Onions and garlic in herbal medicine and homeopathy.
Publication 2: Chemical composition of producing plants and raw materials

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Representatives of the genus Allium and, in particular, onions - Allium cepa L. and common garlic - Allium sativum L. have been widely used as medicines (MP) for several thousand years. Currently, they are successfully used both in allopathic medicine for the manufacture of medicines and in traditional medicine - homeopathy and herbal medicine [10].

In a previous publication [10], devoted to the use of these two representatives of the genus Allium in traditional medicine (TM) in different countries, we outlined the main goal of the study and a number of tasks that need to be solved for its implementation.

This work is an information-analytical study devoted to the chemical composition of the analyzed objects and the characteristics of biologically active substances (BAS) contained in the raw materials of various varieties of onions and garlic.

1. ONION

1.1. Essential oil

Bulbs of onions contain a large amount of essential oil, which, to a certain extent, determines their taste and smell. The content of essential oil in them, according to various sources, ranges from 0.005 to 0.150% [11; 13; twenty; 22]. Spicy varieties of onions contain up to 0.5 g / kg of essential oil, as well as a non-volatile oil that causes a strong burning sensation in the mouth; sweet varieties - up to 0.3 g / kg of essential oil [16].

Research on onion essential oil began in 1892 [29]. Today it is known that essential oil is a complex mixture of sulfides, the main constituent of which is diallyl sulfide $(C_3H_5)_2S$ [15]. The other dominant components are three derivatives of S-alkene (yl) cysteine sulfoxide: (+) - S-methyl-Lcysteine sulfoxide, trans - (+) - S- (1-propene) -L-cysteine sulfoxide - usually found in the highest concentrations and (+) - 8-propyl-L-cysteine sulfoxide [29]. With the help of histochemical reactions, it was found that sulfur-containing essential oils are localized in the lactifers and the zone of the vascular bundles. In the bottom of the bulbs, in the buds — the rudiments of leaves, and the closed inner scales adjacent to the buds, the content of these substances is maximal [23].

1.2. Flavonoids and phenol carboxylic acids

Flavonoids are present in large quantities in onions, mainly in the form of glycosides. Compared to other vegetables, onion bulbs contain the highest amount of quercetin glycosides (bioflavonoids). The prevalence of 3,4'-diglycoside and 4'-monoglycoside of quercetin (in total, their amount is about 85% of the total amount of flavonoids [27; 34]), derivatives of isorhamnetin and kaempferol in various amounts and ratios [34; 35].

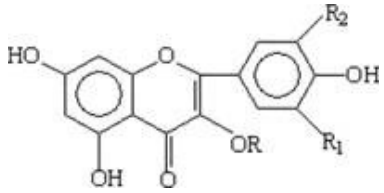
Colored onion varieties contain a higher amount of total quercetin (free and bound forms) compared to white varieties [33]. Brown, red and pink onion varieties contain, according to some sources, 1369-1778 mg of flavonol glycosides per 1 kg of fresh raw material weight; in white varieties this content is lower [34]. According to BS Patil et al. [33], the concentration of quercetin derivatives in different cultivars decreases with the transition from the outer dry scales to the middle rings (fifth to sixth) and inner rings (seventh to tenth) of the bulb. In dry scales, quercetin is present mainly in the form of aglycone, i.e. free form (up to 67% of the total amount of quercetin), in juicy scales, free quercetin is found in small amounts (less than 2% [34]) or does not occur at all [33], but its glycosides predominate.

Colored onion varieties contain anthocyanins, the amount of which varies depending on the variety, growing conditions of the plant, and onion harvesting time [8].

In the research of N.P. Yarosh et al. [23] there is a low content of catechins in onion scales, which sharply increases in the bottom and maximum in the leaf buds (up to 4.13 mg / g).

According to N.P. Yarosh et al. [23], the maximum content of flavonols was noted in the covering scales of bulbs of the Akhtubinets and Volzhsky varieties, which are characterized by high keeping quality (28-50 mg / g).

