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### A Disquisition on *Raphanus sativus* Linn- A Propitious Medicinal Plant

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**Abstract :** Although with the invention of hundreds of allopathic drug preparations and its various combinations, yet the belief on traditional medications for the curing of ailments has not come down. One such medication among the many others is *Raphanus sativus*. The entire plant part has medicinal benefits starting from the roots to the leaves. The extracts of roots are used for treatment of urinary complaints, haemorrhoids, syphilitic disease; reputed medicine for piles etc., the extract obtained from seeds has been used as expectorant, digestive, diuretic, laxative, stomach tonic, carminative, and antitussive. It has anticancer, antimicrobial, antidiabetic, antiurolithiatic, antifertility, hypertensive, nephroprotective, gastroprotective and hepatoprotective properties, in addition used for gynaecological conditions and jaundice. The chemical constituents present are alkaloids, nitrogen compounds, coumarins, enzymes, gibberellins, glucosinolates, oil seed compounds, organic acids, phenolic compounds, sulphur compounds, flavonoids, saponins, carbohydrates, proteins, amino acids, tannins, antraquinones, steroids, terpenoids, cardiac glycosides, chalcones, brassinosteroids and polyphenols. The seeds and leaves of a plant contain 'raphanin' which contains isothiocyanates and dithiolthiones to help lower the risk of cancer. The present study is thus on a review of *Raphanus sativus* which is a highly potential, functional and valuable ingredient that exhibits relatively impressive biological functions of great interest in pharmaceutical and food industries.

**Key Words :** Anticancer, Antidiabetic, Radish, flavonoids.

#### Introduction:

Radish, biologically known as *Raphanus sativus* linn belongs to Brassicaceae family. It is an annual herb and used as a vegetable commonly known as Mooli. Radish is called by various names in many states, such as Mullangi, Moolika, Mooli etc...<sup>[1-3]</sup>

Hariparnam, Bhoomikakhaaram, Neelakandom, Mahakandam, Ruchishya, Hastidanta, Sankhaprabha, Deerkhamoola, Supushpya, SimbibeekainSodhal Nighantu, and as per Bhavaprakasha Nighantu (nighantu which refers to dictionary) for Laghumoolaka(tender Radish)Mooli, Shaalaamarkataka, Visra, Shaleeya,

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Marusambhava, Chanakyamoolaka, Teekshna, Moolakapotika are the synonyms<sup>[3]</sup>. Radish is an excellent species to study because; it has good economical and nutritional value. It also has a high source of two chief compounds, peroxidases and isothiocyanates<sup>[4]</sup>. The fresh juice which is extracted from the leaves have properties like diuretic, laxatives, etc.. and the extract of roots are used for treatment of urinary complaints, haemorrhoids<sup>[5]</sup>, syphilitic disease, reputed medicine for piles<sup>[2]</sup>, gastrodynic pains and various gastric ailments<sup>[5]</sup>.

The extract which is obtained from seeds is used as expectorant, digestive, diuretic, laxative, carminative<sup>[5]</sup>, antitussive and stomach tonic<sup>[2]</sup>. The extract from the root has been stated to have antiurolithiatic property<sup>[4]</sup>. Ascorbic acid, folic acid, and potassium are rich sources and fine source of vitamin B6, riboflavin, magnesium, copper, and calcium are found. They are very low in cholesterol because they are low in saturated fat<sup>[6]</sup>. Researches have been done on the antimicrobial prospective in *Raphanus sativus*. 'Raphanin' is a constituent which is present in seeds and leaves has already been reported for its antibacterial and antifungal activities<sup>[7]</sup>. Even tender radish is recommended to be taken during pregnancy<sup>[8]</sup>. Radish is good source of vitamin C.<sup>[9]</sup>

They have anticancer, antimicrobial, antidiabetic, diuretic, antifertility, hypertensive, nephroprotective, gastroprotective and hepatoprotective property etc., and also used in gynaecological disorders and jaundice<sup>[10]</sup>. Approximately all parts of the plant along with leaves, seeds and roots are also used in medicines<sup>[2]</sup>. For a variety of ailments including liver dysfunction and poor digestion, radish is used as medicinal food. Many studies have proved that radish extracts have biological properties along with antioxidant, antimutagenic and anti-proliferative<sup>[11]</sup>.

#### Vernacular Names:

**Common Vernacular Names:** Forage radish, Fodder radish, Tillage radish, Radish ripper, Daikon, Japanese radish

**Scientific Vernacular Names:** *Raphanus sativus* var. *oleifer* Stokes, *Raphanus sativus* L. ssp. *Oleiferus*, *Raphanus sativus* L. var. *oleiformis* Pers<sup>[12]</sup>.

