



# “Exploring Selenium As An Antioxidant Agent: Impacts On Human Health And Medicinal Applications”

Sahil Solanki, Lekhraj Singh Rajput, Gajendra Rathore, Anuraj Prajapati, Miss Sarvar Jahan

B.Sc. Forensic Science (3<sup>rd</sup> year), School of Science, SAM Global University, Raisen

B.Sc. Forensic Science (3<sup>rd</sup> year), School of Science, SAM Global University, Raisen

B.Sc. Forensic Science (3<sup>rd</sup> year), School of Science, SAM Global University, Raisen

B.Sc. Forensic Science (3<sup>rd</sup> year), School of Science, SAM Global University, Raisen

Assistant professor, School of Science, SAM Global University, Raisen

## Abstract

Selenium is a trace element that fulfils important functions in the organism. Its deficit may cause acute disorders, but an overdose can also lead to severe consequences. Selenium (Se) has a special place among the feed-derived natural antioxidants, being an integral part of selenoproteins participating in the regulation of various Physiological processes in the body. As a part of glutathione peroxidase (GSH-Px) Se. Belongs to the first and second major levels of antioxidant defence in the cell. The functions of selenium in the organism are mainly connected with its antioxidant properties, as it is an essential part of important antioxidant enzymes. Disturbances of oxidant balance are involved in the activity of numerous harmful factors As well as in the pathogenesis of diverse illnesses. Selenium administration has proved to be effective against the toxicity of many agents and the side effects of drugs. The beneficial synergism between selenium (Se) and other antioxidants on human health stimulates the search of new medicinal plants with high antioxidant activity (AOA) and Se Accumulation levels. Using fluorimetric method of Se analysis and the titrimetric method of total AOA Determination monitoring was achieved of 53 species of herbs, 24 species of deciduous and Evergreen trees and shrubs and 11 species of conifers grown on the Southern and South–Eastern Coast of the Crimean peninsular. Two new Se–hyperaccumulators were indicated among Deciduous trees: *Tamarix ramosissima* and *Paliurus spina–christi* with leaves Se content 6236 and 1800  $\mu\text{g.Kg}^{-1}$  d.w. respectively.

**Keyword:** Selenium , Antioxidant activity , Glutathione peroxidase (GSH-Px) , Oxidative stress , Selenoproteins, Redox homeostasis , Medicinal plants

## Introduction

Antioxidants are an important group of compounds capable to protect human Organism from many diseases, suitable For production of food additives and Inhibiting oxidation processes.

Several Groups of phenolics (anthocyanins, Tannins, flavonones, resveratrol, ellagic Acid) are already used in industry as Nutraceuticals and/or functional food Products Despite antioxidant properties, these Compounds demonstrate wide spectrum Of biological activity, including anti-Allergic, anti-inflammation, antithrombotic, Cardio-protective, anticarcinogenic and Vasodilator effect.

The biological functions of selenium result from the occurrence of the selenocysteine amino acid in proteins. The research has revealed that about a hundred selenoproteins can be found in mammal Organisms. The most important of them are the anti-Oxidant enzymes – glutathione peroxidase and thioredoxin reductase, as well as selenoprotein P, responsible For the storage and transport of selenium.

Selenium Supplementation has been proved to be protective against A very wide range of harmful factors, both chemical, such as drugs exerting severe side effects, heavy metals, carcinogens, mycotoxins, or pesticides, and physical, such As heat stress or magnetic fields.

However, the narrow Range between therapeutic and toxic doses of selenium, as well as the dependence of its effect on the applied form, Dose and method of treatment, make the choice of the Most effective supplement a very complex issue.

