected with anti-inflammatory actions are a significant issue in research. Studies from the last five years provide information on the effect of black cumin on the levels of inflammatory markers in various diseases. One of the topics that is gaining more attention is the impact of black cumin on coronavirus disease 2019 (COVID-19). In a randomized, double-blind controlled trial, the effect of 10 days of supplementation with different doses of black cumin seed on selected inflammatory markers (e.g., ferritin, C-reactive protein, white blood cells) in patients with mild COVID-19 was studied. However, there were no significant differences in inflammatory markers between groups after the end of the intervention. The authors suggest that the effects of *N. sativa* as a natural remedy may require a longer time to manifest [80]. In patients with schizophrenia, a four-week intervention consisting of receiving 1000 mg of black cumin daily reduced IL-6 levels 2.5 times faster than in the control group [81]. According to the available literature, black seed oil supplementation may reduce serum CRP levels in dialysis patients [82,83]. In overweight/obese women, supplementation of 2000 mg of nigella sativa oil reduced mRNA expressions and serum levels of IL-1β (interleukin-1 beta) and IL-6 [84]. In vitro studies using LPS-activated Raw 264.7 cells showed that black cumin seed extract significantly restrained the production of several pro-inflammatory mediators, i.e., prostaglandin E_2 (PGE_2), NO, monocyte chemoattractant protein-1 (MCP-1),

cyclooxygenase-2 (COX-2), inducible tumor necrosis factor-α (TNF-α), NO synthase (iNOS), interleukin-1 beta, and IL-6. Moreover, black cumin extract inhibited the phosphorylation of NF-κB, nuclear factor kappa-light-chain-enhancer of activated B cells, and the activation of MAPKs, mitogen-activated protein kinases [85].

3.3.2. Antioxidant Properties

Black cumin seed oil, extracts, and thymoquinone are all known to possess antioxidant properties [86,87]. The research findings indicate that *N. sativa* oil and its active component, thymoquinone, exhibit significant potential in protecting brain and kidney tissues from radiation-induced oxidative stress in animal models [88,89]. The protective effects of nigella oil were also evident in the salivary gland of rats subjected to total cranial irradiation [90]. Additionally, black cumin oil may hold promise as an adjunct in anticancer therapy, particularly in mitigating chemotherapy-induced gonadal toxicity. Pre-administration of black cumin oil before carboplatin treatment resulted in a substantial reduction in oxidative stress, particularly in lowering MDA levels [91]. In a randomized, triple-blind clinical trial, supplementation of 1000 mg of black seed oil daily for 8 weeks in postmenopausal women did not have a significant impact on serum levels of oxidative stress markers, i.e., MDA and total antioxidant capacity (TAC) [92]. In a study conducted by Sana et al. [93], postmenopausal women were given a daily supplement of 1g of black cumin seeds for 8 weeks. The results showed a significant increase in serum glutathione (GSH) levels, which indicates a reduction in oxidative stress. However, it is important to note that the study had some limitations, such as the absence of a control group [93].

3.3.3. Antibacterial Activity

According to the literature data, black cumin oil has antibacterial effects against *Escherichia coli* [94,95] and *Pseudomonas aeruginosa* [94]. Mouwakeh et al.'s [96] research proved that black cumin essential oil and its active compounds, i.e., thymoquinone and carvacrol, show antibacterial activity against methicillin-susceptible and methicillin-resistant *Staphylococcus aureus* strains. In the case of methicillin-resistant *Staphylococcus aureus*, the antibacterial action of extracts derived from *N. sativa* seeds was also confirmed [97,98]. Gawron et al. [97] noted that antibacterial force was related to the higher content of thymoquinone in the extract. Shafodino et al. [99] conducted a detailed phytochemical analysis of black cumin seeds and evaluated their antimicrobial activity. A diverse array of phytochemicals was identified across various extracts utilizing different solvents (petroleum spirit, ethyl acetate, methanol, and water). Alkaloids, steroids, and terpenoids were present in all extracts. Flavonoids, phenols, and tannins were exclusively detected in the methanolic and aqueous extracts. Furthermore, cardiac glycosides were exclusively found in the methanolic extract, while saponins were solely present in the aqueous extract. Shafodino et al. emphasize that the antibacterial activity of *N. sativa* may be ascribed to the content of various phytonutrients and their interactions [99]. Different black cumin seed extracts showed significant activity against various bacterial strains, including *Staphylococcus aureus* and *Escherichia coli* [99].

