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Antioxidant and antimicrobial activities of White Radish

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ABSTRACT

Since prehistoric times, humans have relied on plants for a wide variety of needs, including sustenance, shelter, thermal regulation, and medical treatment. Plants are significant organics because of the many ways they may be put to use. The white radish (*Raphanus raphanistrum* subsp. *sativus* (L.) Domin) was tested for its antioxidant and antibacterial properties, as were its tuber and aerial portions. A soxhlet was used to extract ethanol from plant material. The antioxidant and oxidant capacities were tested with the use of Rel Assay TAS and TOS kits. The agar dilution technique was used to test for antimicrobial activity against the bacteria and fungus included in the experiment. As a result of the studies, the TAS value of the tuber extract of the plant was measured as 6.698±0.187, the TOS value as 5.609±0.245 and the OSI value as 0.084±0.002. The TAS value of the herbal aerial parts extract was 4.689±0.223, the TOS value was 3.746±0.128, and the OSI value was 0.080±0.003. Inhibition of tuber extract was observed at concentrations varying between 25-100 against bacterial strains and 200 µg/mL against fungal strains. Aerial parts extract showed inhibition against bacterial strains at concentrations varying between 100-200 and against fungus strains at concentrations ranging from 200-400 µg/mL. As a result, it was determined that the white radish plant has significant antioxidant and antimicrobial activity.

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Introduction

Many people nowadays utilise natural products as part of their alternative or supplementary healthcare routines (Mohammed et al., 2018). Medicinal, nutritional, preservative, and flavouring applications are just some of the many uses for these all-natural ingredients (Sevindik, 2018). All sorts of fungi, plants, and animals found in nature fall under this category. One category of these natural goods that is both flexible and effective is plants (Kna et al., 2021). Plants have been shown to have many beneficial biological effects, including antioxidant, antimicrobial, anticancer, antiproliferative, anti-inflammatory, DNA protective, hepatoprotective, and antialergic properties (Mohammed et al., 2019a; Soares et al., 2019; Mohammed et al., 2020a; Mohammed et al., 2020b; Li et al., 2021; Pehlivan et al., 2021; Rahim et al., 2021; Uysal et al., 2021; Akgül et al., 2022). In this light, it is crucial to understand the nutritional and therapeutic value of plants that may be used in the treatment of various illnesses. The tuber portions of the Raphanus raphanistrum subsp. sativus (L.) Domin plant were analysed for their antioxidant and antibacterial properties. For thousands of years, people have cultivated radishes for their nutritional value. Depending on the cultivar, the fleshy root sections may be little or large. White, pink, red, purple, and black variants are also accessible. During that time frame (about 3–6 weeks), it expands rapidly. The majority of the time, the subsurface sections are the ones that are eaten. The consumption of above-ground components is another factor. It's a common ingredient in salads and is also eaten by humans and fed to animals. Its peak harvest times are in the spring and fall (Zhang et al., 2020; Park et al., 2022). 100 grammes of radish has 18 calories, 4.1 grammes of carbohydrates, 2.5 grammes of sugar, 1.6 grammes of dietary fibre, 0.1 grammes of fat, and 0.6 grammes of protein, as reported by FoodData Central Search (USA). It's also a good source of vitamins B1, B2, B6, B5, B9, and C, as well as the B vitamins thiamine, riboflavin, niacin, and pantothenic acid. Calcium, Iron, Magnesium, Manganese, Phosphorus, Potassium, Sodium, and Zinc are present, along with 94.5 g of water and a variety of other minerals (FoodData Central Search, 2023). In this study, looked at the nutritional benefits of white radish by testing its tubers and its aerial portions for antioxidant, oxidant, and antibacterial activity.

Materials and Methods

Laboratory Studies

The white radish used in the study was obtained from Kadirli/Osmaniye (Turkey). The tuber parts of the plant samples were sliced and dried, and the above-ground parts were cleaned from the soiled parts and dried. After drying, it was powdered. 30 g of the powder samples were weighed and extracted with ethanol at 50 0C for 6 hours in a soxhlet apparatus. The solvents of the obtained extracts were removed in a rotary evaporator and crude extracts were obtained.

