Research progress of *Sonchus* species

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**ABSTRACT**

*Sonchus* species (Asteraceae) is a class of edible wild plant, with 50 known species widely distributed in Europe, Asia, and Africa. In recent years, researchers worldwide have studied the potential of this species as a crop for humans and animals. *Sonchus* species also has many pharmacological activities. Studies have been conducted to understand the applications of the genus, and their results indicated the potential utilization of *Sonchus* species. This review aimed to compile the scientific information in the literature on *Sonchus* species, including its potential nutrient, medicinal and feed uses, and to identify possible future applications of this plant.

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**Introduction**

*Sonchus* species include annual, biennial, and perennial herbaceous plants.\(^1\) They are a class of edible wild plant\(^2\), with 50 known species widely distributed in Europe, Asia, and Africa, only *Sonchus asper* and *Sonchus arvensis* are widely used in official medicine. The aerial parts of *Sonchus* are a rich source of protein, vitamins, essential amino acids, and minerals in the diets of many people, and they may help to reduce hypoalimentation-associated problems.\(^3\),\(^4\) *Sonchus* species are usually used in infusions or decoction, which are administered orally or externally to treat acute icterohepatitis, cancer, inflammation, rheumatism, diarrhoea, and snake venom poisoning.\(^5\)\(^–\)\(^7\) In recent years, *Sonchus* species has captured the attention of the international health food industry, and there has been a wide range of research on the nutritional ingredients, chemical constituents, and biological activities of the genus. The main objectives of this review are (i) to discuss the available scientific information on the nutrient components, chemical components, and biological functions of *Sonchus* species and (ii) to suggest future applications for *Sonchus* species and future research.

**Research status of *Sonchus* species**

**Ethnobotanical information of *Sonchus* species**

Around 1800 years ago, “Shen Nong’s Herbal Classic” recorded the uses of *Sonchus oleraceus* and *Sonchus arvensis* in traditional Chinese medicine in China.\(^8\) In addition, Andrew Crowe, in his book *A Field Guide to the Native Edible Plants of New Zealand*,\(^9\) also recorded that the early Maori ate and used *S. asper* in New Zealand between 1000 and 2000 years ago. Ethnobotanical information of *Sonchus* species is shown in Table 1.

**Sonchus species is a potential vegetable crop**

Since ancient times, *Sonchus* species has been treated as only a noxious weed of vegetable crops and others. But scientists and nutritionists worldwide have proved through their research findings that,
Table 1. Ethnobotanical information about common *Sonchus* species [36–41].

| Scientific name | Distribution | Edible tissues and uses | Ethnobotanical information: traditional and/or medicinal use |
|-----------------|--------------|-------------------------|------------------------------------------------------------|
| *S. oleraceus*   | New Zealand, China | Young leaves and peeled stems | Bronchitis, pertussis, ophthalmia |
| *S. asper*       | Britain, Ireland and Europe, Asia, Russia (Siberia, far east), Kazakhstan, Uzbekistan, Japan, and China | Young leaves and peeled stems | Whole plant extracts are used to relieve fever, inflammation and in wound healing |
| *Sonchus palustris* | Europe, the Mediterranean, Russia, Kazakhstan, Uzbekistan, Siberia, and China | Young leaves and peeled stems | Edible vegetable |
| *Sonchus lingiancus* | China | Young leaves and peeled stems | Heat-clearing and detoxifying, swelling, empyema, damp elimination, and cooling blood |
| *S. arvensis*    | China | Young leaves and peeled stems | Fever, inflammation, stasis, detoxication, and blood circulation |
| *Sonchus transcaspicus* | Uzbekistan, central Asia, India, the Caucasus, the Mediterranean, Iran, and China | Young leaves and peeled stems | Edible vegetable |
| *S. brachyotus*  | China | Young leaves and peeled stems | Heat-clearing and detoxifying, anti-swelling, apocenosis, cooling blood, removing blood stasis, removing heat from the lung to relieve cough, promoting digestion function, protect liver function, and diuresis |
| *S. uliginosus*  | Russia, Afghanistan, Nepal, Pakistan, and China | Young leaves and peeled stems | Heat-clearing and detoxifying, anti-swelling, apocenosis, cooling blood, removing blood stasis, removing heat from the lung to relieve cough, and promoting digestion function |
although it is widely considered to be a weed, the potential nutritional and medicinal quality of Sonchus species is much more than any other leafy vegetables.\textsuperscript{[10]}