3.3.4. Antidiabetic Properties

Extensive research has been conducted on the antidiabetic properties of black cumin, yielding promising results in studies involving both human subjects and animal models. This issue remains of great interest and significance within the scientific community. Black cumin seeds, oil, and extracts are all utilized in research endeavors. An ethyl acetate fraction from *N. sativa* ethanol extract, administered at a dose of 500 and 1000 mg/kg body weight, significantly reduced blood glucose levels in alloxan-induced diabetic rats. Furthermore, no pancreatic necrosis was observed in these rats, in contrast to the control group [100]. In a randomized, double-blind, controlled trial, it was demonstrated that the supplementation of 2 g/day of nigella oil led to significantly increased levels of superoxide dismutase and total antioxidant capacity, while malondialdehyde, high-sensitivity

C-reactive protein, glycosylated hemoglobin, and fasting blood sugar levels decreased significantly in diabetic patients undergoing hemodialysis. Notably, no significant changes in insulin levels were observed. These findings indicate that the use of nigella oil may serve as a valuable adjunct to the treatment of these patients, mitigating oxidative stress, inflammation, and blood sugar levels in diabetic individuals undergoing hemodialysis [82]. A double-blind, randomized, controlled clinical trial conducted by Javaheri et al. [101] assessed the impact of daily administration of 500 mg of *Nigella sativa* L. seed powder on blood sugar levels and lipid profiles in patients with type 2 diabetes. In the experimental group, there was a significant decrease in HbA1c (glycated hemoglobin) levels and total cholesterol levels, and a significant increase in high-density lipoprotein levels [101]. Reports of black cumin's antidiabetic effects prompted researchers to compare its effects to those of metformin. Moustafa's et al. [102] research was conducted to compare the efficacy of monotherapy with black cumin oil at a dosage of 1350 mg/day to metformin at a dosage of 2000 mg/day in patients newly diagnosed with type 2 diabetes. The findings indicated that while black cumin oil demonstrated lower effectiveness than metformin in managing type 2 diabetes, e.g., by reducing fasting glucose and glycated hemoglobin and increasing pancreatic secretory function, it showed comparable results in terms of reducing body weight, waist circumference, and BMI. Both black cumin oil and metformin therapies exhibited similar effects on fasting insulin levels, insulin sensitivity, insulin resistance, alanine aminotransferase (ALT), total cholesterol (TC), low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglyceride (TG) levels, and total antioxidant capacity [102].

3.3.5. Antiobesity Effect

In a crossover, double-blind, placebo-controlled, randomized clinical trial, researchers assessed the effect of supplementing with 2000 mg of black seed oil daily on anthropometric parameters, body composition, and appetite in overweight and obese women. The results showed a significant reduction in body weight, waist circumference, body fat percent, body fat mass, and visceral fat area. Additionally, participants reported a decrease in appetite and an increase in satiety [103]. In a study conducted by Esmail et al. [104], researchers investigated the impact of black cumin consumption on HFD-induced obesity in rats. The rats were given 300 mg/kg/day of *N. sativa* seed powder for six weeks following the induction of obesity. The results showed that the HFD significantly elevated body weight and atherogenic index, as well as liver enzyme levels. However, the treatment with black cumin led to a notable reduction in final body weight. Additionally, it resulted in an improvement in lipid profile, atherogenic index, and ALT levels, as well as a reduction in liver damage [104]. High-fat diet-induced obesity rats were also a model in a study evaluating the antiobesity effects of thymoquinone. The compound significantly reduced body weight gain in rats fed a high-fat diet, improved glucose tolerance, and increased insulin sensitivity. Additionally, hepatoprotective effects were also observed [105]. The authors emphasize the need for further studies with larger numbers of participants, different doses, and longer intervention times to better understand the potential of black cumin in the treatment of obesity.