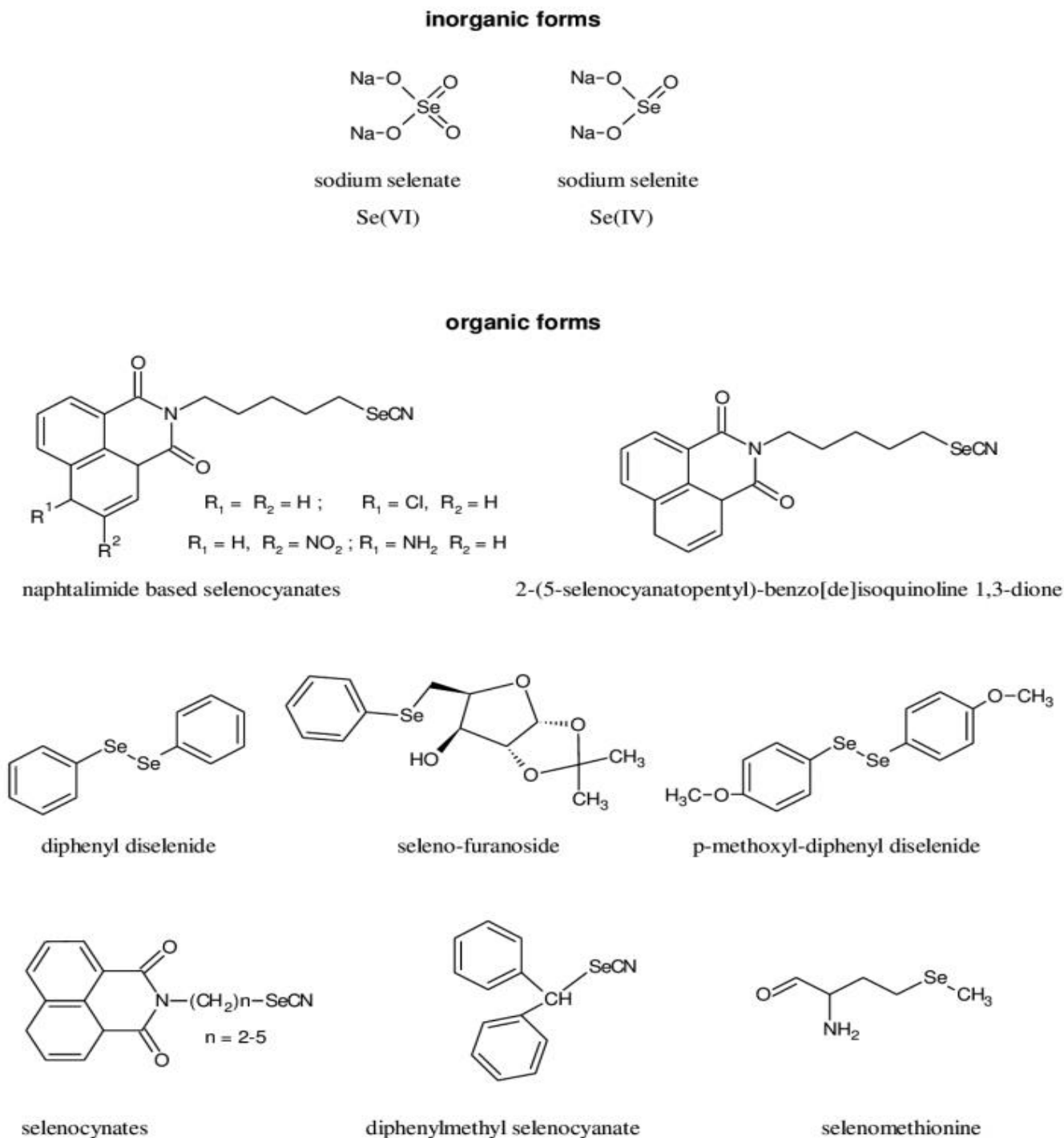


Fig. 1. The different forms of selenium used in scientific research

## Selenium as an influencing part of the antioxidant system

1. Oxygen is an essential element for animal life but can be toxic in excess.
2. Free radicals are constantly produced in physiological conditions and their production increases in stress conditions.
3. The main sources of free radical production in the cell include the electron transport chain in mitochondria, xenobiotic-metabolising enzymes and immune cells. Specifically, immune cells generate free radicals to kill pathogens.

