Alpinia officinalis (Alpinia officinarum) in traditional medicine and modern medical and pharmaceutical practice. Publication 2: chemical composition and biologically active substances, causing pharmacotherapeutic action

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Alpinia medicinal (Alpinia officinarum) in traditional medicine and current medical and pharmacological practice. Article 2: Chemical composition and biologically active compounds responsible for pharmacological activity

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SUMMARY

The present information-analytical research dedicated to objectification modern concepts of the chemical composition of the rhizomes of Alpinia officinarum Hance. The results of phytochemical studies were revealed, confirming the presence of a rich polyphenolic complex, in particular flavonoids (including galangin) and diarylheptanoids, as the main groups of biologically active substances responsible for the anticancer effect. Analysis of data on terpenoids and other volatile compounds of the rhizomes of alpinia officinalis, as well as on derivatives of hydroxycinnamic acids (phenylpropanoids) and phytosterols made it possible to establish the presence of varietal differences in the chemical composition of the plant.

A wide range of biologically active substances can presumably determine various types of biological activity and pharmacotherapeutic action of various extracts (extracts) from the rhizomes of alpinia officinalis. The carried out information-analytical study allows us to consider it expedient to continue the work in terms of objectifying the data and systematizing information about the correlation between the chemical structure and the spectrum of biological activity of individual compounds and groups of biologically active substances, as well as about the mechanisms of their action.

Key words: alpinia officinalis, Alipinia officinarum, phytochemistry, phenolic compounds, flavonoids, diarylheptanoids (DAG), tannins, terpenoids.

RESUME

This analytical research presents current, evidencebased data on the chemical composition of Alpinia officinarum Hance roots. It is elicited that the root is rich with polyphenol complex with anticancer properties, specifically, flavonoids including galangin and diarylheptanoids. The data analysis of the root for terpenoids and other evaporated compounds as well as phenylpropanoids and phitosterins result in detection of the differences in chemical composition in different types of Alpinia officinarum Hance root.

The diversity in biological activity and pharmacological implementation can be due to a wide range of polyphenols extracted from the root of Alpinia officinarum Hance. This work suggests that it is a course of scientific research worth pursuing to identify the correlation between the chemical composition and biological activity of specific polyphenols as well as its mechanisms of action.

Keywords: Lesser galangal, Alipinia officinarum, Phytochemistry, Phenolic compounds, Flavonoids, Diarylheptanoid (DAH), Tannins, Terpenoids.

INTRODUCTION

This work continues the series of publications devoted to alpinia officinalis -Alpinia officinarum. Previously, we have already presented materials related to the characteristicsthe object of research in terms of botanical features, synonymy and traditions of food use of alpinia officinalis [2]. This publication is about learning the chemical composition of the plant and the search for biologically active substances (BAS) that determine its pharmacotherapeutic action.

In domestic (even in professional, or special) literature [1, 9], as well as in proliferating "phytotherapeutic" reference books (of varying degrees of reliability) on the Internet, data on the chemical composition of alpinia officinalis are usually presented in a very generalized manner. In particular, it is reported that fresh rhizomes contain an essential oil (0.6-1.0%), consisting of sesquiterpenes and sesquiterpenes alcohols, cineole and eugenol, with a camphor, spicy smell, reminiscent of the smell of cardamom and myrtle [1, 5, 6 , 9, 13].

In addition to cineole and eugenol, the essential oil contains α-pinene, methyl cinnamate [1, 9], cis- and trans-ethyl cinnamate, cis- and trans-p-methoxyethyl cinnamate, 1,8-cineole, eugenol, borneol, 3-carene, p-methoxystyrene, anisic aldehyde, camphene, p-cymene, α- and β-pinenes, limonene, terpinen-4-ol, α-terpineol, β-felllandrene, eucarvone, bornyl acetate, β-elemene, α-terpinyl acetate, pentadecane, and other substances [13].

Of the sesquiterpenes in essential oil are described: sesquiterpene (α-cadinene) [9], γ-cadinene [13], it also contains sesquiterpene alcohol [9] and it is reported that the essential oil and the resin it contains (about 5%) have a burning taste [5, 6].

The flavonoid fraction contains galangin, O-methylgalangin, quercetin, O-methylquercetin, methyl ether and other derivatives of kaempferol, kaempferid, isorhamnetin, rhamnocitrin, 7-hydroxy-3,5-dimethoxyflavone) [1, 5, 6, 9].

In addition, the rhizomes contained curcumin, dihydrocurcumin, hexahydrocurcumin, octahydrocurcumin, ketones - derivatives of 1,7-diphenylheptanone, as well as stigmasterol-O-β-D glucopyranoside and camposterol-O-β-B-glucopyranoside [9]. In addition, the composition of rhizomes includes starch (up to 33%), resin (about 5%), tannins (about 1%) [5, 6, 13].

In the available domestic literature, we were unable to find data on the study of the chemical composition and pharmacotherapeutic action of individual fractions isolated from the rhizomes of medicinal alpinum using solvents of different polarity, although this plant is increasingly used in our country as a food and in the composition of medicines and dietary supplements for food. At the same time, numerous foreign studies are devoted to the phytochemical study of rhizomesA. officinarum, especially those groups of biologically active substances that contributean important contribution to the pharmacotherapeutic action of this plant - carbohydrates, flavonoids, sterols, proteins, triterpenes and tannins [39, 64]. To date, more than 90 phytochemical components have been identified, many of which determine the widest spectrum of biological activity of this plant [10].

The purpose of this information and analytical study is to objectifyup-to-date information on the chemical composition Alpinia officinarum and spectrum-determining BASbiological activity of the plant.

MATERIALS AND METHODS

The objects of the research were normative documents recommended for use in the prescribed manner, and bibliographic sources of a high degree of reliability, including monographs, scientific periodicals, reference books, dissertations, dissertation abstracts, as well as electronic scientific and official databases. We also took into account Internet resources with links to bibliographic sources of a high degree of reliability.

When performing the work, the following research methods were used: information and analytical, historical, content analysis, systematization.

Keyword search including A. officinarum and synonyms were carried out usingelectronic databases, including ISI, Science direct, Scopus, PubMed, Google Scholar and a database of defended dissertations.

Conventional medical terms are quoted either in quotation marks, in italics, or in capital letters, in accordance with the conventions generally accepted in various traditional medical systems.

1. Results of studying macro-

and micronutrient composition of alpinia medicinal rhizome extract Macronutrients.

Phytochemical and pharmacognostic study carried out inSaudi Arabia in order to confirm and objectify the antitumor activity on standardized substances from the rhizomes of a. medicinal [11], made it possible to establish in the ethanol extract (95% ethanol) rhizomes a high content (in%) of carbohydrates (20.25 ± 1.11) and proteins (18.26 ± 1.24) with a relatively low content of lipids (15 , 15 ± 0.13) (Table 1).

To obtain the investigated substance of the rhizome Alpinia officinarum Hance were acquired by the authors [11] in the so-called Herbal shops in Al-Kharj (Saudi Arabia), then identified by Dr. J. Thomas, a taxonomist at King Saud University. The rhizomes were dried, ground into powder, and extracted with 95% ethanol by percolation until depletion for 2 days according to the method [20]. Then it was filtered through a cotton filter and evaporated using a rotary evaporator at 25 ° C to a predetermined volume [19].

The content of macronutrients and nutritional value were determined according to standard methods, which are referenced in [11]: the content of proteins [68], fats [70] and carbohydrates [35, 36]. The results are presented in table. 1.

Micronutrients. According to the same researchers, the content of micronutrients inethanol (95%) extract of rhizomes was: tannins 20.17 ± 1.11, phenols 2.71 ± 1.13, flavonoids 5.10 ± 1.01 [11].

The content of micronutrients was determined according to standard methods, which are referenced in [11]: the content of phenols, including polyphenols, as an equivalent of gallic acid — according to [57, 68], tannins — according to [61, 65], flavonoids — according to [36]. The results are presented in table. 1.

Macro and microelements. Atomic absorption spectrometry in ethanol (95%) rhizome extract revealed a high potassium content - 3570 ppm (ppm), more than 23 times higher than the sodium content (152.8 ppm) [11], which allows us to consider a. medicinal potassium concentrator. The analysis of macro- and microelements was carried out by researchers according to [57]. The results are presented in table. 1.

Pharmacopoeial quality indicators. Numerical indicators of ethanol (95%) of the rhizome extract was determined according to standard methods, which are referenced in [11]: total ash content - according to [70], ash insoluble in hydrochloric acid - according to [11], water-soluble ash - [12] , humidity - according to [14]. The results are presented in table. 1.