According to our data, different types of onions accumulate different amounts of flavonoids. In the course of a study of the raw materials of the 5 most common onion varieties in the Russian Federation: Myachkovsky, Strigunovsky, Stuttgarten rizen, Carmen, as well as Holland white, it turned out that the largest amount of flavonoids in terms of rutin contains red onions of the Carmen variety - 0, 98% (based on the mass of absolutely dry matter). The varieties Myachkovsky, Strigunovsky, Stuttgarten, and rizen contain approximately the same amount of flavonoids - 0.62, 0.68 and 0.76%, respectively, of the dry matter weight. We did not find flavonoids in the Gollandskiy Bely cultivar by TLC. The qualitative flavonoid composition of the studied varieties turned out to be similar. Anthocyanins were found by us only in the raw material of the Carmen variety (which has a purple color),



kaempferol (R = R_1= R_2= H);
quercetin (R = R_1= H; R_2OH);
rutin (R_1= H; R_2= OH; P = rhamnosyl glucose residue)

1.3. Carbohydrates

On average, more than 50% of the dry matter of juicy scales are non-structural, water-soluble carbohydrates, of which monosaccharides are predominant - (up to 74% of the total); disaccharides and fructosans are significantly less (12 and 14%, respectively). The carbohydrate fraction also includes fructose, sucrose, pectin, and fiber [4]. The onion belongs to the kuls. which do not accumulate starch, Inuli-sh contains up to 10-11% [4].

Outer dry scales, which are dried juicy scales, contain up to 25% of air-saturated fiber. Pectin substances are set aside up to 6%, protopectin predominates [23].

The water content in the juicy scales is §8-90% [23]; according to other sources, the moisture content of red onion varieties averages 85.6% [25].

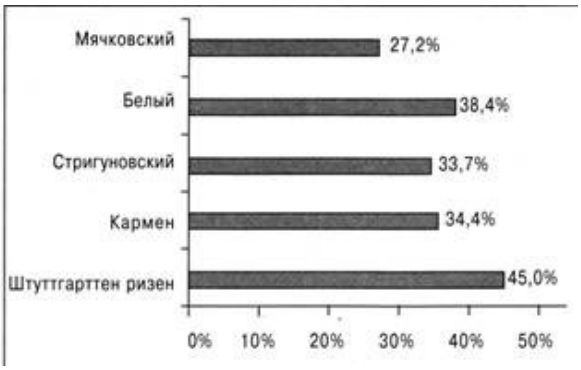
1.4. Amino acids

According to the literature, the amino acid composition of onions is very diverse: there are 7 essential amino acids (AA), a significant part of which are lysine, leucine, isoleucine, threonine, methionine and phenylalanine.Some researchers note a high content of gartamic acid, arginine, histidine, ala-vma, etc. tyrosine [17].

According to our HPLC data, various onion varieties mentioned in Section 1.2 contain the same set of 21 AAs, including 7 irreplaceable ones (tryptophan is absent), which coincides with the literature data. Comparative analysis of the AA composition in fresh onion bulbs made it possible to establish that the qualitative AA composition in the bulbs of different varieties is identical, but their quantitative content is different.

The quantitative content of the sum of free AA is from 56.6 to 100.5 mg / ml in terms of the volume of the supernatant (supernatant), depending on the onion variety. All varieties contain 7 irreplaceable AA, the total content of which is 35.4 mg / ml for the Stuttgarten variety, Riesen - 43.0 mg / ml, Strigunovsky - 36.0 mg / ml, White - 26.4 mg / ml , Myachkovsky - 32.4 mg / ml. The dominant essential AAs are threonine, lysine, and leucine. Their total amount in absolute terms ranges from 22.4-39.4 mg / ml, and threonine contains 18.0-30.8 mg / ml, lysine
- 2.8-5.3 mg / ml, leucine - 1.6-3.3 mg / ml.

The results of a comparative study of various varieties of onion in terms of the content of the sum of free irreplaceable AA as a percentage of the sum of all AA are presented in the diagram (Fig. 1).