#### Taxonomical Classification:

Kingdom: Plantae  
 (unranked): Angiosperms  
 (unranked): Eudicots  
 (unranked): Rosids  
 Order: Brassicales  
 Family: Brassicaceae  
 Genus: *Raphanus*  
 Species: *sativus*<sup>[11]</sup>

#### Habit and Habitat:

The habitat for the plant is at an altitude of 190-1240m mostly grown in the temperate zones. In the hilly regions there sowing occurs from the month of March to July while it is from September to March in the northern plains. The stems are simple or branched and the roots are swollen tap roots, fleshy, variable in size, shape and colour<sup>[11,1,3]</sup>.





**Figure 1: Medicinal uses of the parts of *Raphanus sativus* Linn. a. Seeds, b. Roots of the plant c. Flowers of the plant d. Entire plant under the soil.**

### **Distribution:**

Originating from southern china, it started spreading to places of Japan and other regions of Asian countries. It is an essential food crop found to be widely grown in Korea, South east Asia, Japan, etc. It is found to possess various medicinal properties like in Urinary tract infections, Jaundice, Gynaecological disorders etc.,<sup>[14,10,3]</sup>. The annual production of radish in Brazil is around 9,000 t<sup>[15]</sup>. Oil seed varieties have been widely distributed in regions of USA and Canada. They are developed from varieties of cultivated and wild species<sup>[12]</sup>.

### **History:**

Its domestication was found in the European countries during the pre-roman times. This plant is considered to be the important food product in the Egyptian countries from times immemorial. Older types of the species are generally found to be biennials which require cold treatment or vernalization for a period of time in order to start the production of seeds and flowering. Similarly the case is true for larger species like black Spanish, winter radishes and daikon.

In the case of modern varieties round, icicle shaped, are found in shades of pink, red, white and violet. They are grown out from seeds by requiring a minimum number of cold treatments by taking 30-40 days in order to mature a fully grown radish<sup>[6,11,13]</sup>.

### **Botanical Description:**

#### **Leaves:**

The leaves of *Raphanus sativus* are long, pinnate, coarsely toothed and lyrate. Cauline leaves of *Raphanus sativus* are simple and linear<sup>[2,11,3]</sup>.

#### **Flowers:**

The flowers of *Raphanus sativus* are large yellow, white or pale lilac with purple veins and they are in long terminal racemes<sup>[2,3,11]</sup>.

#### **Flowers and Pollination:**

Radish is a cross-pollinated species. Because each individual plant of radish is impotent to pollinate its own flowers. It is pollinated with the help of insects which is fascinated to plenty of flowers<sup>[13]</sup>.

#### **Fruits:**

The fruit of the plant is found to be inflated, narrow, indehiscent, 2.5 – 7.5 cm long and about 1.25 cm in diameter with a lengthy tapering beak. The fruit is inside with white pith between the seeds, which are globose, yellow or brown and 2 – 8 in number<sup>[11,3]</sup>.

**Seeds:**

The seeds of the plant are pendulous, globose, cotyledons conduplicate.<sup>[2]</sup>

**Roots:**

Radish has tap root. The tap root of radish is swollen, and differs from nearly globular, cylindrical or conical in shape, in the authentic types, and it weighs upto 15 kg.<sup>[11]</sup>

**Root size and shape:**

Every individual radish assortment has a definite shape but moderately different from alternative varieties and they must be maintained. The size of the root in radish is somewhat small or long<sup>[13]</sup>.

**Chemical Constituents:**

*Raphanus sativus*, is an essential dietary vegetable in Asian countries, especially in China, Japan, and Korea<sup>[14]</sup>. The *Raphanus sativus* consist of major chemical constituents of alkaloids and nitrogen compounds, coumarins, enzymes, gibberellins, glucosinolates, oil seed compounds, organic acids, phenolic compounds, sulphur compounds, flavonoids, saponins, carbohygrates, proteins, amino acids, tannins, brassinosteroids and polyphenols<sup>[16, 11, 17]</sup>

The leaves of *Raphanus sativus* are excellent source of protein which has biological value of 76.6 and digestibility co-efficient as 73.5% and the origin is listed below,