Table 1

Phytochemical and pharmacopoeial numerical indicators (average of 3 determinations), characterizing the substance from the rhizomes a. medicinal, obtained with 95% ethanol (according to [11])

Phytochemical group BAS	Quantitative content, %	Chemical element	Quantitative content, ppm (ppm)
Squirrels	18.16 ± 1.04	K	3570
Carbohydrates	16.87 ± 1.09	Na	152.8
Lipids (fats)	15.15 ± 0.13	Ca	438.8
Phenols	2.71 ± 1.13	Mg	569.5
Tannins	20.17 ± 1.11	Fe	85.50
Flavonoids	5.10 ± 1.01	Cu	0.753
		Zn	9,331
Pharmacopoeial numbers,%		Mn	72.30
Humidity	11.02 ± 1.05	Ni	21.02
Ash total	5.64 ± 1.31	Cr	0.680
Ash insoluble in HCl	2.01 ± 1.12		
Ash, soluble in water	3.11 ± 1.01		

2. The results of the study of various groups of biologically active substances that determine the pharmacotherapeutic effect of rhizomes of alpinia officinalisNumerous

studies of both extracts and individual compounds in vitro and in vivo indicate a wide variety of biologically active substances a. medicinal, causing a widea spectrum of pharmacotherapeutic action, including anti-inflammatory, antibacterial, antioxidant, anti-obesity, anti-tumor, inhibiting enzymes and nitric oxide production, as well as unique antiviral properties [21, 64, 81]. Modern concepts of biological activity and pharmacotherapeutic action of rhizomes a. medicinal, as well as the possibility of using its drugs in the global medical and pharmaceutical practice will be detailed in our next publication [3].

Attempts at a phytochemical study of a. medicinal with the aim of detecting both specific groups of biologically active substances and individual compounds that reliably determine the pharmacotherapeutic action, have been undertaken many times [21, 42, 89].

Modern foreign phytochemical studies have revealed the presence of flavonoids [31, 89], diarylheptanoids (DAG) [44, 83], terpenes, essential oil and other volatile compounds [81, 89], glycosides and phenylpropanoids [54–56], as well as DAG adducts with terpenes [21, 48], demonstrating experimentally anti-inflammatory, antioxidant, antiproliferative, antitumor, antiemetic, and some other types of action [42, 89].

In particular, a group of researchers from Brunei (University of Brunei Darussalam) [21] analyzed various groups of biologically active substances and fractions obtained using extractants of different polarity from different parts of the plant (leaves, roots, rhizomes, aerial parts) in order to study the chemical composition and biological activity of extracts. Extraction was carried out with various solvents (methanol, ethanol, ethyl acetate, hexane, dichloromethane, water, chloroform, petroleum ether) using adequate methods: maceration, percolation, ultrasonic extraction and in a Soxhlet apparatus, etc. -solvent "[21]. The most promising (in terms of biological activity) ethanol and methanol extracts were also studied [29, 71, 75, 85].

Chinese researchers [81] studied the chemical composition of extracts of rhizomes of a. medicinal product obtained using supercritical carbon dioxide (CO_2).

Another group of Chinese phytochemists studied varietal differences a. medicinal in the chemical composition of volatile components [50].

Most researchers agree that, in spite of attempts at phytochemical resource-saving studies of ground plant parts, a higher percentage of practically the entire spectrum of biologically active substances is still found in rhizomes [21, 85].

Below is the characteristic of the main groups of biologically active substances isolated with the help of various extractants, which, according to researchers, can most likely be responsible for various types of biological activity of rhizomes and some other parts of a. medicinal.

2.1. Phenols: flavonoids, diarylheptanoids, phenylpropanoids

Using LC-mass spectrometry (MS) / MS in a methanol extract of A.officinarum has been identified 16 compounds represented by 12 flavonoids and 4 diarylheptanoids (DAG) [21, 75] (Fig. 1). In another study in methanol extracts from rhizomes and aerial organs of a 3-year-old plantA. officinarum has been identified 17 flavonoid and DAG compounds [85] (Fig. 1).

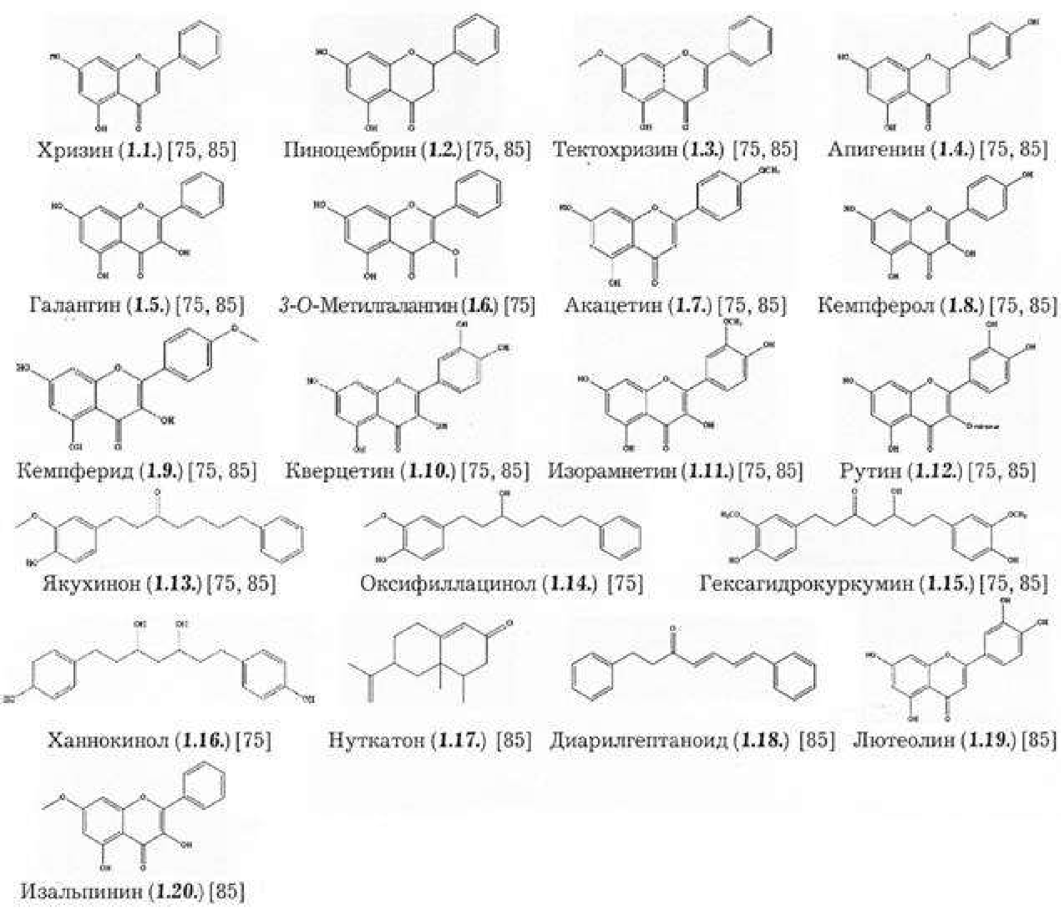
Flavonoid fraction of rhizomes A. officinarum studied [21, 75], contained chrysin (1.1.), pinocembrin (1.2.), Tectochrysin (1.3.), Apigenin (1.4.), Galangin (1.5.), 3Omethylgalangin (1.6.), acacetin (1.7.), Kaempferol (1.8.), Kaempferide (1.9.), Quercetin (1.10.), Isorhamnetin (1.11.) And rutin (1.12.) [21, 75] (Fig. 1).

The flavonoid fraction obtained [86] by purifying the ethanol extract of rhizomes using macroporous adsorption resins [24] contained 5 flavonoids, which were identified as 1.2., 1.5., 1.6., 1.9. (rice.1) and 5.2. (rice.5).

When carrying out extraction with 50% ethanol by hot or cold maceration, it was obtained, respectively, 2 extracts with antibacterial and antioxidant activity. The first of them contained significantly more phenol and flavonol than the second [71].

Ethanol extract A. officinarum (95% ethanol, infusion at 70 ° C for 6 hours) also had a higher total phenol and flavonoid content than aqueous extract [66].

Polyphenols, in particular flavonoids A. officinarum (Fig. 1) aroused the interest of a number of researchers [21, 75, 85] due to their proven antioxidant effect and ability to absorb reactive oxygen species (ROS) [63]. In particular, galangin (1.5. - rice.1), isolated from the rhizomes of a. medicinal [78, 84].



Rice. 1. Biologically active compounds identified
in the methanol fraction of rhizomes and above-ground Alpiniae officinarum (according to [21, 75, 85])

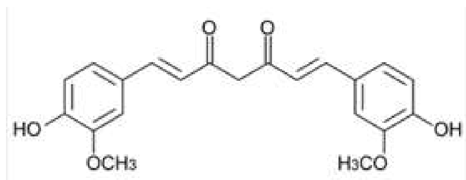
In general, flavonoids (aglycones and their glycosides) identified in various members of the genus Alpinia exhibit significant and varied biological activities.A total of 25 flavonoid compounds are known in plants of this genus [84].