3.3.6. Anticancer Potential

Research into the anticancer potential of black cumin focuses on examining various types of extracts and compounds isolated from this plant. Thymoquinone is of particular interest in this field. Its antitumor effects include several mechanisms, e.g., effects on proliferation, apoptosis induction, and cell cycle arrest [106]. Thymoquinone displays selective toxicity against HepG2 (hepatocellular carcinoma) cells without adversely affecting normal hepatocytes. Thymoquinone treatment leads to inhibition of NF-κB expression, which may limit tumor growth, and increased expression of deleted liver cancer 1 (DLC1) and caspase 3 (Casp3), which supports apoptosis processes [107]. Thymoquinone demonstrates significant interactions with proteins implicated in the development of ovarian cancer and mechanisms of resistance to chemotherapy. Its capacity to attach to crucial amino

acid residues within these proteins indicates that it could potentially serve as an adjuvant in ovarian cancer therapy, particularly in instances of resistance to cisplatin [108]. The combination of simvastatin and thymoquinone demonstrated an inhibitory effect on breast cancer cell viability, colony formation ability, cell migration, and promotion of apoptosis. Two breast cancer cell lines were utilized in the study: MCF-7 and MDA-MB-231 [109]. The other compound derived from black cumin, thymol, demonstrated a noteworthy inhibitory effect on MCF-7 cell proliferation in a concentration-dependent manner. At a 200 µM concentration, a 50% reduction in cell growth was observed. Furthermore, when compared to the control group, thymol treatment resulted in decreased expression of cyclin D1 and PCNA (proliferative cell nuclear antigen), which are pivotal in the proliferation of cancer cells [110]. In a study conducted by Ma and Peng [111], an ethanolic extract of the aerial parts of black cumin was utilized. The extract underwent testing on various cancer cell lines, demonstrating significant inhibitory effects on their proliferation. The lowest inhibitory concentration of cell growth was 12.5 µg/mL for MDA-MB-231 (breast cancer) cells. The extract led to apoptosis in MDA-MB-231 cells. Additionally, cell cycle arrest in the G0/G1 phase was observed [111]. The results of the presented studies seem to be very promising, but the authors agree that there is still a need for further research to determine the specific use of black cumin, its extracts, and isolated compounds in the context of cancer therapy.

3.3.7. Cardioprotective Potential

In a randomized, double-blind, placebo-controlled clinical trial, individuals with coronary artery disease who took 2 g of black cumin oil for 8 weeks experienced significant reductions in both systolic and diastolic blood pressure [112]. Shoaei-Hagh et al. [113] also observed the hypotensive effect of black cumin oil in their randomized, double-blind, placebo-controlled clinical trial. They assessed the effectiveness of black cumin seed oil as an adjunct treatment for hypertension. They found that hypertensive individuals who received 2.5 mL of black cumin seed oil twice daily for 8 weeks experienced significant reductions in systolic and diastolic blood pressure. Additionally, levels of total cholesterol, low-density lipoprotein, malondialdehyde, and fasting glucose decreased, while increases in glutathione reductase and HDL levels were noted [113]. Emamat et al. [114] showed that in individuals with cardiovascular disease risk factors, taking two 500 mg capsules of black seed oil daily for two months led to a significant increase in flow-mediated dilation (FMD), plasma nitrite, and nitrate (NOx) levels compared to the placebo group. No significant differences were observed between groups in the levels of vascular cellular adhesion molecule-1 (VCAM-1) and intracellular adhesion molecule-1 (ICAM-1) [114]. However, a twice higher dose of black cumin oil (2 g per day) used for 8 weeks in patients with coronary artery disease significantly reduced the levels of adhesion proteins sVCAM-1 (soluble vascular cell adhesion molecule-1) and sICAM-1 (soluble intercellular adhesion molecule-1) and oxidative marker MDA; moreover, it increased total antioxidant capacity. This suggests that black cumin oil may have a beneficial effect on endothelial function by reducing inflammation and oxidative markers [115]. Further studies confirming the beneficial effects of black cumin, its underlying pathways, its potential uses, and dosage as a therapeutic or complementary agent in the treatment of cardiovascular diseases are still important.