According to the research, the moisture content is similar to that of commercial green leafy vegetables, and the protein content is more than 31.0 g kg\textsuperscript{−1}.\textsuperscript{[10]} The available carbohydrate content is low and similar to that of S. asper, Sonchus tenerrimus, and S. oleraceus.\textsuperscript{[10]} S. asper, S. tenerrimus, and S. oleraceus were shown to contain high amounts of fibre, with fibre content of 35.6, 31.2, and 32.5 g kg\textsuperscript{−1}, respectively. The most studied nutritional component is vitamin C, with reported amounts ranging from 250–300 mg kg\textsuperscript{−1}\textsuperscript{[11]} to 670–779 mg kg\textsuperscript{−1}\textsuperscript{[10,12]} According to one study of S. oleraceus, consuming a minimum of 77 g of the leaves of this species per day would supply a sufficient amount of vitamin C to satisfy the recommended daily levels for humans (i.e. 60 mg per person).\textsuperscript{[10]}

The carotenoid content of Sonchus species has also been studied, with the total carotenoid content reported to range from 158 to 240 mg kg\textsuperscript{−1}.\textsuperscript{[10,13]} Sonchus species were found to contain high levels of potassium, sodium, copper, calcium, manganese, zinc, and phosphorus. The average Na content was high in Sonchus species, confirming what was stated by Bianco et al.\textsuperscript{[10]} that plants belonging to the asteraceae family generally show a higher Na content. The amounts of phosphorus, zinc, copper, and manganese were similar to those found in commercial green leafy vegetables.\textsuperscript{[10]} Potassium mineral-containing foods have been reported to have anti-depressant effects.\textsuperscript{[14]}

Sonchus species was shown to contain abundant fatty acids, including ω3-polyunsaturated fatty acids (ω3-PUFAs), which are important fatty acids.\textsuperscript{[10]} ω3-PUFA is a-tocopherol and antioxidant-active compound, which plays an essential role in modulating the human metabolism. ω3-PUFAs accounted for high percentages of the total fatty acids in S. asper (41.06%), S. tenerrimus (30.39%), and S. oleraceus (44.37%). α-Linolenic acid (C18:3ω3) was also detected in S. asper (39.94%), S. tenerrimus (30.33%), and S. oleraceus (43.58%). Linoleic acid (C18:2ω6) and palmitic acid (C16:0) were also reported to be present in high proportions. S. asper, S. tenerrimus, and S. oleraceus were shown to contain similar percentages of saturated and monoenoic acids.\textsuperscript{[10]}

Several studies reported that the most important bioactive components of Sonchus species were sesquiterpene lactone, quinic acid esters, flavonoids, glycerate, triterpenes, steroids, coumarins, and saccharides.\textsuperscript{[15,16]} In a study of the total flavonoid and phenolic contents of methanol extracts from Sonchus species, S. arvensis possessed the highest total phenolic content (417.3 mg g\textsuperscript{−1}) and S. oleraceus had the highest total flavonoid content (148.5 mg g\textsuperscript{−1}).\textsuperscript{[17]} The total phenolic and total flavonoid content in descending order was S. arvensis extract > S. oleraceus extract > Sonchus lingianus extract > Sonchus brachyotus extract > S. asper extract, and > Sonchus uliginosus extract.\textsuperscript{[10]} These results demonstrate that marked differences exist in the total phenolic and total flavonoid contents of Sonchus species. The abundance of high levels of these nutrients in Sonchus species points to the potential of the genus as a new source of nutritious food for both humans and animals. Some relevant research findings from the published literature regarding the nutritional constituents and chemical compounds in Sonchus species are summarized in Tables 2 and 3 and Fig. 1.

The present study has revealed that Sonchus species could contribute significantly to the dietary requirements of the people. The nutrient composition of these underutilized vegetables has indicated that they could be good sources of many nutrients such as protein, crude fibre, calcium, iron, manganese, as well as phenolics. Their nutritional value was higher than those of cultivated vegetables like spinach and cabbage. Their consumption could help in alleviating the problem of malnutrition at a negligible cost; therefore, their cultivation and utilization should be encouraged.