4. The development of an antioxidant system is an adaptive evolutionary mechanism of Survival in an oxygenated atmosphere.
5. The antioxidant system in the cell is based on the three major levels of defence. SOD, GSH-Px, catalase and metal-binding proteins form the first level of defence through Prevention of free radical formation. Chain-breaking antioxidants (vitamins A, E, C, Carotenoids, glutathione, uric acid etc.) belong to the second level of defence and deal with prevention and restriction chain formation and propagation. A third level of Antioxidant defence deals with damaged molecules in the cell because of free radical Action and toxic products of their metabolism and includes various enzymatic systems Responsible for repair or removal of the damaged molecules.

### **Intake sources along occurrence**

In nature Se exists in two chemical forms, organic and inorganic. Inorganic Se can be Found in different minerals in the form of selenite, selenate and selenide as well as in the Metallic form. In contrast, in forages, grains and oilseed meals Se is bonded to different Amino acids including methionine and cysteine. Therefore, in nature animals receive Se mainly in the form of selenomethionine. Plants absorb Se from the soil in the form of selenite or selenate and synthesise selenoaminoacids with SeMet representing about 50% of the Se in cereal grains (Olson and Palmer, 1976) and Se-Methyl-selenomethionine, selenocysteine and Se-methyl-selenocysteine being the other Seleno-compounds found in plants. The Se concentration in soil varies significantly and its availability to Plants depends on many factors. In the case of acidic soil pH or low soil aeration, Se can Form insoluble complexes with iron hydroxide and become poorly available.

### **Methodology For Medicinal Application**

#### **Material And Methods**

#### **Sample collection and preparation**

Sample collection and preparation- Samples of plant leaves were Gathered at the end of May– beginning of June 2017–2018 in the territory of Karadag Nature Reserve (44°56'10''с.ш.; 35°14'00''в.д.), Martyan Cape Nature Reserve and Nikitsky Botanical Garden and Ayu–Dag protected area. Among deciduous and evergreen Trees and shrubs 23 plant species were Investigated, belonging to 12 families: Anacardiaceae, Cornaceae, Fabaceae, Elaeagnaceae, Fagaceae, Myrtaceae, Moraceae, Oleaceae, Rhamnaceae, Rosaceae, Tamaricaceae, and Vitaceae. Among conifers 11 evergreens Species were studied. And among Herbaceous species we investigated 54 Taxa (including 3 cultivars of the same Species) belonging to 20 families: Asparagaceae, Asteraceae, Fabaceae, Asphodelaceae, Boraginaceae, Brassicaceae, Hypericaceae, Capparidaceae, Caryophyllaceae, Lamiaceae, Ephedraceae, Euphorbiaceae, Papaveraceae, Rosaceae, Paeoniaceae, Plumbaginaceae, Polygonaceae, Ranunculaceae, Solanaceae, and Urticaceae. Status and nomenclature of taxa Are presented according to modern International databases. The 2013 Plant List, 2020 Catalogue of Life and IPNI. Samples of leaves were cut with Plastic knife and dried at room Temperature to constant weight without Direct sunlight. Dried samples were Homogenized and the resulting powders Were kept in hermetically closed

Polyethylene bags without direct sunlight. Extraction of antioxidants was Achieved using 70 % ethanol. Half gram Of dry leaves powder were mixed with 15 mL of 70 % ethanol, heated at 80 oC During one