Antimicrobial activity

The agar dilution technique was used to assess the antimicrobial activity of ethanol extracts of the plant sample against reference bacterial and fungus strains. The following bacterial strains were utilised as references: *Staphylococcus aureus* ATCC 29213, *Staphylococcus aureus* MRSA ATCC 43300, *Enterococcus faecalis* ATCC 29212, *Escherichia coli* ATCC 25922, *Pseudomonas aerugin*osa ATCC 27853 and *Acinetobacter baumannii* ATCC 19606. Standard fungal strains included *Candida albicans* ATCC 10231, *C. krusei* ATCC 34135, and *C. glabrata* ATCC 90030. The minimal inhibitory concentration (MIC) of plant extract used to stop the development of bacteria and fungi was calculated. The values obtained were reported in milligrammes per millilitre (mg/mL) (Bauer et al., 1966; Hindler et al., 1992; Matuschek et al., 2014).

Antioxidant and Oxidant Tests

Samples of plants were tested with Rel Assay's TAS and TOS kits to find out how antioxidant and oxidant they were, respectively. Tests for TAS and TOS compliance were conducted as specified by the manufacturer. The TAS readings were expressed in millimoles per litre (mmol/L), with Trolox serving as the standard (Erel, 2004). The TOS tests were calibrated using hydrogen peroxide concentrations, and the findings were presented in micromoles per litre (µmol/L) (Erel, 2005). In addition, the OSI value was calculated by dividing the sum of the TOS values by the sum of the TAS values and then taking the percentage (Sevindik, 2019).

Result and Discussion

Antimicrobial Activity

There are many natural goods that are contaminated by microbes in their native environments. This interaction confers antibacterial characteristics to naturally occurring substances (Krupodorova and Sevindik, 2020). Many illnesses nowadays are caused mostly by microorganisms. Antibiotics are used for the treatment of bacterial infections (Sevindik and Bal, 2022). Microorganisms have become resistant to current antimicrobial medications in recent years due to the careless use of antibiotics (Karalt et al., 2022). Finding novel antimicrobial medicines is crucial in this setting. In this work, the antimicrobial and antifungal effects of white radish ethanol extracts from both the tubers and the leaves were examined. Table 1 displays the acquired results.

Table 1. MIC values of tubers and aerial parts of white radish against bacterial and fungal strains*

	Aerial parts	Tuber
S. aureus	100	50
S. aureus	100	50
E. faecalis	100	25
E. coli	200	50
P. aeruginosa	100	25
A. baumannii	200	100
C. glabrata	200	200
C. albicans	200	200
C. krusei	400	200

*25, 50, 100, 200 and 400 µg/mL extract concentrations

As a result of the study, it was determined that the tuber parts of the white radish showed higher activity than the above-ground parts. Tubers were effective against *C. glabrata*, *C. albicans* and *C. krusei* at a concentration of 200 µg/mL. In addition, it was determined to be effective against *A. baumannii* at a concentration of 100 µg/mL against *S. aureus*, *S. aureus* MRSA and *E. coli* at a concentration of 50 µg/mL, against *E. faecalis* and *P. aeruginosa* at a concentration of 25 µg/mL. Above ground parts were determined to be effective against *C. krusei* at a concentration of 400 µg/mL, against *E. coli, A. baumannii, C. glabrata* and *C. albicans* at a concentration of 200 µg/mL and against *S. aureus*, *S. aureus* MRSA, *E. faecalis* and *P. aeruginosa* at a concentration of 100 µg/mL. It has been found that *Aspergillus flavus*, *A. niger*, *A. clavatus*, and *Fusarium solani* may all be inhibited by using an ethanol extract of White radish gathered in Vietnam (Duy et al., 2019). Scientists in India found that White radish ethanol extract significantly reduced *E. coli* growth (Kumar et al., 2019). Researchers in India found that white radish has powerful effects against the bacteria *Agrobacterium rhizogenes* (Muthusamy and Shanmugam, 2020). There was a study done in Korea that found that the White radish ethanol extract was efficient against *Listeria monocytogenes*, *Salmonella Enteritidis*, *Escherichia coli*, *Cronobacter sakazakii*, *Bacillus cereus*, and *Staphylococcus aureus* (Lim et al., 2019). Similar to these other researchs, we found that white radish tuber pieces effectively combat various bacterial and fungal strains. Furthermore, it has been seen that the aerial parts components are efficient as well. In this setting, white radish has been found to be an antibacterial resource in addition to its nutritional benefits.