The results of information and analytical research, dedicated study biological action of rhizome flavonoid fractions a. medicinal, we presented in the next publication [3].

Fraction DAG. Diarylheptanoids, or diphenylheptanoids (DAH,DAH, diarylhep-tanoids) - a group of naturally occurring plant phenols [48], consisting of two aryl rings linked by seven carbon atoms (heptanes), which can be acyclic (linear) or cyclic [52, 53]. This is a group of secondary metabolites on the pathway of polyketide synthesis, that is, “has the potential for the formation of natural products, with a special characteristic of carrying the 1,7-diphenylheptane skeleton” [52, 53]. Based on the characteristic structure of the 1,7-diphenylheptane nucleus, DAGs exhibit tremendous structural diversity as a result of intramolecular cyclization, polymerization, compounds with various functional groups, and hybridization [48].

The best known example is linear DAG curcumin from turmeric rhizomes(Curcuma longa L., Zingiberaceae) (Fig. 2), which was also isolated from other members of the Ginger family.

Curcumin, derived from turmeric, passed Phase II clinical trials in 2018 for the treatment of pancreatic cancer. Recent pharmacological studies have shown that curcumin also has therapeutic potential in the prevention or treatment of a number of neurological diseases [48] and has a pronounced antiviral activity [8].



Rice. 2. Curcumin (linear DAH)

DAGs are mainly distributed in the roots, rhizomes and bark of 4 species of this family - Alpinia, Zingiber, Curcuma and Alnus. For the lastFor 40 years, a number of studies of natural DAHs have been carried out in connection with their unique anticancer, antiemetic, estrogenic, antimicrobial, antioxidant, and neuroprotective activity [47, 52, 53].

Phytochemical studies have shown that diarylheptanoids are the main compounds in the genus Alpinia of more than 100 diarylheptanoids, including 5 characteristic subtypes: linear diarylheptanoids, cyclic diarylheptanoids, dimeric-diarylheptanoids, chalcone / flavanone-diaryl-heptanoids, new-found diaryl-heptanoids. Linear diaryl heptanoids and chalcone / flavanone diaryl heptanoids are the most common diaryl heptanoids of this genus. All of these compounds have the same characteristic skeleton of two aromatic rings linked by a heptane chain. Their structures are shown in Fig. [2–7], and their detailed names are listed in Table. 2.

Phytochemical studies have shown that DAHs are the main group of biologically active substances of the genus Alpinia.To date, more than 100 DAGs of five subtypes have been found in various morphological groups of raw materials from different representatives of this genus: linear, cyclic, dimeric, chalcone / flavanone-DAG and new DAGs, with linear and chalcone / flavanone-DAG being the most common compounds. All of these compounds have the same characteristic skeleton of two aromatic rings linked by a heptane chain.

According to Zhang W.-J. et al. (2016), out of 122 DAHs identified in various morphological groups of raw materials from different representatives of the genusAlpinia, in the rhizomes of a. medicinalSo far, 35 DAGs have been identified and 1 in seeds [84] (Table 2), although other DAGs isolated from this plant and presented in this work are known from a number of bibliographic sources. We pay special attention to this group of biologically active substances, since today DAGs are considered the most active compounds a. medicinal [10].

A series of works devoted to the study of DAG A. officinarum, was started in Japan back in 80s of the last century [22, 23, 32, 33, 76]. The plant used in traditional Chinese recipes for gastrointestinal action attracted the interest of Japanese researchers due to the fact that the hexane and chloroform fractions from its rhizomes inhibited the contractions of the ileum of guinea pigs caused by histamine and barium chloride [32]. In 1981 from rhizomesA. officinarum, two new and two known DAHs were isolated, presumably responsible forthis type of activity. Based on spectral data and chemical correlation, the structure of the new compounds was determined as 1,7-diphenylhepto-4-en-3-one (3.1.) And 7- (4 ›-hydroxy-3› -

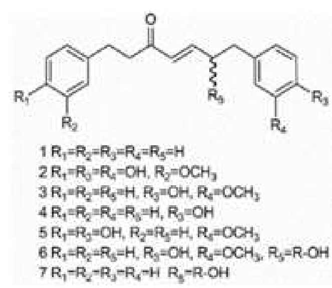
methoxyphenyl) -1-phenylhepto-4-en-3 (3.3.) [32] (Fig. 3).

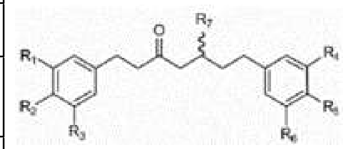
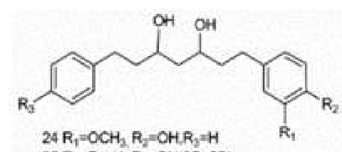
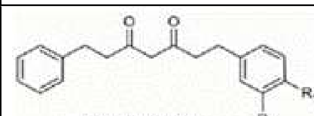
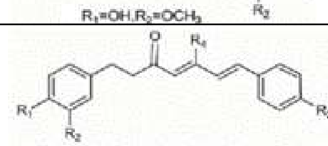
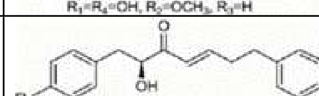
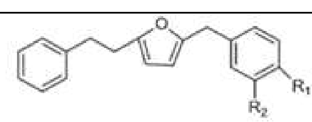
1 : $R_1=R_2=H$ 2 : $R_1=R_2=H$
3 : $R_1=OH$, $R_2=OMe$ 4 : $R_1=OH$, $R_2=OMe$

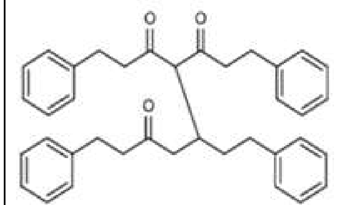
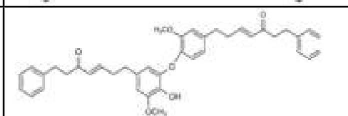
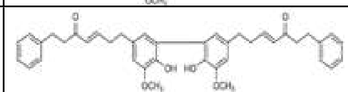
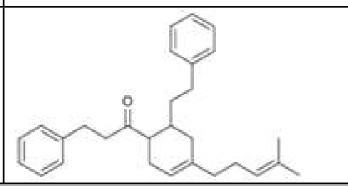
Rice. 3. Diarylheptanoids of rhizomesA. officinarum inhibiting ileal contractionguinea pigs caused by histamine and barium chloride (according to [32]): No. 1 - 3.1., No. 2 - 3.2., No. 3 - 3.3., No. 4 - 3.4.

table 2

DAGs identified in rhizomes A. officinarum (according to [84])

No.	Chemical name		Bible. ist.	Formula
	In Russian	International		
	Linear DAG			
1.	(4 E) -1,7-diphenyl-4-ene-3-heptanone	(4 E) -1,7-diphenyl-4-en-3-heptanone	[46]	
2.	(4 E) -7- (3,4-dihydroxylphenyl) - 1- (4-hydroxyl-3-methoxyphenyl) -4-ene-3-heptanone	(4 E) -7- (3,4-dihydroxylphenyl) -1- (4-hydroxyl-3-methoxyphenyl) -4- en- 3-heptanone	[17]	
3.	7- (4-hydroxyl-3-methoxyphenyl) - 1-phenyl-4-en-3-heptanone	7- (4-hydroxyl-3-methoxyphenyl) - 1-phenyl-4-en-3-heptanone	[46]	
4.	7- (4-hydroxylphenyl) -1-phenyl-4-ene-3-heptanone	7- (4-hydroxylphenyl) -1-phenyl-4-en- 3-heptanone	[46]	
5.	(E) -7- (4-hydroxy-3-methoxyphenyl) -1- (4-hydroxyphenyl) hept-4-en-3-one	(E) -7- (4-hydroxy-3-methoxyphenyl) - 1- (4-hydroxyphenyl) hept-4-en-3-one	[73]	
6.	(4 E, 6 R) -6-hydroxy-7- (4-hydroxy-3-methoxyphenyl) -1-phenyl-4-ene- 3-heptanone	(4 E, 6 R) -6-hydroxy-7- (4-hydroxy-3-methoxyphenyl) -1-phenyl-4-en-3heptanone	[72]	
7.	(4 E, 6 R) -6-hydroxy-1,7-diphenyl- 4-en-3-heptanone	(4 E, 6 R) -6-hydroxy-1,7-diphenyl-4-en-3-heptanone	[72]	
eight.	(R) -5-hydroxy-7- (4-hydroxy-3-methoxyphenyl) -1-phenyl-3-heptanone	(R) -5-hydroxy-7- (4-hydroxy-3-methoxyphenyl) -1- phenyl-3-heptanone	[73]	
nine.	(5 R) -1,7-diphenyl-5-hydroxy-3-heptanone	(5 R) -1,7-diphenyl-5-hydroxy-3-heptanone	[eighteen]	
ten.	(5R) -1- (3,4-dihydroxyphenyl) - 5-hydroxy-7- (4-hydroxy-3-methoxyphenyl) 3-heptanone	(5R) -1- (3,4-dihydroxyphenyl) -5-hydroxy-7- (4-hydroxy-3-methoxyphenyl) 3-heptanone	[17]	
eleven.	(5S) -7- (3,4-dihydroxyphenyl) - 5-hydroxy-1-phenyl-3-heptanone	(5S) -7- (3,4-dihydroxyphenyl) -5-hydroxy-1-phenyl-3- heptanone	[17]	