Rice. 1. The results of a comparative study of various varieties of onions in terms of the content of the sum of free essential amino acids (in% of the sum of all AA)

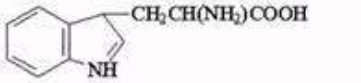
The results of studying the AA fraction after acid hydrolysis indicate that all studied onion varieties contain 21 AA in an amount from 30.5 to 79.5 mg / ml (in terms of the supernatant volume), among which 7 are irreplaceable. The total content of irreplaceable AA for the Stuttgarten rizen variety is 9.5 mg / ml,

Carmen - 9.7 mg / ml, Strigunovsky - 6.0 mg / ml, Dutch white - 6.0 mg / ml, Myachkovsky - 11.0 mg / ml of the sum of all AA, i.e. within the studied varieties, it ranges from 6.0 to 11.0 mg / ml. The dominant essential AAs are lysine, leucine, threonine. Their total amount ranges from 3.4 to 6.6 mg / ml, and lysine contains 1.3-3.4 mg / ml, leucine - 1.1-2.5 mg / ml, threonine - 0.9-1 , 9 mg / ml.

Thus, according to our data, the qualitative amino acid composition in the bulbs of various onion varieties is identical. There was a high content of replaceable AA - arginine (up to 7.7-28.6 mg / ml - depending on the variety) in fresh bulbs of all varieties of onions, which, probably, could explain the hypolipidemic effect of the raw material. The formulas of the discovered AK are summarized by us in table. 1.

Table 1

Formulas and symbols of amino acids found in raw onion and sowing garlic

NameAK	Abbreviated formula	Symbol AK
Alanin	$CH_3CH(NH_2)COOH$	Ala (A)
Valine	$(CH_3)_2CHCH(NH_2)COOH$	Val (V)
Leucine	$(CH_3)_2CHCH_2CH(NH_2)COOH$	Leu (L)
Isoleucine	$CH_3CH_2CH(CH_3)CH(NH_2)COOH$	Ile (I)
Phenylalanine	$C_6H_5CH_2CH(NH_2)COOH$	Phe (F)
Aspartic acid	$HOOCCH_2CH(NH_2)COOH$	Asp (D)
Glutamic acid	$HOOC(CH_2)_2CH(NH_2)COOH$	Glu (E)
Lysine	$H_2N(CH_2)4CH(NH_2)COOH$	Lys (K)
Arginine	$H_2NC(=NH)NH(CH_2)_3CH(NH_2)COOH$	Arg (R)
Threonine	$CH_3CH(OH)CH(NH_2)COOH$	Thr (T)
Tyrosine	$n\text{-}HOC_6H_4CH_2CH(NH_2)COOH$	Tyr (Y)
Methionine	$CH_3S(CH_2)_2CH(NH_2)COOH$	Met (M)
Histidine		His (H)
Tryptophan		Trp (W)

After completing the initiated studies of the AK-composition of fresh bulbs of various varieties of onions collected in different regions of Russia in different years, we plan to publish the results obtained in the journal Traditional Medicine.

1.5. Vitamins

Onions are a source of a large number of vitamins: provitamin A (- carotene) - up to 0.03 mg%; B vitamins, including B_1 -0.03 mg%, B_2 - 0.04 mg%, B_5 - 0.05 mg% [8], B_6, ascorbic acid - vitamin C (up to 30 mg / 100 g); vitamins D, E (up to 1 mg / 100 g), PP, vitamin U [1; 26]; folic acid (B_{nine}), especially green onions are rich in it. In a small amount (0.02 mg% [8]), biotin (vitamin H) is in the active state [6].

The content of - carotene in the green part of the onion is, according to some data [14], up to 2.0 mg / 100 g, according to others - up to 6.00 mg% [3; eight]. In fresh green leaves it accumulates up to

0.06 mg% biotin [8].

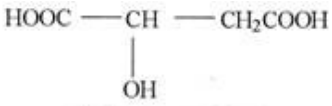
Information about the vitamins found in onions, we summarized in table. 2.

1.6. Macro and microelements

According to literature data, onions contain 18 chemical elements. The elemental chemical composition differs significantly in the bulb and the green part. Onion differs from other vegetables in a significant accumulation of sulfur, zinc (1.4-8.5 mg / 100 Y) and iron [6]. Bulbs contain ash - 3.47%, macronutrients (mg / g), including potassium - 22.30, calcium - 1.00, magnesium - 1.20, iron - 0.04; trace elements (mg / g), including manganese - 0.02, copper - 0.35, zinc - 0.24, chromium - 0.01, aluminum - 0.02, selenium - 5.00, nickel - 0, 06, lead - 0.01, boron - 0.40 μg / g. According to M, Ya, Lovkova et al, [13], onion is a selenium concentrator.