Antioxidant and Oxidant Activity

In order to mitigate the damage caused by oxidising chemicals known as reactive oxygen species, antioxidants are commonly used (Eraslan et al., 2021). Increased quantities of oxidant chemicals cause oxidative stress. Cancer, Alzheimer's, Parkinson's, and cardiovascular illnesses are all linked to oxidative stress in humans (Saridoan et al., 2021). The impacts of these disorders can be mitigated or prevented altogether thanks to the antioxidants. Antioxidant supplements are helpful in circumstances where the body already has too few. The identification of additional antioxidants is crucial in this setting (Islek et al., 2021). This investigation looked at the tuber and stem of white radish to calculate its TAS, TOS, and OSI. Table 2 displays the data collected.

Table 2. Antioxidant and oxidant status of tuber and aerial parts of white radish

	Aerial parts	Tuber
TAS (mmol/L)	4.689±0.223	6.698±0.187
TOS (µmol/L)	3.746±0.128	5.609±0.245
OSI (TOS/TAS×10)	0.080±0.003	0.084±0.002

Values are presented as mean±S.D

Studies on the antioxidant properties of white radish have been published from a variety of countries, including Thailand, Saudi Arabia, Poland, and Romania (Bors et al., 2015; Somman and Siwarungson, 2015; Woch and Hawrylak-Nowak, 2019; Noman et al., 2021). For the first time, the TAS, TOS, and OSI values of white radish tuber and aerial sections were determined in this research. After looking at the TAS values, we can see that the tuber sections are higher than the aerial parts. The TAS value is an indicator of the whole of the antioxidant compounds found in natural products (Mushtaq et al., 2020). TAS values of *Satureja hortensis* (TAS:5.403, TOS:3.537, OSI:0.065), *Thymbra spicata* (TAS:8.399, TOS:6.530, OSI:0.078), Salvia absconditiflora (TAS:7.350, TOS:8.501, OSI:0.116), *Rumex scutatus*(TAS:8.656, TOS:4.951, OSI:0.057), *Alcea kurdica*(TAS:3.298, TOS:8.312, OSI:0.252), *Mentha longifolia* subsp. *longifolia* (TAS:3.268, TOS:4.046, OSI:0.112) and *Glycyrrhiza glabra* (TAS:8.770, TOS:14.509, OSI:0.167) have been reported in studies on different plant species (Sevindik et al., 2017; Mohammed et al., 2019b; Akgul et al., 2020; Mohammed et al., 2020; Mohammed et al., 2021; Mohammed et al., 2022; Unal et al., 2022). In these tests, the TAS value of white radish tubers was lower than those of *T. spicata, R. scutatus, S. abscondita, and G. glabra*, and higher than those of *S. hortensis*, *A. kurdica*, and *M. longifolia* subsp. *longifolia*. White radish's aerial parts had a lower TAS value than *S. hortensis, T. spicata, S. absconditiflora*, *R. scutatus*, and *G. glabra,* but a higher value than *A. kurdica* and *M. longifolia* subsp. *longifolia*. Here, it has been established that both the tuber and the plant's aerial portions contain antioxidant potential. The TOS value is an indicator of the whole of the oxidant compounds produced in natural products (Mushtaq et al., 2020). White radish has a lower TOS value than T. spicata, S. absconditiflora, R. scutatus, A. kurdica, M. longifolia subsp. longifolia and G. glabra, but a higher value than S. hortensis for its aerial portions. White radish tubers have a lower TOS value than *T. spicata*, *S. absconditiflora*, *A. kurdica*, and *G. glabra*, but a higher value than *M. longifolia* subsp. *longifolia*, *R. scutatus*, and *S. hortensis*. The relative TOS values of the tuber and aerial parts were found to be within the typical range. How much the TOS values are suppressed by the TAS values is represented by the OSI value (Mushtaq et al., 2020). White radish has a greater OSI value for its tuber and aerial parts than *S. hortensis*, *T. spicata*, and *R. scutatus*, and a lower OSI value than *A. kurdica, M. longifolia* subsp. *longifolia*, *G. glabra*, and *S. absconditiflora*. When considered in this light, it has been established that the plant significantly inhibits the formation of oxidant chemicals. Therefore, it is believed that both the tuber and the aerial sections of the white radish can be utilised as natural antioxidants.

Conclusion

White radish is a staple in many different cultures throughout the world, and this research looked at the antioxidant and antibacterial properties of both the tubers and the aerial parts of the plant. Significant levels of the plant's antioxidant capacity have been reported in this setting. Both the leaves and the stem have been found to be effective against bacteria and fungi in laboratory tests. Therefore, it has become clear that the plant may be used not only as a food ingredient but also as a natural source of antioxidants and antimicrobials.

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