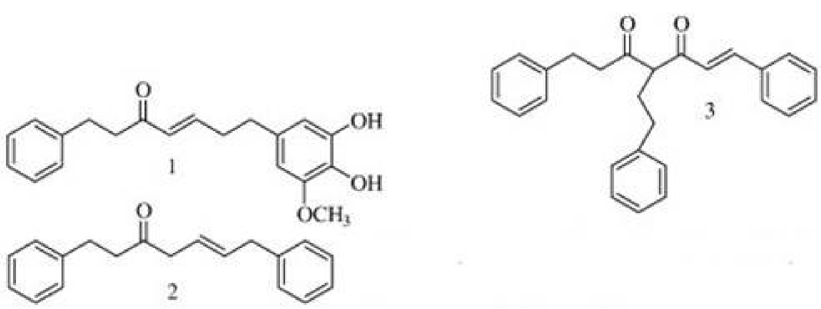
12.	(5R) -1- (4-hydroxy-3-methoxyphenyl) -5-hydroxy-7- (4-hydroxyphenyl) 3-heptanone	(5R) -1- (4-hydroxy-3-methoxyphenyl) -5-hydroxy-7- (4-hydroxy phenyl) 3-heptanone	[69]	 8 $R_1=R_2=R_3=R_4=H, R_5=OH, R_6=OCH_3, R_7=R\text{-}OH$ 9 $R_1=R_2=R_3=R_4=R_5=R_6=H, R_7=R\text{-}OH$ 10 $R_1=R_4=H, R_2=R_3=R_5=OH, R_6=OCH_3, R_7=R\text{-}OH$ 11 $R_1=R_2=R_3=R_4=H, R_5=R_6=OH, R_7=S\text{-}OH$ 12 $R_1=OCH_3, R_2=OH$, R3$=R_4=R_5=H, R_5=OH, R_7=R\text{-}OH$ 13 $R_1=R_4=H, R_2=R_5=OH, R_3=R_6=$OCH3, $R_7=OH$ 14 $R_1=R_2=R_3=R_4=R_6=H, R_5=OH, R_7=R\text{-}OH$ 15 $R_1=R_2=R_3=R_4=R_6=H, R_6=OH, R_7=S\text{-}OH$ 16 $R_1=R_3=R_4=H, R_2=OH, R_5=OH, R_6=OCH_3, R_7=S\text{-}OH$ 17 $R_1=R_3=R_4=H, R_2=OH, R_5=OH, R_6=OCH_3, R_7=R\text{-}OH$ 18 $R_1=R_2=R_3=R_4=R_5=R_6=H, R_7==S\text{-}OCH_3$ 19 R1=R2=R3=R4=R6=H,R5=OH,R7=S-OCH_3 20 $R_1=R_2=R_3=R_4=H, R_5=OH, R_6=OCH_3, R_7=R\text{-}OCH_3$ 21 $R_1=R_4=H, R_2=R_5=OH$,R3=R6=OCH_3,R7=S-OCH_3 22 $R_1=R_2=R_3=R_4=R_6=H$,R5=OH,$R_7=S\text{-}OAc$ 23 $R_1=R_4=R_5=R_6=R_7=H, R_2=OH, R_3=OCH_3$
13.	1,7-bis (4-hydroxy-3-methoxyphenyl) -5-hydroxy-3-heptanone	1,7-bis (4-hydroxy-3-methoxyphenyl) -5-hydroxy-3-heptanone	[33]	
fourteen.	(R) -5-hydroxy-7- (4-hydroxyphenyl) -1-phenylheptan-3-one	(R) -5-hydroxy-7- (4-hydroxyphenyl) -1-phenylheptan-3-one	[37]	
15.	(S) -5-hydroxy-7- (4-hydroxyphenyl) -1-phenylheptan-3-one	(S) -5-hydroxy-7- (4-hydroxyphenyl) -1-phenylheptan-3-one	[73]	
16.	(5S) -1- (4-hydroxyphenyl) - 5-hydroxy-7- (4-hydroxy-3-methoxyphenyl) 3-heptanone	(5S) -1- (4-hydroxyphenyl) -5-hydroxy-7- (4-hydroxy-3 -methoxyphenyl) 3- heptanone	[73]	
17.	(5R) -1- (4-hydroxyphenyl) - 5-hydroxy-7- (4-hydroxy-3-methoxyphenyl) 3-heptanone	(5R) -1- (4-hydroxyphenyl) -5-hydroxy-7- (4-hydroxy- 3-methoxyphenyl) 3-heptanone	[69]	
eighteen.	(5S) -1,7-diphenyl-5-methoxy-3-heptanone	(5S) -1,7-diphenyl-5-methoxy-3-heptanone	[73]	
19.	(S) -7- (4-hydroxyphenyl) - 5-methoxy-1-phenylheptan-3-one	(S) -7- (4-hydroxyphenyl) -5-methoxy-1-phenylheptan-3-one	[73]	
twenty.	(R) -7- (4-hydroxy-3-methoxy phenyl) -5-methoxy-1-phenylheptane 3rd	(R) -7- (4-hydroxy-3-methoxy phenyl) -5-methoxy-1-phenylheptan-3-one	[73]	
21.	(S) - 7- (4-hydroxy-3-methoxyphenyl) - 1- (4-hydroxyphenyl) -5-methoxyheptan-3-one	(S) -7- (4-hydroxy-3-methoxyphenyl) - 1- (4-hydroxyphenyl) -5-methoxyheptan-3-one	[73]	
22.	5 (S) -acetoxy-7- (4-dihydroxyphenyl) -1-phenyl-3-heptanone	5 (S) -acetoxy-7- (4-dihydroxyphenyl) -1-phenyl-3-heptanone	[16]	
23.	1- (4-hydroxy-3-methoxyphenyl) - 7-phenylheptan-3-one	1- (4-hydroxy-3-methoxyphenyl) -7-phenylheptan-3-one	[38]	
24.	1- (4-hydroxy-3-methoxyphenyl) - 7-phenyl-3,5-heptanediol	1- (4-hydroxy-3-methoxyphenyl) -7-phenyl-3,5-heptanediol	[69]	 24 $R_1=OCH_3, R_2=OH, R_3=H$ 25 $R_1=R_3=H, R_2=OH$(3S, 5S) 26 $R_1=R_2=R_3=H$(3R, 5R) 27 $R_1=OCH_3, R_2=R_3=OH$¡¡
25.	(3S, 5S) -1- (4-hydroxyphenyl) - 7-phenyl-3,5-heptanediol	(3S, 5S) -1- (4-hydroxyphenyl) -7-phenyl-3,5-heptanediol	[69]	
26.	(3R, 5R) -1- (4-hydroxy-3-methoxyphenyl) -7-phenyl-3,5-heptanediol	(3R, 5R) -1- (4-hydroxy-3-methoxyphenyl) -7-phenyl-3,5-heptanediol	[73]	
27.	1- (4-hydroxyphenyl) -7- (4-hydroxy-3-methoxy-phenyl) -3,5-heptanediol	1- (4-hydroxyphenyl) -7- (4-hydroxy-3-methoxy-phenyl) -3,5-heptanediol	[88]	
28.	1- (4-hydroxy-3-methoxyphenyl) - 7-phenylheptane-3,5-dione	1- (4-hydroxy-3-methoxyphenyl) -7-phenylheptane-3,5-dione	[38]	 $R_1=OH, R_2=OCH_3$
29.	(4Z, 6E) -5-hydroxy-1- (4-hydroxy-3-methoxyphenyl) - 7-phenylhepta4, 6-diene-3-one	(4Z, 6E) -5-hydroxy-1- (4-hydroxy-3-methoxyphenyl) -7-phenylhepta4,6-dien-3-one	[15]	 $R_1=R_4=OH, R_2=OCH_3, R_3=H$
thirty.	(S, E) -2-hydroxy-1,7-diphenylhept- 4-en-3-one	(S, E) -2-hydroxy-1,7-diphenylhept-4-en-3-one	[73]	
	Cyclic			
1.	Alpinoid D	Alpinoid D	[73]	 $R_1=OH, R_2=OCH_3$ $R_1=R_2=H$
2.	3,6-furan-1,7-diphenylheptane	3,6-furan-1,7-diphenylheptane	[73]	

	Dimeric			
3.	Alpinin B	Alpinin B	[45, 87]	
4.	Alpinin S	Alpinin C	[45, 87]	
5.	Alpinin D	Alpinin D	[45, 87]	
	Chalcon / flavanone-DAG			
	-	-	[84]	
	New DAG			
6.	Officinaruminan B (seed)	Officinaruminane B (seed)	[16]	

In 2010 from ethanol extract of rhizomes A. officinarum by Chinese researchers [83], 13 DAHs were isolated, possessing antibacterial action against Helicobactor pylori,of which 3 connections were new. Their structural identification was carried out mainly by spectroscopic methods. New compounds (Fig. 4) had the following structure: 7- (4 ", 5"
- dihydroxy-3 "-methoxyphenyl) -1-phenyl-4-hepten-3-one (4.1.), 1,7-diphenyl-5-heptene-3-one (4.2.) And 4-phenethyl-1,7-diphenyl-1-heptene-3,5-dione (4.3.) [83] (Fig. 4).