**Medicinal values of Sonchus species**

In addition to their importance as vegetable crops, Sonchus species has potential pharmaceutical importance. The medicinal effects of Sonchus species have a long history. In China, “Shen Nong’s Herbal Classic” recorded the use of S. oleraceus and S. arvensis in traditional Chinese medicine more
Table 2. Nutritional ingredients of *Sonchus* species.

|                | S. asper | S. oleraceus | S. tenerrimus | S. asper | S. oleraceus | S. tenerrimus | Fatty acid | S. asper | S. oleraceus | S. tenerrimus |
|----------------|----------|--------------|---------------|----------|--------------|---------------|------------|----------|--------------|---------------|
| Moisture (g)   | 864.3 ± 11.2 | 872.4 ± 14.0 | 877.3 ± 20.8 | Na 1903 ± 216 | 2582 ± 282 | 3130 ± 419 | C14:0 3.44 | 1.77      | 9.54         |
| Protein (g)    | 32.5 ± 3.2  | 31.7 ± 1.5   | 31.8 ± 2.0   | K 5839 ± 491 | 6225 ± 783 | 5084 ± 589 | C16:0 15.33 | 19.07     | 16.14        |
| Available carbohydrates (g) | 19.8 ± 1.1  | 18.2 ± 1.4   | 13.2 ± 1.8   | Ca 990 ± 189 | 324 ± 102  | 899 ± 213  | C16:1ω7 0.99 | 1.84     | 1.53         |
| Fibre (g)      | 35.6 ± 2.2  | 32.5 ± 2.4   | 31.2 ± 1.6   | P 493 ± 99   | 580 ± 96   | 387 ± 88   | C16:2ω6 0.94 | 0.13     | 3.60         |
| Lipids (g)     | 6.8 ± 0.7   | 7.5 ± 0.9    | 5.2 ± 0.4    | Fe 29.8 ± 7.8 | 37.8 ± 4.0 | 43.1 ± 7.0 | C16:3ω3 1.03 | 0.56     | 0.55         |
| Ash (g)        | 30.4 ± 3.0  | 29.9 ± 1.8   | 30.2 ± 1.9   | Cu 3.1 ± 0.7 | 2.9 ± 0.8  | 2.5 ± 0.5  | C18:0 2.01 | 1.84     | 0.73         |
| Oxalic acid (mg) | 1220 ± 190 | 1310 ± 330  | 640 ± 140   | Zn 8.8 ± 1.0 | 7.7 ± 2.1  | 7.2 ± 1.4  | C18:1ω9 3.34 | 2.15     | 4.08         |
| Vitamin C (mg) | 628 ± 90   | 779 ± 88    | 457 ± 59    | Mn 9.0 ± 0.7 | 12.0 ± 2.3 | 9.2 ± 3.0  | C18:2ω6 9.90 | 8.10     | 8.70         |
| Carotenoids (mg) | 80 ± 21   | 158 ± 19    | 57 ± 13    | C18:3ω3 39.94 | 43.58     | 30.33     |
| Energy (kJ)    | 1110 ± 120 | 1098 ± 155  | 935 ± 105  | C18:3ω6 0.47 | 0.34      | 0.35      |
|                |           |              |               | C18:4ω3 0.09 | 0.23      | 0.11      |
|                |           |              |               | C20:0 3.33 | 1.48      | 0.65      |
|                |           |              |               | C20:1ω9 9.15 | 0.15      | 1.83      |
|                |           |              |               | C20:3ω6 0.49 | 0.11      | 0.10      |
|                |           |              |               | C20:4ω6 9.15 | 0.15      | 1.83      |
|                |           |              |               | C22:0 2.96 | 3.01      | 0.75      |
|                |           |              |               | C24:0 1.42 | 2.03      | 1.99      |

Nutritional composition of *Sonchus* (*S. oleraceus, S. asper,* and *S. tenerrimus*) were reported by Guí-Guerrero et al.[10]
than 1800 years ago. Between 1000 and 2000 years ago, the early Maori used them. Recent research has reported that *Sonchus* species possess powerful pharmaceutical properties (e.g. hepatoprotective, anticancer, antioxidant, anti-inflammatory, and antimicrobial) and helps to prevent cardiac dysfunction. The following section highlights the pharmacological importance of *Sonchus* species.