1.7. Organic acids

Like most other vegetables, onions contain mainly malic acid in the amount of 1.80% of dry matter, and citric acid - 0.48% [8].



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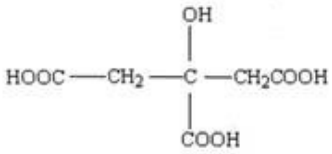

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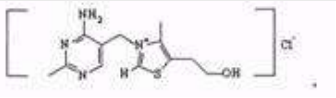
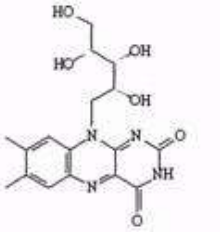
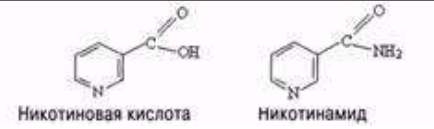
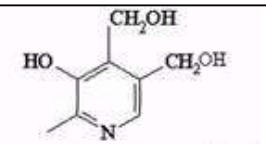
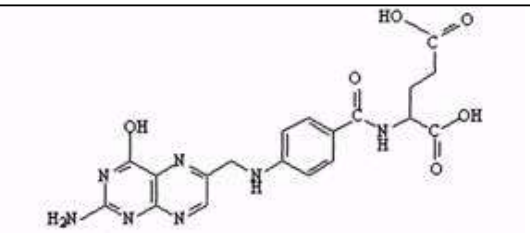
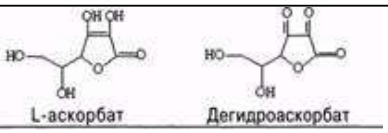
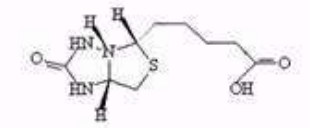
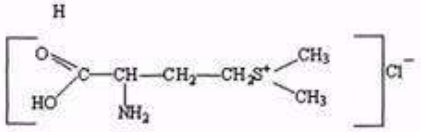
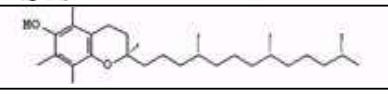
1.8. Various groups of biologically active substances

In addition to the biologically active substances described above, onions contain phytin - up to 2.5%, nitrogenous substances with hypotensive action, substances with hormonal action [36], steroid saponins, which also have a pronounced specific biological action.

With the help of qualitative and histochemical reactions, it was found that the composition of the milk juice of onions includes mono- and polysaccharides, incl. high polymer, mucus containing carbohydrates and nitrogenous substances; S-containing compounds, lipids, phosphorus-containing compounds, minerals (potassium), redox enzymes [9].

table 2

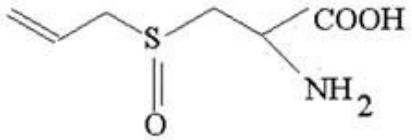
Vitamins found in the leaves and bulbs of onions and garlic

Vitamin (literal designation)	Name vitamin A	Structural formula
WATER-SOLUBLE VITAMINS		
IN 1	Thiamine	
IN 2	Riboflavin	
PP, B5	Nicotine acid, nicotinamide, niacin	
AT 6	Pyridoxine, pyridoxol	
B9, Sun	Folic acid, folacin	
WITH	Ascorbic acid	
N	Biotin	
R	Bioflavonoids	see above
U	Methylmethionine-sulfonium chloride	
FAT-SOLUBLE VITAMINS		
Provitamin A	--carotene	
E	RRR-b-tocopherol	

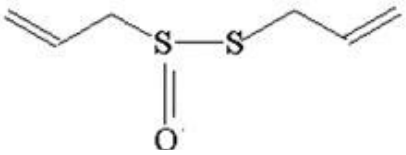
2. SEED GARLIC

2.1. Essential oil

Essential oil is contained in garlic bulbs in an amount of 7-100 mg / 100 g [19], and according to some sources, up to 0.4% [21]. The essential oil of garlic and onion is bound in cells and is released only after enzymatic digestion [8]. It is a complex mixture of reactive sulfur-containing compounds, mainly various sulfides, disulfides and trisulfides, which give the characteristic pungent and pungent smell of the essential oil. Most of the essential oil of garlic is excreted by the liver, kidneys, intestines and a small part - by the lungs and skin [36]. The sulfur-nitrogen-containing compound - alliin - makes up 0.3% of the weight of fresh raw materials, or about 65-75% of the total substances of the bulb [12; thirty; 31; 32]. In its pure form, alliin is a crystalline substance, easily soluble in water, odorless, does not possess bactericidal properties, it is quite stable. Under the action of the enzyme allinase, which is in the same tissues of the bulb, alliin is rapidly degraded when it is crushed. From 2 residues of alliin molecules, 1 allicin molecule (diallyl disulfide S-oxide) is obtained.