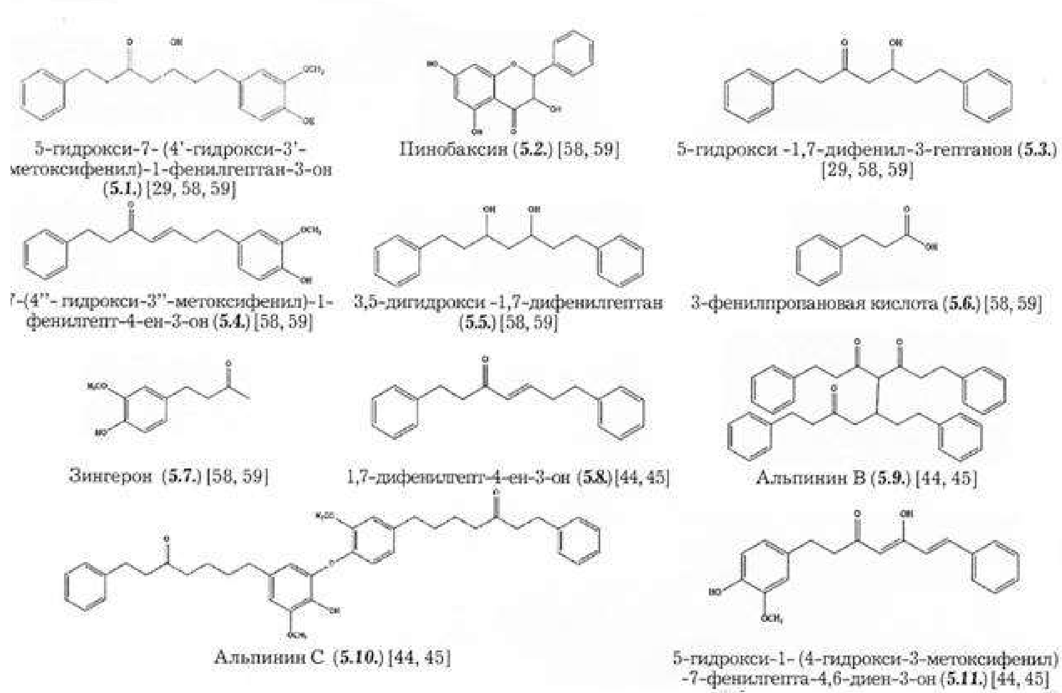
DAG fraction from leaves A. officinarum, studied in more recent work by Chineseresearchers [75], was represented by yakuquinone A (1.13.), Oxyphylacinol (1.14.),hexahydrocurcumin (1.15.) And hannokinol (1.16.) [21] (Fig. 1).

Of the already named BAS, the following compounds were identified in [85] 1.1. – 1.5., 1.7. – 1.13., 1.15. (rice.1), nutcaton (1.17.), DAH (1.18.), Luteolin (1.19.) And isalpinin (1.20.). Quantitativethe content of these compounds (except for the compound 1.10.) Was higher in rhizomes than in abovegroundparts of the plant. A total of 6 connections (1.1., 1.2., 1.5., 1.9., 1.11., 1.15.) Wasfound in all studied objects, both in aerial parts and in rhizomes [21, 85].



Rice. 4. Diarylheptanoids of rhizomesA. officinarum, with a pronounced antibacterial effect in a relationship Helicobactor pylori (by [83]): No. 1 - 4.1., No. 2 - 4.2., No. 3 - 4.3.

Polyphenols, in particular flavonoids and DAGs, passed not only into methanol extraction and ethanol of various concentrations [21, 71], but also into ethyl acetate extraction [21]. VS Honmore et al. (2016) to clarify the specific compounds responsible for certain types of biological activity, carried out their additional purification using the stripping of methanol extraction ethyl acetate. Compounds were transferred to ethyl acetate extraction1.5. [29] (Fig. 1) and 5.1. (rice. 5), which have a pronounced anti-inflammatory effect [3, 29].



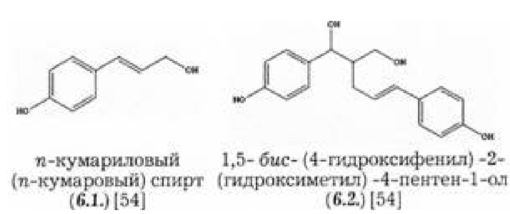
Rice. 5. Biologically active compounds identified
in the ethyl acetate fraction of rhizomes and aerial parts Alpiniae officinarum (according to [21])

In another study, ethyl acetate extraction was carried out from crude acetoneretrieving [21, 59]. A number of compounds with anticancer activity have been identified in various models -5.1. – 5.7. (rice.5), along with previously identified compounds 1.5. [21, 29, 59] and 1.9. [59] (Fig. 1).

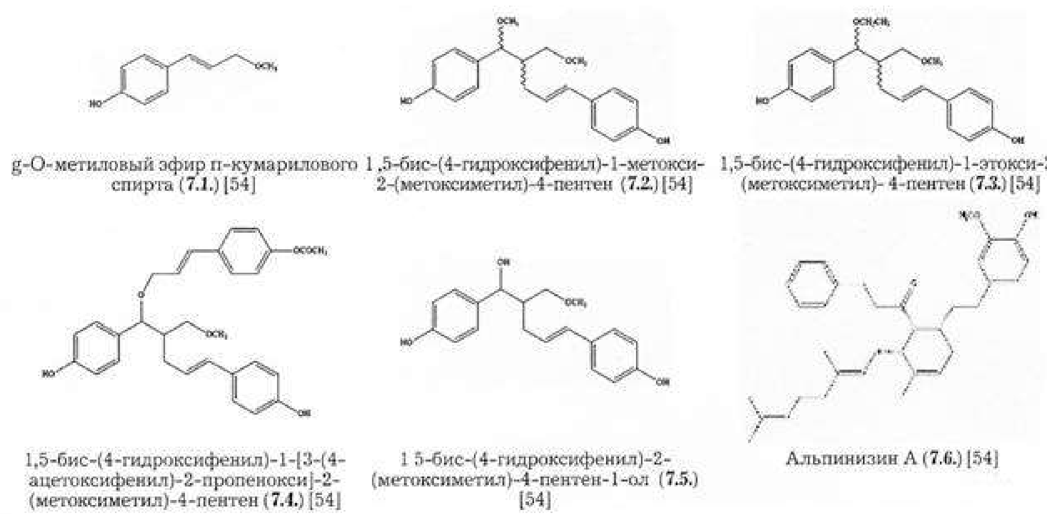
From the ethyl acetate fraction of the ethanol extract D. Liu et al. (2014) also identified several new DAGs (5.8. – 5.11., Fig. 5), including dimeric (5.9. and 5.10.) havingcytotoxicity against a number of cell lines [3, 44, 45].

Thus, to date, the flavonoid and DAG composition of the rhizomes of a. medicinal can be considered well studied.

Phenylpropanoids (from the Greek. phaino - illuminate> phenyl - phenyl - C_6N_5 + propane - C_3, + eidos -species) - aromatic, mainly phenolic, compounds containing the C fragment in their structure$_6$-WITH$_3$ - (phenylpropane) [4]. This group of phenolic structures (of varying degrees of complexity) includes compounds6.1., 6.2. (rice.6) and 7.1. – 7.5. (rice.7) (according to [21]), as well as compounds 8.1. – 8.3.(Fig. 8), highlighted in [54–56] (after [84]). It has been shown that their antioxidant activity can be influenced by the number of hydroxyl groups present in the molecule [54].