### Anticancer activity

Lupeol from ethanol extracts of *S. arvensis* and *S. asper* markedly induced the differentiation of B16 mouse melanoma-derived subclones, with high differentiation capability (B16 2F2), indicating that lupeol might have cytostatic activity against B16 2F2 cells. Hepatoprotective effects of the methanol extract of *S. asper* against the carbon tetrachloride (CCl₄)-induced liver injury in rats. The methanol extract of *S. asper* clearly reduced CCl₄-induced liver injury by lowering the hepatic content of glutathione and the activities of catalase (CAT), glutathione-S-transferase (GST), and glutathione. Protective effects of the methanol extract of *S. arvensis* against CCl₄-induced genotoxicity and DNA oxidative damage in hepatic tissues of experimental rats demonstrated that CCl₄ reduced the activities of endogenous antioxidant enzymes of liver tissue homogenate, CAT, superoxide dismutase (SOD), GSHpx, GST, and glutathione reductase (GSR). These returned to control levels following treatment with the methanol extract of *S. arvensis*. The methanol extract of *S. arvensis* treatment also reduced CCl₄-induced hepatic cirrhosis and hepatic glutathione (GSH) levels, in addition to improving improved lipid peroxidative products. Furthermore, the CCl₄ treatment gave rise to genotoxicity and DNA fragmentation, which were eliminated following treatment with the methanol extract of *S. arvensis*. Khan et al. evaluated the protective effects of the methanol extract of *S. asper* against CCl₄-induced oxidative stress in lungs. Male Sprague–Dawley rats were orally administered 100 or 200 mg kg⁻¹ body weight of the methanol extract of *S. asper* and 50 mg kg⁻¹ body weight of rutin after 48 h of CCl₄ treatment biweekly for 4 weeks. They found that the methanol extract of *S. asper* and rutin restored the lung content of GSH and CAT, peroxidase, SOD, GSHpx, GST, GSR, and quinine reductase to normal levels. It also restored lipid peroxide, hydrogen peroxide, nitrile, DNA fragmentation, and the activity of γ-glutamyl transferase to normal levels. Lung histopathology showed that the methanol extract of *S. asper* and rutin reduced the incidence of CCl₄-induced lung injury in the rats. The results showed that *S. asper* extracts and rutin can protect the lungs against CCl₄-induced oxidative damage in rats. To sum up, *Sonchus* species could be used as a potential resource of anticancer drug.

**Table 3. Chemical compounds of *Sonchus* species.**

| Compounds               | Origin               | References |
|-------------------------|----------------------|------------|
| Sesquiterpene lactone   | *Sonchus transcapicus* | [34]       |
|                         | *S. arvensis*        | [9,26,36,42] |
|                         | *S. uliginosus*      | [43]       |
|                         | *Sonchus macrocarpus*| [26,44]    |
|                         | *S. asper*           | [45,46]    |
|                         | *S. oleraceus*       | [47]       |
|                         | *Sonchus tuberfer*   | [48]       |
| Quinic acid esters      | *S. arvensis*        | [49]       |
| Flavonoids              | *S. arvensis*        | [50–52]    |
| Glycerate               | *S. oleraceus*       | [53, 54]   |
|                         | *S. arvensis*        | [42]       |
|                         | *S. arvensis*        | [42]       |
|                         | *S. asper*           | [53]       |
|                         | *S. oleraceus*       | [36]       |
| Triterpene              | *S. arvensis*        | [42]       |
| Steroids                | *S. oleraceus*       | [36]       |
| Coumarin                | *S. arvensis*        | [36]       |
| Saccharides             | *S. arvensis*        | [36]       |
Antioxidant activity

A study of the antioxidant activities of the extracts from Sonchus species found that they exhibited obvious ABTS$^+$ radical scavenging power.$^{[18,26,27]}$ In descending order, their potency was S. arvensis (IC50 55.22 mg mL$^{-1}$) > S. oleraceus (IC50 60.34 mg mL$^{-1}$) > S. brachyotus (IC50 66.70 mg mL$^{-1}$) > S. lingianus (IC50 71.46 mg mL$^{-1}$) > S. asper (IC50 81.30 mg mL$^{-1}$) and > S.
uliginosus (IC50 93.06 mg mL\(^{-1}\)). These Sonchus species extracts also displayed obvious 2,2-diphenylpicrylhydrazyl (DPPH) radical scavenging power, with their potency in descending order, as follows: S. arvensis (IC50 15.92 mg mL\(^{-1}\)) > S. oleraceus (IC50 17.42 mg mL\(^{-1}\)) > S. brachyotus (IC50 18.65 mg mL\(^{-1}\)) > S. lingianus (IC50 22.59 mg mL\(^{-1}\)) > S. asper (IC50 25.35 mg mL\(^{-1}\)) and > S. uliginosus (IC50 31.32 mg mL\(^{-1}\)). The same study found that the ability of the S. arvensis extract, which contained the highest phenolic content, to scavenge DPPH radicals was similar to that of ascorbic acid and rutin.

