

Componentes fitoquímicos de las especies botánicas de rumex, plantas de uso medicinal

Rodríguez de Vera, B.C*; Jiménez Díaz, J.F*; Navarro García, E**; Alonso Díaz, S.J**; Trujillo Carreño, J***

Dpto. Enfermería (Univ. Las Palmas de Gran Canaria)*

Dpto. Farmacología (Facultad Medicina - Univ. La Laguna)**

Instituto de Productos Naturales y Agrobiología de Canarias (Consejo Superior de Investigaciones Científicas)***

Resumen:

Se efectúa una revisión bibliográfica de los diversos trabajos científicos publicados sobre las especies botánicas de Rumex, haciendo especial hincapié en las características de los componentes fitoquímicos de las mismas. Es necesario resaltar la presencia entre nuestra flora endémica de la especie botánica Rumex lunaria Linneaus, usada popularmente, entre otros fines, para acciones cicatrizantes. La práctica inexistencia de trabajos científicos sobre nuestro representante botánico, objeto de esta revisión bibliográfica, nos permite orientar en el futuro investigaciones experimentales y clínicas acerca de su comportamiento, eficacia y rentabilidad en el manejo de situaciones patológicas relacionadas con la cicatrización de heridas y úlceras cutáneas.

Palabras clave:

Botánica. Fitoquímica. Rumex. Planta medicinal.

Introducción

El reino vegetal ha constituido, clásicamente, un dispensario para la ciencia de una gran cantidad de productos de uso medicinal. Así, hasta el siglo XVIII, el 68% de los medicamentos usados estaban integrados, total o parcialmente, por drogas de origen vegetal. Esto justifica la preeminencia que la ciencia de las plantas ejercía sobre la medicina y el que fueran médicos y farmacéuticos los impulsores de la Botánica en aquellos tiempos⁽¹⁾.

A lo largo del siglo pasado, el desarrollo espectacular de la Química con la síntesis de productos farmacológicos, hace decaer el interés por las plantas medicinales aunque persiste la necesidad de seguir obteniendo sustancias natura-

les para sintetizar nuevos productos en el laboratorio. A este requerimiento se ha unido el desarrollo, en los últimos años, de la medicina naturalista que ha mantenido el interés por los estudios fitoquímicos⁽²⁾.

La medicina popular, no obstante, mantuvo su creencia en la virtud curativa de una gran variedad de plantas, muchas de las cuales nunca fueron utilizadas por la medicina científica o profesional. La aplicación popular de las plantas medicinales, con bastantes dosis de curanderismo y de ciencia oculta, acentuó el menosprecio de la ciencia ortodoxa hacia los remedios a base de hierbas guardando, sin embargo, un importante fondo de conocimientos tradicionales sobre las virtudes medicinales de las plantas⁽³⁾.

Plantas medicinales

En nuestro archipiélago se ha desarrollado una amplia y diversa flora silvestre de carácter endémico o naturalizada que ha sido utilizada con diversos fines terapéuticos⁽⁴⁾, destacando por el uso popular de las mismas aquellas con aplicación en la cicatrización de heridas y úlceras cutáneas (Aeonium urbicum, Aloe vera L., Caléndula arvensis L., Ceropogia dichotoma Haw., Hedera helix ssp. canariensis Willd., Hypericum canariensis L., Ilex canariensis S.L., Rumex lunaria L., Scrophularia glabrata, Visnea mocanera L.P., etc.)

Componentes fitoquímicos de las especies de rumex

De todas las especies botánicas señaladas, nos centraremos en reseñar, tras la correspondiente revisión bibliográfica, cuáles son los componentes fitoquímicos analizados y descritos por los diversos autores en las especies botánicas de Rumex (Tabla 1), representada en nuestra flora por el endemismo Rumex lunaria Linneaus⁽⁴⁾.

Conclusiones

Tras la realización de esta revisión bibliográfica sobre los componentes fitoquímicos de las diversas especies botánicas de Rumex podemos concluir que los mismos pertenecen mayoritariamente al grupo fitoquímico de las antraquinonas (presente en cincuenta de las sesenta especies botánicas referenciadas). El segundo lugar lo ocupa el grupo de las flavonas (presente en veintidós especies), seguido por el de los ta-

Correspondencia:

Bienvenida del Carmen Rodríguez de Vera
Dpto. Enfermería (Centro de Ciencias de la Salud)
c/ Dr. Pasteur, s/n
35016 Las Palmas de Gran Canaria
Tf. 928-453468 Fax: 928-453482
E-mail: brodriguez@denf.ulpgc.es

ninos (21 especies). En doce especies botánicas se comprueba la presencia de los grupos fitoquímicos de los esteroides y los azúcares, seguido por el de los ácidos grasos y los aminoácidos (10 es-

pecies). Los ácidos carboxílicos fueron identificados en ocho especies y en cuatro los compuestos terpénicos. Así pues, al quedar identificados los diferentes grupos fitoquímicos de las diversas espe-

cies botánicas de Rumex nos permite conocer sus propiedades farmacológicas y, por tanto, poder orientar en la terapéutica sus aplicaciones tanto a nivel experimental como clínico.