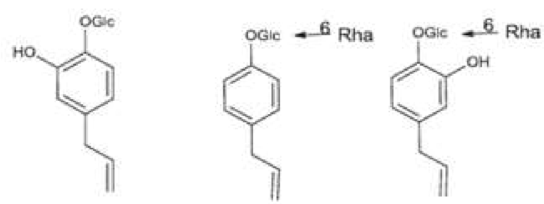


Rice. 6. BAS identified in aqueous fractions of methanol extractsAlpinia officinarum [21, 54].



Rice. 7. Compounds identified
in chloroform extraction from methanol extract a. medicinal (according to [21, 54])

8.1. 8.2. 8.3.



Rice. 8. Simple phenylpropanoids [4], isolated from the rhizomes of a. medicinal (according to [84])

Reextraction of methanol extraction with water identified 2 antioxidant compounds - pcoumaril alcohol (6.1.) And 1,5 bis(4-hydroxyphenyl) -2- (hydroxymethyl) -4-penten-1-ol (6.2.) (Fig. 6). When stripping methanol recoverychloroform has been identified 6 compounds of antioxidant action [21] (Fig. 7), including g-Pcumaryl alcohol methyl ester (7.1.) And other phenylpropanoids (7.2. – 7.5.), And also alpinizin A (7.6.), Related to adducts of DAG-terpene nature (Sec. 2.3) and has a very interesting spectrum of activity [3].

Varietal differences in the composition of the phenolic fraction of rhizomes a. medicinal. Chemicalcomposition of the flavonoid fraction of two varieties Alpiniae officinarum (Zhutou galangal, Fengwo galangal) wasstudied at Guangdong University of Pharmacy (Guangzhou, China). Using the HPLC-Fingerprint method and other methods, it has been shown that the average galangin content (comp.1.5. - rice.1) in Zhutou galangal and Fengwo galangal is,respectively, 0.30% and 0.98% [50]. Galangin is one of the most important biologically active flavonoids of rhizomesA. officinarum, which converts to methanol, ethanol andwater extraction, showing, among other things, antitumor activity [27].

2.2. Terpenes

Most researchers agree that it is terpenes that are responsible for the proven antimicrobial effect. A. officinarum [21, 49, 67, 77]. For a number of terpene compounds, other types of action are also known [3], in particular antioxidant [79], anti-inflammatory [26, 79], immunotropic [26].

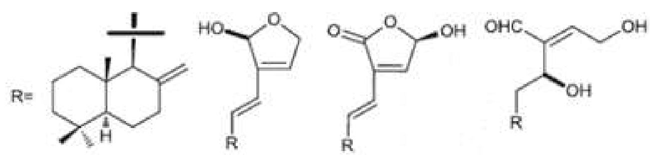
The Herbal Medicines Directory of Medicine (PDR for Herbal Medicines) classifies sesquiterpene hydrocarbons and sesquiterpene alcohols as the main constituents of essential oil a. medicinal [41].

Mono- and sesquiterpenes A. officinarum was practically not devoted to special studies:most of them were usually identified by HPLC / GC-MS fingerprint method from a spectrum of essential oils or volatile fractions.

Diterpenoids are another group of compounds that are found in plants of this genus as the main biologically active substances. The main one in the group is the subtype of eudesmana, in which of the plants there are 9 species of the genusAlpinia, three types of basic structures of diterpenoids have been identified [84]. In fig. 9 shows the only basic structure (9.1.) And 3 diterpenoids based on it (9.2. – 9.4.),allocated [30] from the above-ground parts of a. medicinal.

Volatile oils (essential oils) are considered essential components of the genus Alpinia and consist ofmainly from various terpenoids [82]. A number of publications have reported that essential oils of various species of the genusAlpinia has a wide range of pharmacological properties: antihypertensive, antinociceptive, anxiolytic, antimicrobial, antipsychotic and antioxidant [82, 84].

9.1. 9.2. 9.3. 9.4.



Rice. 9. Basic structure (9.1.) And 3 diterpenoids (9.2.-9.4.),allocated [30] from the above-ground parts of a. medicinal (according to [84])

GC-MS (GC-MS) is currently the most common and suitable approach to the qualitative and quantitative analysis of essential oils and is used to study and compare the volatile profiles of various types of essential oil feedstocks [84].

Chinese researchers have studied the chemical composition of the essential oil of rhizomes a. medicinal, obtained by hydrodistillation (steam distillation) [80], and extracts obtained from the same raw material using supercritical CO_2 [81], in a comparative aspect (Table 3).

Compared to hydrodistillation, extraction with supercritical liquid CO_2 is a softer method that reduces thermal degradation and preserves thermolabile components without any changes. This method also has an economic advantage, since it is significantly faster than the extraction processes with other liquid extractants [25, 28]. CO_2-extract of rhizomes is also interesting in that, in addition to volatile terpenes, DAGs also pass into its composition [51].

Compound	Molecular formula	RI *	Relative content	
			Essential oil	CO_2 extracts
αpinene	CtenH16	940	3.26	-
Camphene	CtenH16	+ 956	4.57	-
Sabinen	CtenH16	+ 976	3.65	0.14
βpinene	CtenH16	+ 978	-	0.09
αfellandrene	CtenH16	1005	0.49	0.13
βfellandrene	CtenH16	1026	3.42	-
1,8-cineole	CtenHeighteenO	1031	51.64	0.80
γ Terpinene	CtenH16	1057	0.67	0.19

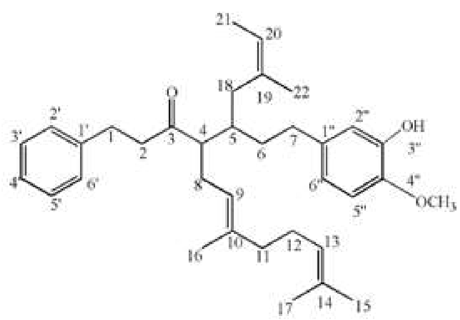
Isoterpinolene	$C_{ten}H_{16}$	1085	0.23	0.13
Linalool	$C_{ten}H_{eighteen}O$	1099	0.28	0.06
Camphor	$C_{ten}H_{eighteen}O$	1145	1.84	0.05
Camphene hydrate	$C_{ten}H_{eighteen}O$	1152	0.16	-
Borneol	$C_{ten}H_{eighteen}O$	1159	0.38	-
Benzenepropanol	$C_{nine}H_{ten}O$	1167	-	7.42
Terpinen-4-ol	$C_{ten}H_{eighteen}O$	1177	1.4	-
αterpineol	$C_{ten}H_{eighteen}O$	1191	9.85	0.68
Benzylacetone	$C_{ten}H_{12}O$	1211	0.53	26.77
Phenylacetate	$C_{12}H_{twenty}O_2$	1218	0.55	-
Nonanoic acid	$C_{nine}H_{eighteen}O_2$	1283	-	0.35
αkubebene	$C_{15}H_{24}$	1352	0.50	-
αterpinyl acetate	$C_{12}H_{twenty}O_2$	1360	-	0.24
α Copen	$C_{15}H_{24}$	1372	0.45	-
Isoleden	$C_{15}H_{24}$	1375	0.38	-
β-element	$C_{15}H_{24}$	1388	0.37	-
αbergamoten	$C_{15}H_{24}$	1410	-	0.56
αsantalol	$C_{15}H_{24}O$	1417	-	0.34
βkaryophyllene	$C_{15}H_{24}$	1420	0.44	0.07
Undecanoic acid	$C_{eleven}H_{22}O_2$	1441	-	0.27
α humulene	$C_{15}H_{24}$	1455	0.13	-
Alloaromadendren	$C_{15}H_{24}$	1463	-	0.12
βpachulene	$C_{15}H_{24}$	1465	0.41	-
Hermacren D	$C_{15}H_{24}$	1480	1.13	-
βselinene	$C_{15}H_{24}$	1485	0.14	0.05
Valensen	$C_{15}H_{24}$	1489	-	0.09
αselinen	$C_{15}H_{24}$	1492	1.62	0.05
αmuurelen	$C_{15}H_{24}$	1497	0.34	-
Zingiberen	$C_{15}H_{24}$	1498	1.05	-
Kalamenen	$C_{15}H_{22}$	1504	0.42	-
δcadinene isomers	$C_{15}H_{24}$	1523	5.44	0.42
Guaycylacetone	$C_{ten}H_{12}O_3$	1528	-	10.13
Viridiflorol	$C_{15}H_{26}O$	1588	-	1.42
τmuurolol	$C_{15}H_{26}O$	1643	-	0.04
βevdesmol	$C_{15}H_{26}O$	1648	-	0.03
αcadinol	$C_{15}H_{26}O$	1654	0.65	-
Z-α-trans-bergamotol	$C_{15}H_{24}O$	1685	-	0.18
Aristolon	$C_{15}H_{22}O$	1765	-	0.05

1,7-diphenyl-5-hydroxy-3-heptanone	C19HtwentyO	1785	-	17.68
3-phenylbutanol	CtenHfourteenO	1789	-	0.35
Monoterpenoids			81.84	9.69
Sesquiterpenoids			13.47	3.42
Total amount			96.39	68.90

* RI-chromatographic retention index (determined on an HP-5MS column using the homologous series of p-alkanes as a reference) [81].