Sonchus species extracts significantly inhibited the formation of thiobarbituric acid reactive substances (TBARS) in brain homogenates in a dose-dependent manner. The S. arvensis extract showed the most potent suppression of lipid peroxidation (IC50 74.95 mg mL\(^{-1}\)), followed by the S. oleraceus extract (IC50 85.36 mg mL\(^{-1}\)), S. brachyotus extract (IC50 103.05 mg mL\(^{-1}\)), S. lingianus extract (IC50 205.20 mg mL\(^{-1}\)), S. asper extract (IC50 238.78 mg mL\(^{-1}\)), and S. uliginosus extract (IC50 268.10 mg mL\(^{-1}\)). In addition, Gould et al.\(^{[28]}\) reported that S. oleraceus leaf extracts possessed four times the antioxidant activity of blueberry extracts.\(^{[29,30]}\) Sonchus species are used as an important resource of antioxidant material.

**Anxiolytic-like effect**

Cardoso Vilela et al.\(^{[6]}\) reported the effect of the extracts of S. oleraceus in mice submitted to the elevated plus-maze and open-field tests. Clonazepam was used as the standard drug. In the elevated plus-maze test, the S. oleraceus extracts increased the percentage of open arm entries (P < 0.05) and time spent in the open-arm portions of the maze (P < 0.05). The S. oleraceus extracts induce an anti-thigmotactic effect, evidenced by increased locomotor activity into the central part of the open field set-up (P < 0.05). The S. oleraceus extracts administered at 30–300 mg kg\(^{-1}\), p.o. had an anxiolytic effect similar to clonazepam (0.5 mg kg\(^{-1}\), p.o.). These results indicate that S. oleraceus extract has an anxiolytic-like effect on mice.

**Antidiabetic activity**

Ethanol extracts of S. oleraceus exhibited significant antidiabetic activities in vivo.\(^{[31]}\) These findings suggest that S. oleraceus could be used as a raw and processed material for the study and development of new drugs and precursors against diabetes.

**Anti-inflammatory activity**

Lu et al.\(^{[20]}\) investigated the anti-inflammatory activity and mechanism of S. oleraceus extract and found that it alleviated the swelling of rats’ paws and ears and the permeability of abdominal blood capillaries. The same study reported that the S. oleraceus extract significantly reduced levels of nitric oxide, interleukin-IB, and tumour necrosis factor-\(\alpha\) in inflammatory exudates of rat foot, in addition to NOS activity, in a dose-dependent manner. Carrageenan-induced paw oedema, peritonitis, and febrile response induced by lipopolysaccharide tests, as well as fibrovascular tissue growth induced by s.c. cotton pellet implantation, were used to investigate the anti-inflammatory activity of S. oleraceus hydroethanolic extract in rats. S. oleraceus at test doses of 100–300 mg kg\(^{-1}\) p.o. clearly demonstrated anti-inflammatory effects by reduced paw oedema induced by carrageenan, inhibited leukocyte recruitment into the peritoneal cavity, and reduced lipopolysaccharide (LPS)-induced febrile response. Also, in the model of chronic inflammation using the cotton pellet-induced fibrovascular tissue growth in rats, the S. oleraceus significantly inhibited the formation of granulomatous tissue. The extract administered at 300 mg kg\(^{-1}\) p.o. had a stronger anti-inflammatory effect than indomethacin (10 mg kg\(^{-1}\)) or dexamethasone (1 mg kg\(^{-1}\)). The hydroethanolic extract of S. oleraceus markedly demonstrated anti-inflammatory action in rats, which supports previous claims of its traditional use.\(^{[32]}\)
**Cardiac dysfunction**

*S. arvensis* extract undoubtedly shortened the duration of barium chloride (BaCl$_2$)-induced arrhythmia and reduced the incidence of CCl$_4$-induced ventricular fibrillation in rats. *S. arvensis* extract also visibly reduced the effect of adrenaline-induced arrhythmia and prolonged the isolated left atrial refractory period in rabbits. The anti-arrhythmic effect of *S. arvensis* is realized by blocking $\alpha$-receptors.