- biochemical substances such as methins, sapogenins, levon
- enzymes such as phosphatase, catalase
- histaminergic component and a weak spasmolytic
- amino acids such as lysine, methionin etc..
- polyphenolics such as protocatechuic acid, vanillic acid
- antibacterial substances such as Sulphoraphene and raphanin
- free radical scavengers etc. <sup>[1]</sup>

Factors such as climate, soil, genotype, seasonal variation, processing, extraction quantification can affect the enzyme activity and stability, leading to increase or decrease in the hydrolysis of glucosinolates. <sup>[18]</sup>

*Raphanus sativus* seeds and leaves contain 'raphanin' which is an important constituent present in the vegetable<sup>[7]</sup>. It also contains glucoraphanin, glucobrassicin, methoxyglucobrassicin, and glucoraphasatin. This is present in both the skin and flesh <sup>[4]</sup>.

The peels of *Raphanus sativus L. varnigar* has most of the important phyto-constituents such as tannins, saponins, flavonoids, phlobatannins, anthraquinones, carbohydrates, reducing sugars, steroids, phytosterol, alkaloids, amino acids, terpenoids, cardiac glycosides and chalcones. These are the component which is used for medicinal purposes <sup>[19]</sup>.

There is some taste determining factors also present. They are glucosinolate and soluble carbohydrate content and myrosinase activity. It also consists of proximate nutrients such as protein, dietaryfiber, carbohydrate, antioxidant property<sup>[20]</sup>. Mainly these vegetables contain a compound called isothiocyanates and dithiolthiones which helps to lower the risk of cancer <sup>[21]</sup>.

These medicinal plants are studied as a wealthy resource of ingredients which can be used in drug development and synthesis. Besides, these plants play a demanding role in the development of human cultures all around the world. Moreover, some plants are considered as significant origin of nutrition and as a result these plants are recommended for their therapeutic values<sup>[22]</sup>

## Pharmacological Actions:

### Antibacterial Activity:

Preetiet *al* determined the antibacterial activity against streptococcus, Pyococcus, Pneumococcus and Escherichia coli. He found that sulphoraphene is a compound which has the very good antibacterial activity against the microorganisms. Raphanin is an active substance which is obtained from radish. It has sulphur containing oil which is active against gram positive and negative bacteria. The seeds of *Raphanus sativus* possess a broad-spectrum antibiotic effect. From seeds machrolysin is obtained which is active against mycobacterium tuberculosis<sup>[1]</sup>.

Radish is a plant, which is grown as edible root. To test the potential of different solvent like ethanol, methanol, ethyl acetate, chloroform, benzene, aqueous hot and cold with pathogenic bacterial strains like E.coli (ATCC-25922), klebsiella pneumonia (ATCC-27736), proteus vulgaris (ATCC-6380), pseudomonas aeruginosa (ATCC-27853), staphalococcus aureus (ATCC-25923), shigellasonnie (ATCC-25931), salmonella typhi (ATCC-25241), and salmonella paratyphi (ATCC-9150). The antibacterial activity was done by *invitro* method using agar diffusion and the diameter of zone of inhibition was measured and noted<sup>[2]</sup>.

Janjuaet *al* analysed for phytochemicals and invitro antibacterial activity. The peels of *Raphanus sativus* L. *Varnigarisis* used for this analysis. The antibacterial extract was tested to employ the agar well diffusion assay. It is prepared by using different solvent against gram positive Staphylococcus aureus ATCC 12598, Bacillus subtilis-QAU and Micrococcus luteus ATCC 10240 and gram negative bacteria Escherichia coli-ATCC 8739, Salmonella typhi- ATCC 14079, Klebsiella pneumonia-QAU, Pseudomonas aeruginosa ATCC 7700, Bordetella bronchiseptica ATCC 4617 and Enterobacteraerogenes-QAU. The effect of the extract against different bacterial strains were measured in millimetres according to terms of zone of inhibition, MIC and MBC values were compared with the positive control which is used<sup>[19]</sup>.

### Antimicrobial Activity:

Watalet *al* determined that 'raphin' extracted from seeds of *Raphanus sativus* possessed antifungal and antibacterial properties. It can fight against the strains like E.coli, Pseudomonas aerugaenosa, Klebsiella pneumonia, Enterococcus faecalis and Staphylococcus aureus. The antimicrobial activity in raphin is tested to all microorganisms at a MIC that ranges from 0.078 to 0.625mg/ml. ampicillin is used as reference drug<sup>[7]</sup>.

