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Fatty acid compositions of different organs of *Alhagi Pseudalhagi* (M.Bieb.) Desv. Ex B. Keller & Shap

Abstract. *By employing gas chromatography, the fatty acid contents were determined in the root, stem, and leaf of A. pseudalhagi. The composition of fatty acids varied among the organs of A. pseudalhagi. The unsaturation percentages for each part were 47.78%, 48.17%, and 44.12%, respectively. The dominant fatty acid in leaves and stems was palmitic acid. The content of palmitic acid in these organs varied from 19.25% to 19.69%. The other major fatty acids were γ-linolenic acid in the leaves and lignoceric, oleic acids in the roots. Moreover, ω-6 and ω-3 polyunsaturated fatty acids were found, including cis-linoleic, α-linolenic, and eicosapentaenoic acids.*

Keywords. *Saturated, polyunsaturated fatty acids, gas chromatography, "rapid" transmethylation method, A. Pseudalhagi.*

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Introduction

The genus *Alhagi* (Leguminosae) has 8 species around the world. There are 4 species in Kazakhstan such as: A. *pseudalhagi* (M.Bieb) Desv.; *A. Kirghisorum* Shrenk.; A *sparsifolia* Shap. and *A. persarum* Boiss..[1] *A. pseudalhagi* (M.Bieb) Desv. is a subshrub with a height of 50-100 cm., growing in the desert clay steppes and on the outskirts of hilly sands. The plant is commonly used in folk medicine as a cure for rheumatic pains, bilharziasis, and various types of gastrointestinal disorders, as well as for diseases of the urinary tract and liver.[2] Flavonoid glycosides,[3] oligomeric proanthocyanidin glycosides,[4] alkaloids [5,6] have been isolated from the different parts of *Alhagi pseudalhagi*. In addition, in previous studies, various biologic activities such as antiprotozoal,[7] antimicrobial,[8] antibacterial,[9] antifungal,[10] antinociceptive,[11] anti-diarrheal [12] and sympathomimetic activites[6] of these compounds or extracts were investigated.

A literature survey shows that plant oils are a source of ω-3 and ω-6 polyunsaturated fatty acids (PUFAs). Polyunsaturated fatty acids such as linoleic acid called essential fatty acids are essential for human metabolism and have many positive effects on human health. The dietary intake with sufficient consumption of PUFAs reduces the risk of developing cardiovascular and oncological diseases, increases the functions of the immune system, lowers cholesterol levels, and increases the body's resistance to infections, colds, etc...[13] This plant seed oil is reported to contain unsaturated fatty acids 88%.[14] The aim of this study was to determine the fatty acid composition of different organs of *A. pseudalhagi.*

Experimental research

Plant material

Organs (root, stem, and leaves) of *A. pseudalhagi* were collected in September 2019 from the Kyzyl-Orda region of Kazakhstan. The identified voucher specimen of *A. pseudalhagi* (MW0849681) is stored in the herbarium collection of the Institute of Botany and Phytointroduction in Kazakhstan.

Plant materials were dried in the open air in the shade and have been kept for 2 months in a closed dark room.

Extraction of lipid

The required portion of the crushing plant was taken into the glass. With the help of ethanol (96%), a quantitative sample was transferred with a glass rod into a filter-separating funnel. Pour 20 cm^3 of the extracting mixture (two volumes of chloroform with one volume of ethanol), close the funnel with a stopper and shake the contents for 2 minutes. The funnel was connected to the receiver, the water-jet pump was turned on, and the resulting fat extract was drawn off. The extraction was repeated twice more, adding the required amount of the extraction mixture to the sample in the funnel and shaking the funnel for 1 min. The extracts from the receiver were quantitatively transferred into a separating funnel with a capacity of 1000 cm^3 using an extraction mixture. There was added distilled water and sodium chloride. The funnel was shaken with the contents for 2 minutes. After separating the layers, the lower chloroform layer was poured into a weighing bottle. The bottle with the extract was placed in a water bath and the solvent was evaporated until its odor disappeared. Then the bottle with the remainder was placed in an oven heated to (100 ± 5)^{0}C, dried at this temperature for 10 minutes, cooled in a desiccator for 25-30 minutes andthen it was weighed.

Gas Chromatography of fatty acid composition

The lipid extracted from various organs (root, stem, and leaf) of *A. pseudalhagi* were dissolved in hexane and mixed with a solution of sodium methylate in methanol. The obtained fatty acid methyl esters were analyzed using the gas chromatograph «ChromosGC-1000» (Russia) under the following conditions: the column thermostat temperatureis 180-190^{0}C, the evaporator temperature is 250^{0}C, the detector temperature is 200^{0}C, the carrier gas (nitrogen) flow rate is 30-40 cm^3/min. All analytical investigations were performed triplicate.