**Antimicrobial activity**

Our group shows that ethanol extract from *S. brachyotus* DC. exhibited antimicrobial activity against *Escherichia coli*, *Enterobacter cloacae*, *Klebsiella pneumonia*, *Salmonella enteric*, *Staphylococcus aureus*, and *Micrococcus luteus*; this is especially so in the case of *E. coli*. This study investigated the novel antibacterial mechanism of ethanol extract from *S. brachyotus* that shows an apoptosis-like response in *E. coli*. Xia et al. compared the antibacterial activities of the extracts of *Sonchus* species (*S. oleraceus*, *S. arvensis*, *S. asper*, *S. uliginosus*, *S. brachyotus*, and *S. lingianus*) *in vitro* by using the disc-diffusion method. According to their results, most of the *Sonchus* species extracts inhibited both Gram-negative and Gram-positive strains, which frequently cause food spoilage. The methanol extract of *S. oleraceus* showed the highest antibacterial activity of the tested *Sonchus* species extracts. The antibacterial activity of the methanol extract of *S. oleraceus* against *E. coli* and *S. enterica* at a dose of 0.5 mg of extract per disc was comparable to that of a positive control (ofloxacin, 20 mg per disc). Another study also confirmed the antibacterial effect of *S. oleraceus* against *S. aureus*, *Salmonella typhi*, bacillary dysentery, and *haemolytic streptococcus*. In all cases, the minimal inhibitory concentration was 2.1 mg mL$^{-1}$. S. lingianus and *S. arvensis* extracts at a dose of 0.5 mg per disc exhibited antibacterial activities against these four food-spoilage bacteria. *S. oleraceus* showed the most potent activity against *S. enterica* and *Vibrio parahaemolyticus* at a minimal inhibitory concentration of 0.05 mg mL$^{-1}$ and the most potent activity against *E. coli* at a minimal inhibitory concentration of 0.04 mg mL$^{-1}$. It showed the strongest activity against *S. aureus* at a minimal inhibitory concentration of 0.02 mg mL$^{-1}$. Furthermore, *S. aureus* was more susceptible than *E. coli* and *S. enterica* to *Sonchus* species extracts. This difference in antibacterial activities is probably related to the repulsion between the flavonoid (or phenolic) compounds and the surfaces of Gram-negative bacteria, which are covered with lipopolysaccharide. Therefore, the presence of flavonoids or phenolics in the *Sonchus* species extracts might play a role in the antibacterial activity. The flavonoid content of the tested *Sonchus* species extracts was similar. Thus, *Sonchus* species extracts could be considered good candidates as raw materials in antibacterial phyto-preparations.

**Utilization of Sonchus species as an animal feed**

*Sonchus* species were also collected for livestock consumption. The feeding value of another *Sonchus* species, sowthistle, was demonstrated in a feeding experiment in which chickens, pigs, cattle, and sheep were fed with 4–6%, 7%, 9%, and 25–30% of sowthistle powder. In addition to demonstrating the value of sowthistle powder as a foodstuff, the study showed that it could reduce feed costs. The same study reported that the quality and smell of the meat, milk, and eggs produced by the animals were unchanged and that the animals did not experience digestive system diseases.

**Conclusion**

The published literature documents that *Sonchus* species could be important vegetable and medicinal herbs as well as feed with a varied nutritional and pharmacological spectrum. *Sonchus* species is an attractive candidate as a useful vegetable crop and as a cosmetic ingredient containing a high
quantity of nutrients. It is highly rich in antioxidant properties, ω-3 and ω-6 fatty acids, and has antimicrobial effects together with wound-healing capacity in addition to its classical application as a remedy in other relevant circumstances. Hence, a few questions need to be addressed to fully understand and realize its potential in the future. Studies are needed to identify the chemical structure biotransformation of its compounds to obtain active ingredients and study its pharmacodynamic mechanisms. In addition, the available cultivars of Sonchus species show potential and are productive when cultivated on any type of land, home garden, or even roof gardens using plastic or earthen pots with minimum inputs and labour. Considering the global environmental changes, initiatives to develop new high-yielding and more stress-tolerant varieties, to extend its cultivation and uses and to strengthen the commercial production of this novel vegetable crop, are now needed.

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