hour and cooled to room Temperature. Mixtures were quantitatively Transferred to volumetric flasks and the Volume was adjusted to 25 mL with 70 % Ethanol and samples were filtered through A pleated filter. Despite the fact that each Biological object requires a special Selection of optimal conditions for Antioxidants extraction, 70 % Ethanol is used most frequently which Allows to simplify the process of Monitoring. Antioxidant activity (AOA) of Medicinal plants leaves was assessed Using a redox titration method via titration of 0.01 N  $\text{KmnO}_4$  Solution with ethanolic extracts of dry Samples. The reduction of  $\text{KmnO}_4$  to Colorless  $\text{Mn}^{+2}$  in this process reflects the Quantity of antioxidants dissolvable in 70% ethanol. The values were expressed In mg gallic acid equivalents (GAE) g<sup>-1</sup>d.w. The  $\text{KmnO}_4$  acidic solution has been successfully used earlier for the determination of the *Ocimum basilicum* antioxidant potential and the antioxidant capacity of serum. Simplicity of the method and Its cheapness makes it more and more Popular in modern biochemical Laboratories. Selenium was analyzed using the Micro fluorimetric method previously Described for tissues and biological fluids. The method includes wet Digestion of dried homogenized samples Via heating with a mixture of nitric–chloral Acids, subsequent reduction of selenate ( $\text{Se}^{+6}$ ) to selenite ( $\text{Se}^{+4}$ ) with a solution of 6 N HCl, and formation of a complex (piazoselenol) between  $\text{Se}^{+4}$  and 2,3–Diaminonaphtalene. The calculation of Se Concentration was achieved by recording Piazoselenol fluorescence values in Hexane at 519 nm  $\lambda$  emission and 376 nm  $\Lambda$  excitation. Each determination was Performed in triplicate. The precision of The results were verified using in each Determination a reference standard–Lyophilized cabbage with Se concentration of 150  $\mu\text{g}\cdot\text{kg}^{-1}$ . Statistical analysis Data was processed by analysis of Variance and mean separations were Performed through the Duncan multiple Range test, reference to 0.05 Probability level, using SPSS software Version 21.

## Result And Discussion

Literature data indicate several Plant orders and families where Se Hyperaccumulators are revealed. Among them 6 families should be Mentioned: Asteraceae, Brassicaceae, Fabaceae, Rubiaceae, Chenopodiaceae, And Orobanchaceae (Table 1). Se Hyperaccumulators is considered to be plants containing more than or equal to 1000  $\mu\text{g Se/kg d.w.}$

In the present work monitoring of Se Accumulation and levels of AOA in plants Was achieved regardless of plants family but grown in unpolluted areas of Nature Reserves (Karadag, Martyan Cape), Nikitsky Botanical Garden and specially Protected area Ayu–Dag (Figure 1). Karadag Nature Reserve is situated in the Territory of paleovolcano, while Ayu–Dag Mountain is a laccolite. Objects of investigation included Herbs, deciduous and evergreen trees and shrubs and conifers.

**Table 1. Known selenium hyperaccumulators among angiosperms**

Order (Family)	Species
Asterales (Asteraceae)	Haplopappus fremonti; Machaeranthera (4 taxa); Oonopsis (4 taxa); Xylorhiza (8 taxa)
Brassicales (Brassicaceae)	Stanleya bipinnata; Stanleya pinnata
Caryophyllales (Chenopodiaceae)	Atriplex confertifolia
Fabales (Fabaceae)	Astragalus (24 taxa)Neptunia amplexicaulis
Gentianales (Rubiaceae)	Coelospermum decipiens(Morinda reticulata)
Lamiales (Orobanchaceae)	Castilleja angustifolia var. dubia (Castilleja chromosa)

## Conclusions

Se plays an important role in the regulation of various metabolic processes in the body, Being an integral part of selenoproteins. Organic Se in the form of selenomethionine is a Predominant form of this element in feed ingredients. Therefore, the digestive system of Animals, including chickens, has adapted to this form of the element during evolution. In this regard selenite (a common form of Se used in diets) is not found naturally and as a Result is less effective in terms of assimilation from the feed and building Se reserves in the Body. Se deficiency and toxicity are rare events in poultry production. However, the precise Se requirements of various poultry species under commercial conditions require further Elucidation.

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