The yield of extracts obtained using hydrodistillation and CO_2, amounted to 0.62% and 11.1%, respectively [80]. This is because diffusion in supercritical media is much faster than in liquids. In addition, due to the absence of surface tension and low viscosity (compared to liquids), the extractant can penetrate into the matrix to such an extent that is inaccessible for liquids [74].

According to GC-MS data, the main chemical components of CO_2-extract were benzylacetone (26.8%), 1,7-diphenyl-5-hydroxy-3-heptanone (17.8%), guaiacylacetone (10.0%), and benzenepropanol (7.4%). In total, during the extraction with supercritical carbon dioxide, 5 known compounds were identified: pinocembrin (1.2. - rice.1), galangin (1.5.), Galangin-3-methyl ether (1.6. - rice.1), 5-hydroxy-1,7-diphenyl-3-heptanone (5.3. - rice.5), 1,7-diphenyl-4-hepten-3-one (5.8. - rice.5), as well as one new compound - 1-phenyl-4- (16,17-dimethyl-9,13-octadiene) - 5-isopentenyl-7- (4'-methoxyl-3'-hydroxyl-phenyl) -3 -heptanone (10.1. - rice.10) [81].

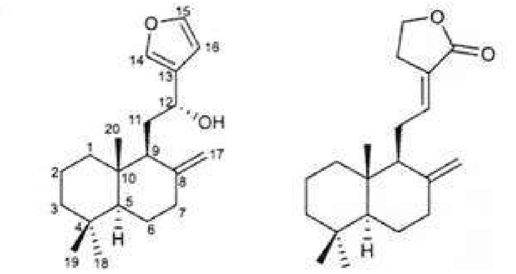


Rice. ten.1-phenyl-4- (16,17-dimethyl-9,13-octadiene) -5-isopentenyl-
7- (4'-methoxyl-3'-hydroxyl-phenyl) -3-heptanone (10.1.)

In the case of obtaining essential oil by hydrodistillation (Table 3 - column 4), GC-MS analysis revealed 31 components, and the main compounds were identified as 1,8-cineole (51.5%), α-terpineol (9.9 %), and δ-cadinene isomers (5.4%) [81].

In 2016 T. Wen et al. singled out from a. medicinal two new diterpene compounds with antioxidant and anti-inflammatory effects (Fig. 11): (12S) -15-16-epoxy-8 (17), 13 (16), 14-labdatrient-12-ol (11.1.) And (12E) -labda-8 (17), 12 (13) -diene-15,16-olide (11.2.) [79]. Extraction was carried out with petroleum ether from ethanol (95%) extract of rhizomes.

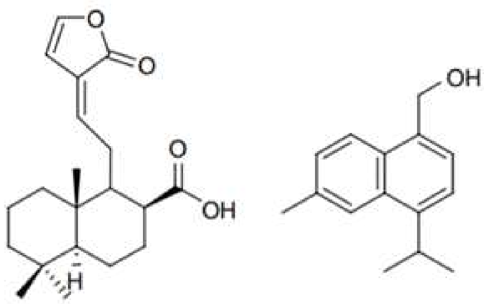
In the same year from rhizomes A. officinarum, a new labdan-type diterpene (Z) - 12,14-labdadiene-15 (16) -olide-17th acid (12.1.) And the new natural sesquiterpene cadinan, 4-isopropyl-6-methyl-1-naphthalenemethanol (12.2.) [89] (Fig. 12). New compounds were identified by the authors along with galangin, kaempferol and quercetin (Fig. 11).



(12 *S*)-15-16-эпокси-8 (17),13(16),14-лабдатриент-12-ол (**11.1.**)

(12 *E*)-лабда-8 (17),12 (13)-диен-15,16-олид (**11.2.**)

Rice. 11. New diterpenes identified in the extract
obtained with petroleum ether from ethanol (95%) extract of rhizomes a. medicinal (according to [79]).



1 **2**

Rice. 12. New diterpene labdan type (Z) -12,14-labdadiene-15 (16) -olide-17-oic acid (1) and a new natural sesquiterpene cadinan, 4-isopropyl-6-methyl-1-naphthalenemethanol (2) (according to [89])

Variety differences in the content of volatile aromatic, ketone and aldehyde components. Using the methods of "electronic nose" (Electronic Nose, or E-nose) and gas chromatography-mass spectrometry in combination with chemometrics, a study of the composition and quantitative content of volatile components of raw materials (rhizomes A. officinarum) of two varieties (Zhutou galangal and Fengwo galangal) alpinia officinalis [49]. A total of 56 volatile components were identified: terpenes (Camphene, β-Pinene, β-Myrcene, γ-Terpinene, Terpinolene, β-Caryophyllene, α-Caryophyllene, γ-Muurolene, α-Selinine, Germacrene B, Calarene, α-Elemene, () α-Pinene, dLimonene, 1 , 8Cineole, Camphor, Ylangene, α-transBergamotene, α-Guaiene, Isoledene, β-Selinene, α-Farnesene (±)γ-Cadinene, (+) δ-Cadinene, β-Ocimene, α-Cubebene, Alloaromadendrene, Cadina1 (6), 4diene, 1ξ, 6ξ, 7ξ- Cadina4,9diene, Epizonarene, γ-Selinene, Selina3,7 (11) diene) , alcohols (Borneol, α-Cadinol, β-Bisabolol, Linalool, Terpinen4ol, α-Terpineol, Epicubenol, TCadinol, α-Bisabolol, Juniper camphor, α-trans Bergamotenol, Geraniol, Copaborneol, Epicubenutyl, acetate, 2 Methylbutyl2methylbutyrate, 2Methylbutyl3methylbutanoate, Phenethyl butyrate) and others connections (oCymene, Benzylacetone, 6Methyl5hepten2one, α-Citral, Humulene oxide II) [49].

In varieties Zhutou galangal and Fengwo galangal were identified, respectively, 52 and 43 compounds, the relative content of terpenes in Zhutou galangal made up 76.4%, and in Fengwo galangal - 74.5%. In both varietiesA. officinarum has been identified in total 32 terpene compounds, of which 24 were quite common, 5 were specific for Zhutou galangal and three were specific to Fengwo galangal.

Of the 24 common terpene compounds, the proportion of only 12 components varied significantly between the two varieties. The largest difference in the relative content (percentage of the total) was noted for α-farnesene (maximum - inZhutou galangal) and
1,8-cineole (maximum - in Fengwo galangal), and the content of α-farnesene in Zhutou galangal (42.7%) was almost 7 times higher than in Fengwo galangal (6.0%). On the contrary, the content of 1,8-cineole inFengwo galangal (29.1%) was almost 79 times higher than in Zhutou galangal (0.4%) [49]. The smell of 1,8-cineole is defined as cool and camphor-like, and α-farnesene is one of the

flavor components for many fruits (apples, bananas, and pears) [43, 62].

In [49], obvious differences in the content of D-limonene, camphor, α-transberbamoten, (±) -γ-cadinene. To specific terpenesZhutou galangal include β-oxymene,α-cubeben, alloarmadendren, of which the highest content of α-cubeben (3.4%) was found. To specific terpenesFengwo galangal includes episonarene, γ-selenene, and celine-3.7 (11) - diene, with the highest content shown for celine-3.7 (11) -diene (1.2%).

The relative content of the fraction of volatile alcohols in Zhutou galangal made up 12.5%, in Fengwo galangal - 19.8%. A total of 14 compounds were identified, of which 11 are fairly common alcohol compounds, and 3 are specific forZhutou galangal. 8 components out of 11 common compounds showed significant proportions for both varieties. The content of α-terpineol (has a lilac aroma) inFengwo Galangal (9.5%) was almost 7 times higher than in Zhutou Galangal (1.5%) [49].

The relative content of the fraction of esters in Zhutou Galangal made up 1.1%, and inFengwo Galangal - 1.5%. A total of 5 ester compounds were identified, among which isobutyl-2-methylbutyrate and phenylacetate were found in the raw materials of both varieties, while 2-methylbutyl-2-methylbutyrate and 2-methylbutyl-3-methylbutanoate were specific forZhutou Galangal, and phenethyl butyrate for Fengwo Galangal [49].