### Anti Inflammatory Activity:

Kambleet *al* determined the anti-inflammatory activity with the help of *Raphanus sativus* leaf juice and root juice (FRJ) in acute and chronic experimental models in albino rats. Albino rats which weigh between 200-250gm were taken and grouped into 4. Out of it Group 4 received 3ml of freshly squeezed *Raphanus sativus* leaf juice. A fleshly squeezed FRS was studied in carrageenan induced right hind paw edema in albino rats and paw volume is measured plethysmometrically at 0 and 3hr after injection of 1% carrageenan in hind paw and compared with control and standard of diclofenac. Then, 2% formalin is induced and the degree of inflammation was measured on day 1 and 7 and compared with control and standard drug of diclofenac. FRJ significantly reduced carrageenan and formalin induced paw edema in rats. However the radish leaf juice is compared to root juice produces more potent anti-inflammatory effect in both acute and chronic models of inflammation and diclofenac sodium has more anti-inflammatory effect than radish leaf juice.<sup>[23]</sup>

### Anti-Cancer Activity:

Rakhmawati *et al* study was aimed to know the toxicity effect and antimicrobial activity of active fractions from lobak leaves. Radish is one of the vegetable which is used to prevent cancer and it had been used traditionally to cure infection, such as lobak (*Raphanus sativus* L.) Toxicity study was conducted using Brine Shrimp Lethality Test (BST). Antibacterial study against Staphylococcus aureus was conducted using agar-well diffusion method at concentration 30, 40, 50, 60, 70, 80, 100%. Ethyl acetate fraction from methanol extract is most active that had larger clear zone in S. aureus culture (10,64 mm). Bioactive compounds at active fraction were identified to contain polar compounds<sup>[24]</sup>.

### Antioxidant Activity:

According to BROS *et al* the authority of the variety, vegetative state total phenolic content and oxidative capacity are present in *Raphanus sativus*. To the test, the total phenolic content and the antioxidant activity, the samples of roots, sproutes and seeds were used. Folin-Ciocalteau assay is used for the determination of total phenolic content and DPPH assay is used for antioxidant activity. Then, he found that sprouts have more contents of phenolic and antioxidant activity and the root has the less<sup>[25]</sup>.

The *in vitro* method is of two types. They are DPPH radical scavenging activity and b-carotene – linoleic acid assay. The plant leaves like radish (white or red), cabbage (white or red), carrot (red or yellow), red beet, sugar beet, cauliflower, parsley, spinach. These were extracted in cold and boiling water for 10,30 and 60 minutes. The extract contains total phenolic and flavonoid which is determined using folin-ciocalteu reagent and aluminium chloride method. Their amount is calculated as gallic acid/100g and rutin/100g fresh weight respectively<sup>[26]</sup>.

According to Teklić *et al*, the antioxidative capacity of the species *Raphanus sativus* was examined on laboratorial practises. It was found out that the nutrient quality enzyme action and many other properties were found to be deteriorated if the level of metals like Cu and Pb where increased in the soil especially in the urban areas and suburban areas. Somehow the values were found to be less than that of the original data obtained by taking *Raphanus sativus*. Thus the work focuses on the cross checking of the antioxidative capacity of the species and comparing it with the original data<sup>[4]</sup>.

### Liver Toxicity:

Our soil is polluted by toxic substances such as cadmium, lead, CCL<sub>4</sub> etc..<sup>[27]</sup>. Cadmium (Cd) is a heavy metal and extremely toxic to plants<sup>[28]</sup>. Due to this it has led to special conditions such as kidney insufficiency, respiratory disturbances, etc..<sup>[29]</sup>. phytohormones with significant growth promoting effects, which are essential for many processes in plant growth and development<sup>[28]</sup>. Plants have been again and again used as indicators in the investigation for metal pollution or accretion of ores, or as accretion for soil remediation. It is called as phyto-remediation.<sup>[27]</sup> Humic acid or chitosan has been shown to increase plant growth, yield and improve physiological processes in plant, but its roles on alleviating the harmful effect of cadmium on plant growth and some physiological processes in plants is very rare.<sup>[30]</sup>

Kalantri *et al* determined that; The test group received the crude drug extract which is administered orally in doses of 100, 200, 400, 600, 800 mg/kg on first and fourth day. Hexobarbital sodium is administered intraperitoneal on fifth day to determine the sleeping time. Liver is removed from animal and kept in 10% formalin. The result showed that group which received 600&800mg/kg were significant (reduction in liver damage) as compared with positive control group. As a result the serum enzyme is analysed by one way ANOVA method indicating that these 2 groups (600&800mg/kg) were also potent as compared with carbon tetrachloride group. It resulted in the liver damage induced by carbon chloride can be protected by crude hydro ethanolic extract of radish seed in dose of (600&800mg/kg).<sup>[31]</sup>

### Cholestrol and Gall Stones:

Torres *et al* determined that, *Raphanus sativus L. varniger* has been used as traditional medicine in Mexico for the treatment of gall stones. It has been tested in mice, where juice of radish decreases the cholesterol levels in plasma and dissolves gallstones. Glucosinolates and isothiocyanates are the constituents which have the antioxidant property and prevent the formation of gall stones<sup>[32]</sup>.