Results and discussion

The total lipid content varied from 2.09% in root to 4.73% in leaves. Fatty acid composition in *A .pseudalhagi* (root, stem and leaf) determined by Gas Chromatography based on the ISO 12966 "rapid" transmethylation method.[15]

The qualitative and quantitative composition of fatty acids in roots, stems and leaves of *A. pseudalhagi* differ from each other (Table 1).

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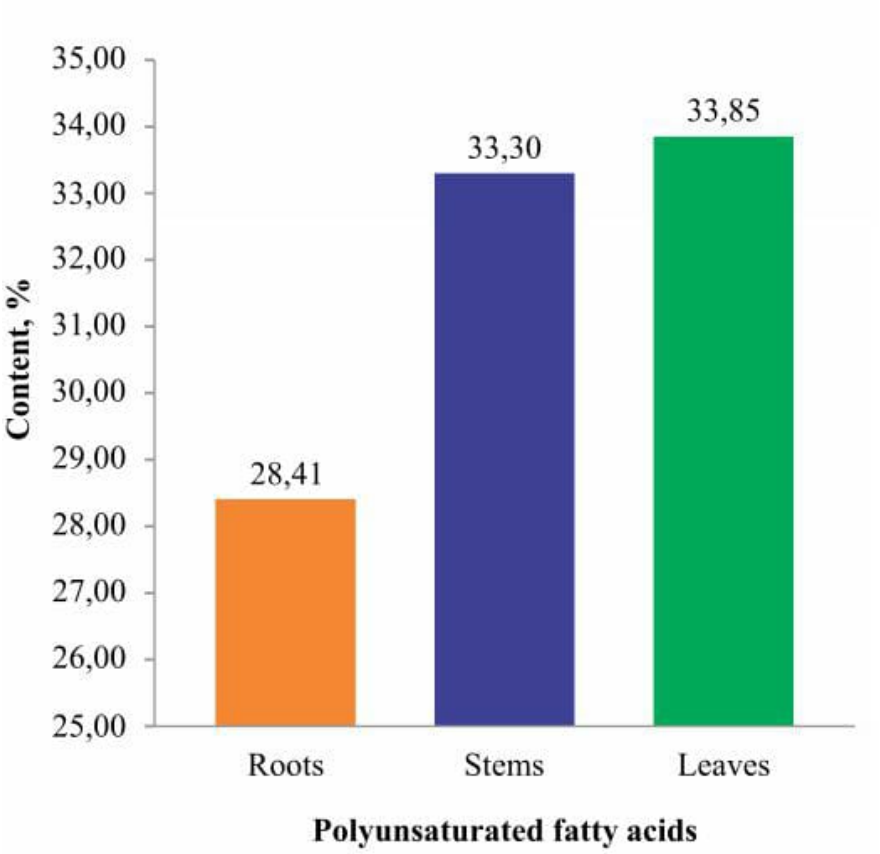
Table 1. Fatty acid compositions of *A. pseudalhagi*, %

№	Fatty acid	Content		
		Roots	Stems	Leaves
	Saturatedfattyacids:	**52.22**	**51.83**	**55.87**
1	C12:0 lauric	-	-	0.58
2	C13:0 tridecane	-	2.97	2.08
3	C14:0 myristic	0.22	1.02	1.06
4	C16:0 palmatic	8.27	19.69	19.25
5	C17:0 margarine	0.65	1.48	1.01
6	C18:0 stearic	2.71	6.30	4.02
7	C20:0 arachidic	1.18	2.08	6.55
8	C21:0 heneicosanic	0.94	-	-
9	C22:0 behenic	16.81	15.67	16.22
10	C23:0 tricosane	0.39	-	-
11	C24:0 lignoceric	21.04	2.62	5.10
	Monounsaturated:	**19.37**	**14.87**	**10.27**
12	C16:1 (cis-9) palmitoleic	1.48	0.65	2.14
13	C18:1(cis-9) oleic	17.27	7.62	3.27
14	C20:1(cis-11) eicosene	0.62	-	-
15	C22:1(cis-13) erucous	-	5.14	3.85
16	C24:1(cis-15) selacholic	-	1.47	1.02
	Polyunsaturated:	**28.41**	**33.30**	**33.85**
17	C18:2n6cis-linoleic	17.80	17.63	7.20
18	C18:3n6α-linolenic	7.18	-	23.67
19	C18: 3n linolenic	0.39	9.71	-
20	C20:2 eicosadienic	-	-	1.35
21	C20:3n6c (cis-8,11,14)eicosatrienoic	-	-	0.94
22	C20:3n3c (cis-11,14,17)eicosatrienoic	1.59	-	-
23	C20:5n3eicosapentaenoic	0.22	2.64	0.70
24	C22:2c docosadienic	1.24	3.32	-
	Lipid	**2.09**	**2.22**	**4.73**



There were identified 18 Amino acids in root and leaves, 16 in stem of *A. pseudalhagi* were identified. In all plant organs, saturated fatty acids predominate by several units over unsaturated fatty acids and amount for the roots 52.22%, for the stems 51.83%, and 55.87% for the leaves.