Among other aromatic, ketone and aldehyde components, an important contribution to the differential diagnosis of the studied varieties A. officinarum introduces methyl ketone5-hepten-2-one, specific for Zhutou galangal. Its relative content in the raw material of this variety was 1.25%. The relative content of other compounds was lower, therefore, according to the conclusion of the authors [49], they have less influence on the differences in the odors of the raw materials of the two varieties.

Thus, the compounds identified in [49] are key substances that cause not only the difference in the smells of the two varieties A. officinarum, but also the possibility of themdifferential diagnosis, which is important, including for drug manufacturers.

2.3. DAG adducts and terpenes

Adducts are the products of attachment of molecules to each other, or chemical compounds formed as a result of the interaction of 2 or more compounds, in which there is no cleavage of fragments. Today, in the rhizomes of a. drug, several biologically active adducts have been identified that have experimentally cytotoxicity, as well as antiproliferative and neuroprotective properties [21, 48].

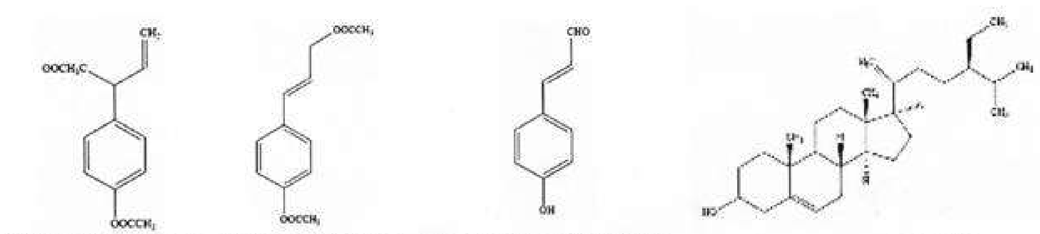
In particular, Na W. et al. (2016) identified one of such adducts - alpinizin A (7.6. - rice. 7), consisting of DAG associated with a chain sesquiterpenoid, which has anticancer activity [60].

An N. et al. found in rhizomesA. officinarum in addition to DAG-sesquiterpene adductalpinizin A, and also a DAG-mono-terpene adduct - officinaruminan B (Table 2) [16]. In this case, officinaruminan B was described exclusively as a flat structure, while alpinisin A was characterized as an optically pure compound with specific negative rotation (its relative configuration was determined based on the NOESY experiment) [48].

In 2018 Liu H. et al. from rhizomesA. officinarum isolated 2 pairs of new enantiomers of diarylheptanoid-monoterpene adducts - (±) -alpininoids A and B, as well as three pairs of new enantiomers of diarylheptanoid-sesquiterpene adducts - (±) -alpininoids CE. For this, air-dry rhizomes A. officinarum was extracted 95% ethanol at room temperature. The crude extract was then suspended in water and sequentially fractionated with petroleum ether, chloroform and n-butanol. From the fraction soluble in petroleum ether, using a number of chromatographic procedures, 5 pairs of the already mentioned new enantiomers of diarylheptanoid-terpene adducts were isolated along with four known diarylheptanoids (Table 2): (5R) -5-hydroxy-1,7- diphenyl-3-heptanone, 1-phenyl-7- (4-hydroxy-3-methoxyphenyl) - 4E-en-3-heptanone, 1-phenyl-7 (4-hydroxyphenyl) -4E-en-3-heptanone and 1 , 7-diphenyl-4E-en-3-heptanone. All selected compounds were positively assessed in terms of their neuroprotective action [3, 48].

2.4. Hydroxycinnamic acids

Derivatives of hydroxycinnamic acids, showing high anticancer activity, were isolated from fractions obtained using dichloromethane during rhizome extraction A. officinarum in the Soxhlet apparatus [34, 40] (Fig. 13).



1'-ацетоксихавикола ацетат (**13.1.**) [40] | *Транс-р*-кумароила диацетат (**13.2.**) [40] | 4-гидроксициннамальдегид (**13.3.**) [40] | β-ситостерол (**13.4.**) [40]

Rice. 13. BAS identified in dichloromethane extracts / fractionsAlpinia officinarum by [21, 40].

2.5. Phytosterols

The identification of sitosterol and daucosterol is reported by [84]. Identified by CC Lee and P. Houghton (2005) in dichloromethane extract from rhizomes β-sitosterol (13.4. - rice.13) did not show antiproliferative activity in the experiment [40].

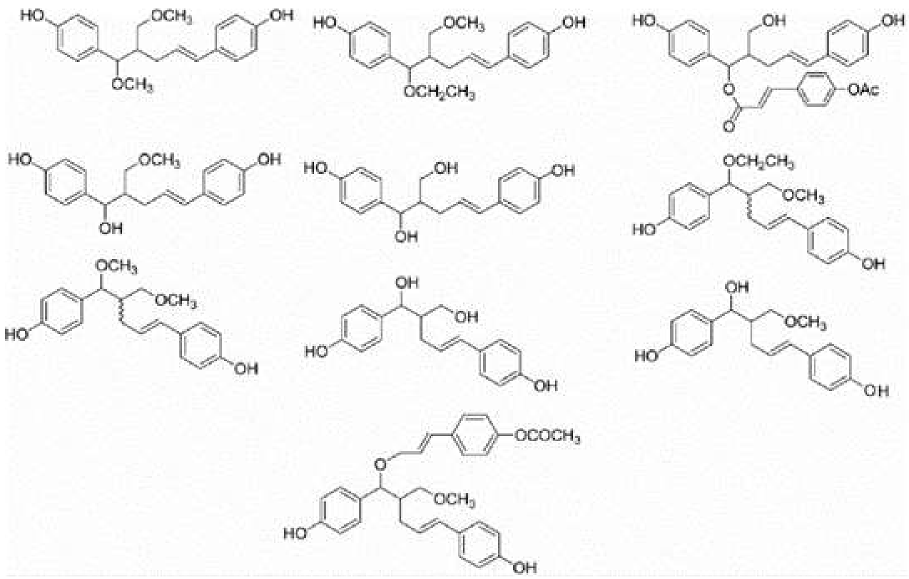
2.6. Polysaccharides

In various representatives of the genus Alpinia, biologically active substances belonging to the class of polysaccharides have been found [84], but their structure and pharmacotherapeutic action have not been described in the available literature.

2.7. Lignin and lignans

Chemically, lignin is a conventional and generalized concept, since there is no single formula for lignin. It is an irregular three-dimensional natural polymer that plays an extremely important role in plant life. Oxycinnamic alcohols act as precursors of lignin, as well as lignans: p-coumaric (6.1. - rice. 6), coniferyl and synap, however, lignans and lignin have independent pathways of biosynthesis [4, 7]. According to the phytochemical classification, lignans are classified as complex phenylpropanoids [4] (see also Section 2.1.).

Currently, it is known that only two types of plants - A. officinarum Hance [54, 55] and A. galangal [84]) of 9 well-studied species of the genus Alpinia [84] have components related to lignans. Identified lignan structures isolated from the rhizomes of a. medicinal are shown in Fig. 14. We have not found data on the study of the pharmacotherapeutic action of the complete lignan fraction of the rhizomes of this plant in the available literature.



Rice. 14. Lignan structures isolated from rhizomes a. medicinal (according to [84])

CONCLUSION

So Thus, the information and analytical research carried out allowed to establish that the main groups of biologically active substances responsible for the biological action of alpinia officinalis can be terpenes of various structures and degrees of complexity, as well as phenols - flavonoids, phenylpropanoids, diarylheptanoids. The varietal differences in the qualitative and quantitative content of the indicated groups of biologically active substances, which, among other things, are of commercial importance, and which make it possible to predict the chemical composition of medicinal plant materials for the production of dietary supplements to food, medicines and specialized food products, have been established.

CONCLUSIONS

1. An information and analytical study was carried out with the aim of objectifying modern ideas about the chemical composition of rhizomes Alpinia officinarum coming tothe domestic food market, as well as a dietary supplement for food and natural raw materials for the production of medicines, specialized food products, dietary supplements and flavoring additives.

2. Revealed the results of phytochemical studies, confirming the presence of a rich a polyphenolic complex, in particular flavonoids (including galangin), phenylpropanoids and diarylheptanoids, as the main groups of biologically active substances responsible for anti-cancer action.
3. The analysis of data on terpenoids and other volatile compounds, as well as on phytosterols of rhizomes of alpinia officinalis.
4. Shown the presence of varietal differences in the chemical composition and quantitative content BAS a. medicinal.
5. Presumably a wide range of biologically active substances can cause various types biological activity and pharmacotherapeutic action of various extracts from rhizomes of alpinia officinalis.
6. The carried out information and analytical research allows us to consider it is advisable to continue work in terms of objectifying data and systematizing information about the correlation between the chemical structure and the spectrum of biological activity of individual compounds and groups of biologically active substances, as well as about the mechanisms of their action.

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