TABLA 1
Componentes Fitoquímicos de las especies botánicas de Rumex

Especies de Rumex	Componentes Fitoquímicos	Autores
abyssinicus	antraquinonas (crisofanol, emodina, reocrisina, palmidina C)	Fassil (5), Midiwo (6)
acetosa L.	giberelinas (Gas) (C20-Gas-GA18, GA38 y GA23,GA1, GA4, GA9, GA19,GA20, GA53), aminoácidos, proteínas, carotenos, minerales, aminoácidos esenciales, lípidos, flavonoides, ácido pantoténico, piridoxina, nepodina, emodina, reocrisina, crisofanol, polisacáridos, catequinas, antraglicósidos, taninos, oxalatos, fibra, pentosa	Gregg (7), Purdir (8), Sors (9), Lyuft (10), Aritomi (11), Bagrii (12), Salikhov (13), Sharma (14), Ito (15), He (16), Tamano (17), Kato (18), Slapkauskaitė (19), Ladeji (20, 21), Pilipenko (22), Saleh (23), Rijnders (24), Xiong (25, 26), Stokes (27)
acetosella L.	oxalatos (ácido oxálico, potasio binoxalato), emodina, citreoseína, crisofanol, luteolina, citoquinas(similar a isopenteniladenina, adenosina, zeatina, zeatina ribósido), antraquinonas	Orlandini (28), Brazdova (29), Martinod (30), Jelic (31), Culafic (32), Choe (33)
acutus L.	ácido L-treónico	Helsper (34)
alpinus L.	antraquinonas (reocrisina, crisofanol, emodina, nepodina, diantronas, ácido crisofánico, reomodina, crisofaneína, reocrisina, reocrisidina, reomodina, aglucona X, glucoemodina, antracénoglicósidos), taninos catequinas, naftalenos, benzenos, glucosa, fructosa, galactosa, rhamnosa	Schlemmer (35), Czetsch-Lindenwald (36), Budzik (37, 38) Lukic (39) Adam (40, 41, 42), Bagrii (43), Krmelova (44), Salikhov (13), Bauch (45), Csajtai (46), Babulka (47), Elmazova (48), Van den Berg (49), Chubinidze GD (50)
angustifolius	antraquinonas	Demirezer (51)
bequaertii	antraquinonas (crisofanol, emodina, reocrisina, nepodina)	Midiwo (6)
britannicus	antraquinonas	Rada (52)
bucephalophorus	resveratrol, estilbenos, antraquinonas, flavonoides	Rada (52, 53, 54), El-Fattah (55), Kerem (56)
chalepensis Mill.	antraquinonas, flavonoides glicosados, crisofanol, emodina, parietina, aloe emodina, nepodina, reocrisina	He (16), Hasan (57, 58, 59) Fang (60)
confertus Willd.	antraquinonas, polisacáridos (glucosa, fructosa, sacarosa, arabinosa, xylosa, galactosa, ácido glucurónico), lípidos, flavonoides, astragalina,	Khazanovich (61, 62), Chumbalov (63, 64), Bagrii (12, 65), Brazdova (29), Salikhov (13), Bargman (66), Sayed (67), Stanescu (68, 69),