Behenic acid is found in significant quantities in all plant organs. γ-Linolenic acid dominates in the leaves and lignoceric acid dominates in the roots. Palmitic acid predominates in stems and leaves, and oleic acid predominates in roots. Eleven fatty acids were in all the plant organs examined.

All plant organs contained significant quantities of an essential fatty acid such as cis-linoleic acid. Essential fatty acids are a series of polyunsaturated fatty acids that take a significant part in the metabolism of animals and humans, but the body is not able to synthesize them. The percentage of cis-linoleic acid in the roots is 17.80%, for the stems – 17.63% and for the leaves – 7.20%. Also in the roots and stems α-linolenic acid was found, 0.39% and 9.71%, respectively. Lack of cis-linoleic and α-linolenic acids in mammalian food inhibits growth, reproductive function, causes dermatitis, reduces the coagulating properties of blood, disrupts heart function.[16]

Essential fatty acids also include one of the metabolites of cis-linoleic and α-linolenic acids, eicosapentaenoic acid. Eicosapentaenoic acid is found in small amounts in all the plant organs (roots 0.22%, stems 2.64% and leaves 0.70%).

Conclusion

This study was the first to provide comparative information about lipid and FA contents in different organs of *A. pseudalhagi*.

The leaves exhibited the highest lipid content, with low levels of monounsaturated fatty acids and high levels of saturated fatty acids.

With regard to essential fatty acid, the roots and stems exhibited the highest levels of cis-linoleic acid, and all presented plant organs (roots, stems, and leaves) exhibited the lowest levels of eicosapentaenoic acid.

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Disclosure statement
No potential conflict of interest was reported by the authors.

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Alhagi Pseudalhag i (M.Bieb.) Desv. Ex B. Keller & Shap әртүрлі мүшелерінің май қышқылды құрамы

Аннотация: Газ хроматография әдісінің көмегімен *A. pseudalhagi*-дің тамырындағы, сабағындағы және жапырақтарындағы май қышқылдарының құрамы анықталды. *A. pseudalhagi*-дің түрлі мүшелеріндегі май қышқылдарының құрамы әр түрлі болды. Әрбір өсімдік мүшесі үшін қанықпаған май қышқылдарының пайызы сәйкесінше 47,78%, 48,17% және 44,12% құрады. Жапырақтары мен сабақтарында пальмитин қышқылы басымдықта болды. Пальмитин қышқылының әртүрлі мүшелердегі мөлшері 19,25%-дан 19,69%-ға дейін өзгерді. Көп мөлшерде жапырақтарында γ-линолен қышқылы және тамырларында лигноцерин, олеин қышқылдары кездескен. Сонымен қатар, ω-6 және ω-3 полиқанықпаған май қышқылдары, соның ішінде цис-линол, α-линолен және эйкозапентаен қышқылдары да табылды.

Түйін сөздер: қаныққан, полиқанықпаған май қышқылдары, газ хроматографиясы, "жылдам" трансметилдендіру әдісі, *A. Pseudalhagi.*

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Жирнокислотный состав различных органов *Alhagi Pseudalhagi* (M.Bieb.) Desv. Ex B. Keller & Shap

Аннотация. Методом газовой хроматографии изучен жирнокислотный состав корней, стеблей и листьев *A. pseudalhagi*. Жирнокислотный состав разных частей *A. pseudalhagi*. отличается. Содержание ненасыщенных кислот для каждой части растения составляет 47,78%, 48,17% и 44,12% соответственно. Доминирующей жирной кислотой в листьях и стеблях является пальмитиновая кислота. Содержание пальмитиновой кислоты в этих органах составляет от 19,25% до 19,69%. Другими основными жирными кислотами в листьях являются γ-линоленовая кислота, а в корнях-лигноцериновая, олеиновая кислоты. Кроме того, были обнаружены ω-6 и ω-3 полиненасыщенные жирные кислоты, такие как цис-линолевая, α-линоленовая и эйкозапентаеновая кислоты.

Ключевые слова. Насыщенные, полиненасыщенные жирные кислоты, газовая хроматография, метод “быстрого” трансметилирования, *A. Pseudalhagi*.

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