### Food Safety and Storage:

Radishes should be washed thoroughly before eating. People usually discard it, but they are edible and nutritious. As storing radish for long time with leaves left on will cause loss of nutrients and moisture content, it should be removed separately and stored.<sup>[9]</sup>

## Conclusion:

Plants are the most important source used therapeutically. Because, they have a mixture of active and in-active compounds, these helps to cure various diseases and disorders. A review on *Raphanus sativus* has revealed *Raphanus sativus* as a highly potential functional and valuable ingredient that exhibits relatively impressive biological functions of great interest in pharmaceutical and food industries. In India, mortality rate due to infections is largely due to *S. aureus*, *K. pneumonia*, *E. coli*, *P. vulgaris*, etc., which are highly reactive to the species due to its antibacterial, antifungal, anti-inflammatory, anticancer properties, etc., Hence further researches in the upcoming years would help know more on the various unknown properties and beneficial activities of a number of plants.

## References:

1. Singh P, Singh J. Medicinal and therapeutic utilities of *Raphanus sativus*. International journal of plant, animal and environmental sciences. 2013, 3(2): 103-105.
2. Ahmad F, Hasan I, Chishti D K, Ahmad H. Antibacterial Activity of *Raphanus sativus* Linn. Seed Extract; Global Journal of Medical Research. 2012, 12(11): 25-34.
3. Sreelekshmi G, Pratibha K. A safe body through moolaka–*Raphanus sativus* linn. International Ayurvedic Medical Journal. 2015, 3(10): 3091-3096.
4. Teklic T, Hancock J T, Engler M, Paradikovic N, Cesar V, Lepedus H, Stolfa I, Beslo D. Antioxidative responses in radish (*Raphanus sativus* L.) Plants stressed by copper and lead in nutrient solution and soil. Actabiologicacracoviensia Series Botanica. 2008, 50(2): 79–86.
5. Alqasoumi S, AL-Yahya M, AL-Howiriny T, Rafatullah S. Gastroprotective effect of radish "*Raphanus sativus* L. On experimental gastric ulcer models in rats". Farmacia. 2008. 56(2): 204-214.
6. Badar A, Jan M. Effect of crude extract of *Raphanus sativus* roots on isolated trachea of albino rat. Pak j physiol. 2012, 8(1): 23-26.
7. Shukla S, Chatterji S, Yadav D K, watal G. Antimicrobial efficacy of *Raphanus sativus* root juice. International Journal of Pharmacy and Pharmaceutical Sciences. 2011, 3(5): 89-92.
8. S. Mira. Advice and Restrictions During Pregnancy. Chetna XXV. 1996: 01-25.
9. Klavinski R. Using, Storing and Preserving Radishes. Michigan state university extension. 2013: 01-02.
10. Agarwal KK, Varma R. Radical Scavenging Ability and Biochemical Screening of a Common Asian Vegetable – *Raphanus sativus* L. International Journal of Pharmaceutical Sciences Review and Research. 2014, 27(1): 127-134.
11. Aruna G, Yerragunt V G, Raju A B. Photochemistry and pharmacology of *Raphanus sativus*. International journal of drug formulation and research. 2012, 3(1): 43-52.
12. Jacobs, Alayna A. Oilseed radish. United states department of agriculture natural resources conversation services Booneville Plant Materials Center, Arkansas. 2012: 01-05.
13. Dr. Navazio J, Colley M, Dillon M. Principles and Practices of Organic Radish Seed Production in the Pacific Northwest. Organic Seed Alliance. 2007: 1-11.
14. Kim S J, Uddin R MD, Park S U. Glucosinolate accumulation in three important radish (*Raphanus sativus*) cultivars. Australian journal of crop sciences. 2013, 7(12): 1843-1847.
15. Cortez J W M, Filho A B C, Coutinho E L, Alves A. Cattle manure and N-urea in radish crop (*Raphanus sativus*). Ciencia e investigation agraria. 2010, 37(1): 45-53.
16. Gutierrez R M P, Perez R L. *Raphanus sativus* (Radish): Their Chemistry and Biology. The Scientific World journal. 2004, 4: 811-837.
17. Sham T T, Yuen A C Y, Ng Y F, Chan C O, WahMok D K, Chan S W. A Review of the Phytochemistry and Pharmacological Activities of Raphani Semen. Hindawi Publishing Corporation. 2013: 1-16.
18. Praa V D, Jardima N S, Dolwitscha C B, Mazuttib M A, Viana C, Bohrer D, Nascimento P C, Carvalho L M D, Silvac M B D, Carvalhod C A D, Rosa M B D. A review of influence of environment and process parameters on glucosinolate-myrosinase system from Brassica. Journal of Applied Pharmaceutical Science. 2013, 3(08): 121-128.
19. Janjua S, Shahid M, Abbas F I. Phytochemical analysis and in vitro antibacterial activity of root peel extract of *Raphanus sativus* L. varniger. Advancement in Medicinal Plant Research. 2013, 1(1): 1-7.

