Antioxidant activity evaluation of aqueous extracts of chickpea and lentil seedlings

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Abstract. The aim of the study was to explore the antioxidant activity of aqueous extracts of leguminous crop seedlings - chickpea and lentils. For the study of antioxidant activity, an in vitro method of autooxidation of adrenaline in an alkaline medium was used. The process of adrenaline autooxidation was investigated as a model reaction of quinoid oxidation, proceeding through a series of intermediate stages with the formation of the final product of adrenochrome. The accumulation of the adrenaline autooxidation intermediate product - adrenalinquinone - in an aqueous-alkaline medium and in the presence of aqueous chickpea or lentil extracts was recorded using a UV 1700 spectrophotometer (Shimadzu) at a wavelength of 348 nm. It was revealed that aqueous extracts of legumes exhibit antioxidant activity. Inhibition of adrenaline autooxylation with a selected exposure time of 5 minutes in the presence of aqueous extracts of lentils was 25%, and of chickpea - 16%. The interrelation of the manifestation of the antioxidant activity of seedlings and the content of biologically active compounds with reducing properties (reducing sugars, flavonoids, vitamin C and tannins) was revealed.

1. Introduction

Adverse environmental factors, the presence of pollutants in the atmosphere and food products contribute to the accumulation in the human body of an excess of free oxygen-containing radicals, thereby causing oxidative stress and impaired antioxidant status [1].

For the pharmacological prevention of oxidative stress of the body, it is necessary to consume compounds of a reducing nature - antioxidants that can easily interact with active forms of oxy radicals to form kinetically stable molecules. Today, daily norms of antioxidant consumption have been defined, which help to maintain the normalization of the biochemical mechanism of utilization of active oxygen and prevent a number of different diseases [2].

Synthetic antioxidants, due to their possible toxic effects, are replaced by plant-derived antioxidants - biologically active compounds of the polyphenol class - anthocyanins, ascorbic acid, flavonoids, tannins, and essential oil components most commonly found in vegetables, fruits, and aromatic plants. A number of studies are devoted to the search for alternative plant sources with antioxidant properties, as well as the development of methods for determining the antioxidant activity of plant raw materials [3-6].
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Conscious desire of the population to a healthy diet led to the emergence on the table of seedlings of grain and legumes. It is known that seedlings are a product of consumption, which is a concentrated source of proteins, carbohydrates, vitamins and minerals, as well as such important biologically active substances as glucosinolates, polyphenolic compounds and selenium-containing biomolecules [7-10]. In dry grains and beans, many biologically active substances "sleep", in seedlings they "wake up", giving away all their vital energy in the process of feeding. From this point of view, it was interesting to study the antioxidant activity of seedlings, in particular their aqueous extracts.

The aim of the study was to determine the total antioxidant activity of aqueous extracts of seedlings of some legumes: lamb chickpea or chickpea (Cicer arietinum) and lentils (Lens culinaris).

The objects of study - chickpea and lentil sprouts - were grown under the production conditions of the company “Prophets” (Krasnoyarsk) (figure 1).

Aqueous extracts from seedlings were prepared as follows: samples of seedlings obtained on the third day from the start of soaking were dried in a drying cabinet (at 40° C) to constant weight. The dried seedlings were ground to homogeneity using a laboratory mill. A sample of the sample was poured with water and kept for 24 hours with periodic shaking. The extract was separated from the residue by filtration through a paper filter.

For the study of antioxidant activity (AOA), an in vitro method of adrenaline auto-oxidation was used in an alkaline medium. This AOA evaluating method is based on the ability of biologically active substances of a reducing nature to inhibit the action of superoxide radicals during adrenaline auto-oxidation [11]. The process of adrenaline auto-oxidation is essentially a model reaction of quinoid oxidation, which proceeds through a series of intermediate stages with the formation of the final product of adrenochrome. The accumulation of an adrenaline auto-oxidation intermediate – adrenalinquinone - was recorded using a UV 1700 spectrophotometer (Shimadzu) at a wavelength of 348 nm.

In determining the AOA samples, a technique developed for aqueous extracts was used [11]. Antioxidant activity (AOA) of the samples studied was expressed as a percentage of inhibition of adrenaline autooxidation and was calculated by the formula:

\[ \text{AOA} = \frac{(D_1 - D_2) \times 100}{D_1}, \% \]  

where \( D_1 \) and \( D_2 \) - optical density at 348 nm of adrenaline solution in the absence and presence of seedling extract, respectively.

Quantitative determination of vitamin C, bioflavonoids, reducing sugars and tannins was carried out according to [12].
Evaluation of antioxidant activity (AOA) is one of the important indicators of biochemical control of food products [6]. In figure 2 the results of the AOA study of aqueous extracts of chickpea and lentil sprouts are presented. For the calculated AOA value, the exposure time of 5 minutes recommended in the procedure [11] was used.

![Figure 2. The change in optical density of adrenalinquinone: 1) adrenaline in an aqueous alkaline medium; 2) adrenaline in the presence of chickpea extract; 3) adrenaline in the presence of lentil extract.](image)

The AOA value calculated by the formula (1) was: for chickpea - 16%, for lentils - 25%. In accordance with the data of the publication [13], the AOA value of more than 10% indicates the presence in the extracts of seedlings of the studied leguminous cultures of compounds with antioxidant properties. It was revealed that seedlings of lentils show a slightly greater antioxidant activity compared to chickpea sprouts.

To study the relationship between AOA seedlings of legumes and the presence of biologically active substances that have reducing properties, a quantitative analysis of the seedlings and the determination of reducing sugars, flavonoids, vitamin C and tannins (table 1) was performed.

**Table 1.** Quantitative analysis data for chickpea and lentil seedlings in the determination of compounds with reducing properties.

| Compounds     | Chickpea            | Lentils            |
|---------------|---------------------|--------------------|
|               | Mass fraction, %    | Mass fraction, %   |
|               | in terms of a.s.n.  | in terms of a.s.n. |
| Reducing sugars | 0.69 ±0.03          | 1.78 ± 0.13        |
| Bioflavonoids  | 0.42 ±0.02          | 0.62 ±0.03         |
| Vitamin C     | 0.046 ± 0.002       | 0.096 ± 0.005      |
| Tannins       | 0.1 ± 0.005         | 0.008 ± 0.001      |

Comparative analysis of the data in the table gives a good correlation of the AOA seedlings of the studied legumes and the content of compounds of reducing nature in them. In particular, phytochemical spectral research in [14] showed that lentil seeds contain compounds that play the role of antioxidants: β-sitosterol benzoates and carbohydrate compounds of the nature - glucuronic pyranosides and galactopyranosyls.

2. Conclusion

The results of the study confirm the biological value of chickpea and lentil seedlings from the point of view of their manifestation of antioxidant properties. Inhibition of adrenaline autoxoylation with a selected exposure time of 5 minutes in the presence of aqueous extracts of lentils was 25%, and chickpea - 16%. The interrelation of the manifestation of the antioxidant activity of seedlings and the content of
biologically active compounds with reducing properties (reducing sugars, flavonoids, vitamin C and tannins) was revealed.

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