3.3.8. Hepatoprotective Potential

Non-alcoholic fatty liver disease is a prevalent liver condition worldwide, characterized by the excessive accumulation of fat in the liver in the absence of secondary causes or other liver diseases [116]. In a randomized, double-blind, and placebo-controlled clinical trial by Khonche et al. [117], the administration of 2.5 mL of black cumin oil every 12 h for 3 months in patients diagnosed with NAFLD was associated with a reduction in the degree of fatty liver disease compared to the placebo group. Additionally, significant improvements were observed in the levels of ALT, AST, triglycerides, LDL-C (low-density lipoprotein cholesterol), and HDL-C (high-density lipoprotein cholesterol) [117]. Rashid-

mayvan et al. [118] investigated the impact of supplementing black cumin oil in individuals diagnosed with non-alcoholic fatty liver disease on cardiometabolic outcomes such as adiponectin, leptin, and blood pressure. After 8 weeks of supplementing with 1000 mg of oil daily, there were no significant differences in adiponectin, leptin, or blood pressure levels between the experimental and placebo groups [118]. The hepatoprotective properties of black cumin oil have been confirmed in animal models, showing a protective effect in liver damage induced by bisphenol A (BPA) or CCL4, and liver damage caused by carboplatin administration [119–121]. One of the more recent studies showed that thymoquinone exhibits promising hepatoprotective properties by effectively inhibiting thioacetamide-induced liver fibrosis in rats. It inhibits the increase in serum liver enzymes, significantly increases the level of antioxidant markers, and effectively reduces the level of inflammatory markers and fibrosis markers [122].

3.3.9. Immunomodulatory Properties

In a randomized, placebo-controlled, double-blinded clinical trial authored by Salem et al. [123], a group of healthy young adults (aged 18 to 25 years) underwent a four-week intervention involving the administration of 500 mg, 1 g, or 2 g of powdered black seed in capsule form. The findings revealed that a 1 g dose of *N. sativa* led to a significant increase in lymphocyte absolute count, T-lymphocyte ($CD3^+$), and T-helper cell ($CD4^+$) levels within the subjects. However, it was observed that elevating the dosage to 2 g resulted in the disappearance of this effect [123]. In vitro studies using nigella hydroethanolic seed extract showed that these extracts increase the phagocytic and killing activity of three types of macrophages [124]. Research conducted by Meles et al. [125] proved that *N. sativa* oil exhibits immunomodulatory activity. It effectively supported the immune response in *S. typhimurium*-infected rats by maintaining normal leukocyte, neutrophil, eosinophil, basophil, lymphocyte, and monocyte levels and activating macrophages [125]. The effect of oil on peripheral blood lymphocytes and interleukin-2 (IL-2) expression in healthy smokers was studied. Although there was a tendency for an increase in IL-2 expression compared to the placebo, these differences were not statistically significant [126].

4. Conclusions and Future Perspectives

Safflower, camelina, and black cumin are plants with a rich profile of bioactive compounds that show promising health-promoting potential. Each of these plants is characterized by a unique chemical composition, including a high content of fatty acids, antioxidants, and other substances with a wide range of activities. In light of the reports to date, there is a wide field for further research on the health-promoting properties of these three rare oil plants. Future studies should focus on several aspects. One of them is the mechanisms of action. Molecular studies aimed at understanding the exact action of bioactive compounds contained in these plants will allow for a more precise determination of their potential therapeutic applications. In addition, a larger number of randomized clinical trials are needed to confirm the effectiveness and safety of using extracts, seeds, and oils from these plants in the prevention and treatment of various diseases. Another point to consider is the development of new health products and dietary supplements using safflower, camelina, and black cumin. There is a need for research on the best extraction methods, as well as the stability and bioavailability of the active compounds. Further research may not only deepen our knowledge of safflower, camelina, and black cumin properties but also contribute to the development of new therapeutic and preventive strategies based on natural plant components.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/app14198843/s1, Pictures of selected uncommon oilseed plants: safflower (*Carthamus tinctorius* L.), camelina (*Camelina sativa* L.), and black cumin (*Nigella sativa* L.).

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