Especies de Rumex	Componentes Fitoquímicos	Autores
	isoquercitrina, crisofaneina, crisofanol, emodina, frangulina, reocrisina, ácido palmítico, ácido crisofánico, taninos, ácido ascórbico, sustancias resinosas, catequinas	Csajtai (46), Rada (54), Grigorescu (70), Mukhamed'yarova (71), Khomova (72), Glukhovetskaya (73), Danilova (74)
conglomeratus	flavonas, antraquinonas, taninos	Sors (9), Lyuft (10), Niculescu (75), Rada (76), García (77)
crispus L.	antraquinonas (crisofanol, reocrisina, emodina, nepodina, crisofaneina, frangulina, reocrisina) proantocianidinas (cianidina, catequina, epicatequina), ácido ascórbico, proteínas, lípidos, N, P, Fe, Ca, Na, Mn, oxalatos, antocianinas, antracenos, antranolas, taninos, ácido crisofánico, ácido fosfórico, antranas, oxalatos, glucosa, fructosa, fitosterol, ácido palmítico, ácido esteárico, ácido erúgico, ácidos grasos insaturados y saturados, terpeno	Beal (78), Murayama (79), Sors (9), Lyuft (10), Peyer (80), Domsky (81), Raffo (82), Bagrii (12), Brazdova (29), Koukol (83), Sparrow (84), Leveau (85), Sayed (67), de Siqueira (86), He (16), Midiwo (6), Alan (87), Panciera (88), Dabi-Lengyel (89), Demirezer (90, 91, 92), Wiese (93), Gunaydin (94)
cristatus	antraquinonas (emodina, reocrisina, crisofanol, reina, aloe-emodina y α -hidroxiemodina)	Erturk (95)
cyprius Murb.	antraquinonas (crisofanol, emodina), flavonas (isovetexina, orientina, isoorientina, quercetina)	El-Fattah (96), Nanba (97), Al-Nuri (98)
dentatus Linn.	antraquinonas, ácidos grasos	Elkeiy (99), Sayed (67), Bhadoria (100), Khan (101), Liu (102)
dictyocarpus	emodina, crisofanol, quercetina, quercitrina	Guo (103)
domesticus	antraquinonas	Rada (52), Grznar (104)
ecklonianus	fitosterol, ramnol, ácidos palmítico, esteárico, oleico, linoléico, linolénico, isolinolénico, ipuranol, kaemperol, ácido crisofánico, emodina, d-fenilglucosa	Tutin (105)
flexuosus	antraglicósidos	Krmelova (44)
gracilescens Rech.	antraquinonas	Demirezer (51, 91, 106)
gmelini Turcz.	antraquinonas, resveratrol, daucosterol, sacarosa, ácido p-hidroxicinámico	He (16), Kang (107), Wang (108)
Ginii	antraquinonas	Rada (52, 54)
hastatus D. Don	fenoles, taninos, antraquinonas	Tiwari (109), Makkar (110)
híbrido lumeikesi	proteínas, vitamina C, carotenos	Xiong (111)

Especies de Rumex	Componentes Fitoquímicos	Autores
hydrolapathum Huds.	antraglicósidos, antraquinonas, antocianinas, taninos	Sors (9), Czetsch-Lindenwald (36, 112), Olszewski (113), Rada (52, 54), Sparrow (84), Labadie (114, 115), Csajtai (46)
hymenosepalus Torr	antraquinonas (emodina, crisofanol, reocrisina), β -sitosterol, taninos, leucodelphinidina, leucopelargonidina, leucocianidina, ácido benzoico, ester polifenólico	Cole (116), Buchalter (117, 118), Rada (76), Flores (119), Domínguez (120)
intermedius	ácido oxálico, ácido málico, ácido ascórbico	Ruthsatz (121)
japonicus Houtt.	emodina, nepodina, reocrisina, crisofanol, ácido crisofánico, quinolonas, musizina, reocrisina, antimicrobianos (2-metoxiestipandrona, tracrisona), naftoquinonas, proteínas, grasa, carbohidratos, aminoácidos, aceites esenciales (1,2-diacetina), ácidos grasos, β -sitosterol, flavonas, antifúngicos (naftaleno)	Aritomi (11), Odani (122), Endo (123), He (16), Miyazawa (124, 125), Itabashi (126), Nishina (127, 128), Kim (129), Zee (130), Sun (131) Li (132)
japonicus var. hadroocarpus	crisofanol, reocrisina, emodina, taninos	Xu (133)
Rumex crispus var. japonicus Mak. (japonicus Meisn)	ácido crisofánico, emodina	Murayama (79)
k-1 (híbrido)	lípidos, proteínas, flavonas, carbohidratos, vitaminas, fenoles, polisacáridos, antraquinonas	Omarova (134), Khodzhaeva (135)
luminiastrum Jaub & Spach	crisofanol, reocrisina, emodina, crisofanina, emodina-8-O-glucósido, kaempferol-7-ramnoglucósido, quercimeritrina, orientina	El-Fattah (136)
lunaria	taninos, ácido oxálico, oxalatos, antraquinonas	Pérez de Paz (4)
maderensis	taninos, ácido oxálico, oxalatos	Pérez de Paz (4)
maritimus L.	antraquinona, cromona, flavona, reocrisina, emodina, β -sitosterol, β -sitosterol- β -D-glucósido	Brazdova (29), Rada (54), Agarwal (137), Ahmed (138)
mexicanus	antraquinonas	Rada (52)
nepalensis Spreng.	antraquinonas, β -sitosterol, nepodina, emodina, reocrisina, crisofanol	Suri (139), He (16), Khetwal (140)
nepalensis Wall.	crisofanol, emodina, reocrisina, lupeol, sitosterol, musizina, orientalona	Sharma (141)