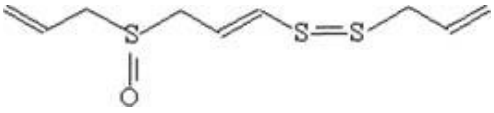


Аллиин



Allicin

Allicin is a volatile phytoncide [15] and has a very strong antibacterial effect - it inhibits the growth of bacteria at a dilution of 1: 125,000 [5; 36]. A large number of studies have been carried out on allicin and various garlic thiosulfates, as well as raw materials of other species of the genus Allium [32]. Allicin is an extremely reactive compound and immediately turns into a number of active compounds, one of which is ajoene:



Ajoen

Ajoene - 2-propenyl-3 [3- (2-propenylsulfinyl) -1-propenyl] disulfide - is considered one of the most active components of garlic extractives [18]. Ajoene is not present in whole garlic bulbs, but is formed in a homogenate or extract as a result of allicin decomposition [19]. It was first discovered in garlic extract in 1984; has a number of biological effects (see publication 3). The group of analogs and isomers of ajoene formed in the course of secondary reactions includes isoadjoene,

characterized by the position of the C = C double bond in the molecule.

Garlic bulbs contain fatty oil - up to 0.06% [13].

2.2. Vitamins

The bulbs of garlic contain vitamins: ascorbic acid - vitamin C (up to 30 mg%) [21], provitamin A [26; 36], vitamins of group B - B_1, V_2 - 0.16-0.21 mg% [2]; E; PP - 1.0-2.0 mg / 100 g [1; 19; 36]; biotin (vitamin H) - up to 0.02 mg% [8].

2.3. Amino acids and proteins

Proteins add up. 6.5-8.0% of the mass of fresh garlic and contain 17 amino acids, of which 7 are essential - lysine, threonine, valine, isoleucine, leucine, phenylalanine, methionine [19]. Tryptophan or isoleucine may be absent in different varieties of garlic [19].

Chinese scientists isolated two selenium-containing proteins from garlic, the hydrolysis of which made it possible to find Se-methionine and Se-cysteine in them. Thus, selenium-rich garlic can serve as a source of selenium in food [19].

According to our data obtained by HPLC, garlic contains a set of amino acids presented in table. 3 and 4.

Table3

Free amino acid content in fresh garlic bulbs

Name AK	Content in raw material (mg / ml)
X	0.75
XI	1.21
X2	0
Asp	4.56
Thr	48.90
Ser	13.90
Glu	21.20
Pro	18.60
Gly	2.90
Ala	9.56
Cys	6.14
Val	8.44
Met	1.75
He	3.02
Leu	5.76
Tyr	9.49
Phe	8.67
OH-Lys	0.84
Orn	1.17
Lys	20.90
EA	1.66
NH3	69.20
His	5.97
Arg	108,00
Sum	373,00

The results of studying the amino acid fraction after acid hydrolysis indicate that fresh garlic bulbs contain a set of 21 amino acids in

the amount of 478.5 mg / ml in terms of the volume of the supernatant, among which 7 are irreplaceable (no tryptophan). The total content of essential AA is 131.32 mg / ml.

The results of studying the free AA-fraction of fresh garlic bulbs indicate that they contain 21 free AA. The quantitative content of free AA is 299.85 mg / ml in terms of the volume of the supernatant. There are 7 irreplaceable AAs (no tryptophan), the total content of which is 97.34 mg / ml.

It should also be noted that garlic bulbs are extremely high in arginine. The quantitative content of free arginine, as well as arginine after acid hydrolysis of protein in fresh garlic and onion bulbs, is shown in the diagrams (Fig. 2 and 3).