20. Levine L H, Bisbee P A, Richards J T, Birmele M N, Prior R L, Perchonok M, Dixon M, Yorio N C, Stutte G W, Wheeler R M. Quality characteristics of the radish grown under reduced atmospheric pressure. *Advances in space research*. 2008, 41: 754-762.
21. Ingrid adams. The health benefits of cruciferous vegetables. University of Kentucky college of agriculture. 2013, (5): 01-03.
22. Dr. Ramaswamy L, AbinayaR. Phytonutrient Profile and Applications of Selected Edible Foliages in Kashayams. *International Journal of Ayurvedic and Herbal Medicine*. 2014, 4(3): 1499-1507.
23. Kamble S, Ahmed MD Z, Ramabhimaiaha S, PatilP. Anti-Inflammatory Activity of *Raphanus sativus l* in Acute and Chronic Experimental Models in Albino Rats. *Biomedical & Pharmacology Journal*. 2013, 6(12): 315-320.
24. Rakhmawati R, Anggarwulan E, Retnaningtyas E. Potency of Lobak Leaves (*Raphanus sativus L. var. hortensis* Back) as Anticancer and Antimicrobial Candidates. *Biodiversitas*. 2009. 10(3): 158-162.
25. Bors M D, Nsemeniuc C A, Socaci S, Varva L, Moldovan O, Vlaic R, Tofana M. Total Phenolic Content and Antioxidant Capacity of Radish as Influenced by the Variety and Vegetative Stage. *Bulletin UASVM Food Science and Technology*. 2015, 72(1): 77-81.
26. Shehata A N, Mahmoud A B, Abdou H M. Quantification of Total Phenolic and Total Flavonoid Contents in Extracts of Some Egyptian Green leaves and Estimation of Antioxidant Activity. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*. 2014, 5(6): 266-273.
27. Gaspar G M, Anton A. Heavy metal uptake by two radish varieties. *Proceedings of the 7th Hungarian Congress on Plant Physiology*. 2002, 46(3-4): 113-114.
28. Anuradha S, Rao S S R. The effect of brassinosteroids on radish (*Raphanu ssativusl.*) seedlings growing under cadmium stress. *Plant soil environ*. 2007, 53(11): 465-472.
29. Cannata M, Bertoli A, Carvalho R, Bastos A R, Freitas M, Augusto A, Varennes A D. Toxic metals in *Raphanus sativus*: assessing the levels of cadmium and lead in plants and damage to production. *Revista de Ciências Agrárias*. 2013, 36(4): 426-434.
30. Farouk S, Mosa A A, Taha A A, Ibrahim H M, EL-Gahmery A M. Protective Effect of Humic acid and Chitosan on Radish (*Raphanus sativus, L. var. sativus*) Plants Subjected to Cadmium Stress. *Journal of Stress Physiology & Biochemistry*. 2011, 7(2): 99-116.
31. Kalantari H, Kooshapur H, Rezaii F, Ranjbari N, Moosavi M. Study of the protective effect of *Raphanus sativus* (radish) seed in liver toxicity induced by carbon tetrachloride in mice. *Jundishapur Journal of Natural Pharmaceutical Products*. 2009, 4(1): 24-31.
32. Torres B G C, Arciniega M D L O, Estudillo J G, Rodriguez E B N, Ortiz M A D. *Raphanus sativus l. varniger* as a source of phytochemicals for the prevention of cholesterol gallstones. *Phytotherapy research*. 2013: 1-5.

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