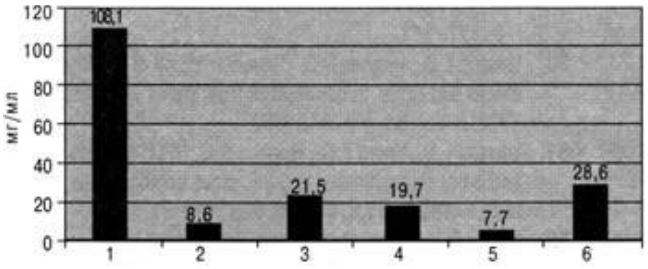
The diagrams show that the arginine content of garlic bulbs is about 12-15 times higher than that of onion bulbs. In the studied onion varieties, the arginine content decreases in the following order: Myachkovsky, Carmen, Strigunovsky, Stuttgarten rizen, Gollandsky white.

Comparative analysis of the AA composition of fresh garlic bulbs showed the presence of a wide range of free AA and AA after acid hydrolysis and made it possible to establish that the qualitative AA composition in the bulbs is identical, but their quantitative content is different.

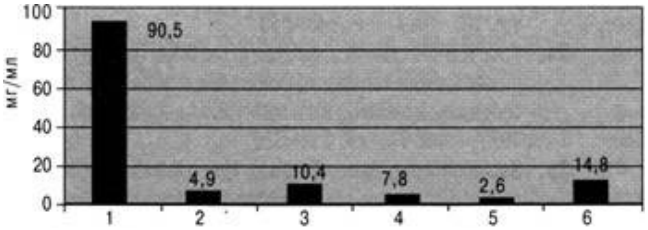
Table 4

Amino acid composition of garlic bulbs after acid hydrolysis

Name AK	Content in raw materials (mg / ml)
Asp	52.40
Thr	16.80
Ser	24.30
Glu	85.00
Pro	24,80
Gly	30.50
Ala	27.20
Cys	0.68
Val	28.60
Met	3.12
He	14.00
Leu	25.50
Tyr	2.21
Phe	12.00
OH-Lys	0.45
Orn	1.13
Lys	31.30
NH3	91.50
His	7.90
Arg	90.50
Sum	570,00



Rice. 2. Content of free arginine in fresh garlic and onion bulbs:1 - garlic; 2 - Stuttgarten Riesen; 3 - Carmen; 4 - Strigunovscue; 5-Dutch White; 6 - Myachkovsky



Rice. 3. The content of arginine in the amino acid fraction of fresh onion bulbs onions and garlic after acid hydrolysis:
1 - garlic; 2 - Stuttgarten Riesen; 3 - Carmen; 4 - Strigunovsky; 5 - Dutch white; 6 - Myachkovsky

2.4. Carbohydrates

Fresh raw garlic contains pentonases [19], sugar - 20-27% [21], pectin substances [19], inulin - 12-22%, fiber - 0.7% [21].

2.5. Macro and microelements

Bulbs contain up to 1.0% of minerals [19]; of which macronutrients (mg / g), including potassium - 18.40; calcium - 0.50; magnesium - 1.00; iron -0.04, phosphorus; as well as trace elements, including manganese - 0.03; copper - 0.35; zinc - 0.41; selenium - 3.33; nickel - 0.04; lead - 0.02; boron - 0.90 μg / g [13; 26], 100 g of garlic contains about 320 mg of phosphorus in terms of absolutely dry matter [7; 19; 21].

2.6. Various groups of biologically active substances

Enzymes, mucous substances [36], substances with hormone-like action (phytosterols) [12; 21, 36]; there are prostaglandins [28], saponins [28], flavonoids, nitrogenous compounds, organic acids, antibiotics [19]. Dry matter contains 36-43%, moisture - 57-64% [19].

The green leaves of garlic contain a large amount of nitrogenous substances,pectin substances, vitamins of group B, PP [21], vitamin C (up to 280 mg / 100g) [19]. Contains macronutrients - potassium, calcium, magnesium, iron; trace elements - manganese, copper, zinc, selenium, nickel, lead [21].

Thus, the wide range of biological effects of onions and garlic can be largely due to their diverse chemical composition. In our next publication, we will present some results of studying the mechanisms of action of biologically active substances, raw materials and preparations of common garlic and onion.

LITERATURE

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