Especies de Rumex	Componentes Fitoquímicos	Autores
nervosus Vahl.	D-glucosa, ácido D-glucurónico, glucosa, sacarosa, fructosa, arabinosa, rhamnosa, xylosa, galactosa, aminoácidos libres, aminoácidos protéicos, ácidos cítrico, tartárico y succínico, taninos, flavonas, β -sitosterol, ácidos linolénico, esteárico y palmítico	Shalaby (142)
obtusifolius L.	antraquinonas (nepodina, emodina, aloe-emodina, reocrisina, crisofanol, crisofaneina, frangulina, reocrisina), γ -Glutamil-péptidos, 3-(2-furoyl)-alanina, ácido ascorbalámico, ácido crisofánico, alfa-picolina, carbohidrato, Ca, P, aminoácidos (alanina, metionina), citoquinas (zeatina, kinetina), giberelinas, glucósidos	Veronesi (143), Wilkinson (144), Bowman (145), Elkeiy (99), Brazdova (29, 146), Felipe (147), Van Staden (148), Haslett (149), Rada (53, 54), Sayed (67), Voigtlaender (150), Kasai (151), He (16), Arellano (152), Nashiki (153, 154)
odontocarpus	taninos	Sors (9)
orientalis Bernh.	antraquinonas (nepodina, emodina, tricosanol, orientalona), β -sitosterol	Rada (76), Sharma (155), Grznar (104), Suri (156)
palustris Sm.	taninoss	Sors (9)
patientia L.	estigmasterol, γ -asarina, reocrisina, emodina, nepodina, crisofanol, xantorina, arctiina, kaempferol, quercetina, isoramnosa, flavonas, antraquinonas, taninos, ácido gálico, catequinas, naftalenos (patientósido A y B, rumexosidolabadósido, orientalósido), flavonas, vitamina C, ácido abscísico, β -sitosterol, catequinas	Sors (9), Lyuft (10), Schlemmer (35), Muskat (157), Rada (158), Csajtai (46), He (16), Zhang (159), Su (160, 161), Demirezer (162, 163), Kuruuzum (164), Yuan (165), Gao (166)
paulsenianus	ácidos oxigenados, β -sitosterol, campesterol, estigmasterol, antraquinonas (crisofanol, reocrisina, aloe-emodina)	Gusakova (167, 168)
pictus Forssk.	flavonas, alcaloides dipertenos (orientinina, acorientina, panicudina), taninos	Salama (169, 170, 171)
pulcher L.	antraquinonas, taninos, kinetina, adenina, emodina, pulcheremodina, ácido crisofánico, ácido pulcherínico	Emmanuel (172), Back (173), Csajtai (46), Harborne (174)
rechingerianus Losinsk.	antraquinonas	Taraskina (175), Vysochina (176, 177), Gontar (178)
ruwenzoriensis	antraquinonas	Midiwo (6)
sanguineus	antraquinonas, antocianina, taninos	Sors (9), Lyuft (10), Sparrow (84), Krmelova (44), Grznar (104)

Especies de Rumex	Componentes Fitoquímicos	Autores
scutatus	antraquinonas	Krmelova (44), Demirezer (179)
stenophyllus	nepodina, emodina, reocrisina, crisofanol	He (16)
thyrsoflorus	flavonas (rutina, hiperina), antraquinonas	Rada (52), Volkhonskaya (180)
tianschanicus Losinsh.	esculetina, Ca, P, K, ácido carboxílico, aminoácidos, Mn, Fe, Zn, Cu, B, Mo, carbohidratos, taninos, caroteno, ácido ascórbico, polifenoles, flavonas, catecolaminas, leucoantocianidinas	Chumbalov (181), Yakubov (182, 183), Lysenko (184, 185), Pershukova (186), Pipinys (187, 188), Vitkus (189), Smaliukas (190), Zaitsev (191), Klyshev (192), Pribytkova (193)
tingitanus L.	antraquinonas (crisofanol, reocrisina, emodina, aloe-emodina, crisofaneína), flavonas (apigenina, luteolina, catequina)	Zaghloul (194)
usambarensis	antraquinonas (crisofanol, reocrisina, emodina)	Midiwo (6)
venosus	oxalatos	Dickie (195)
vesicarius L.	taninos, esteroides, triterpenos, carbohidratos, antraquinonas (crisofanol, emodina, reocrisina, reina), flavonas (apigenina, isoorientina, isovitexina, luteolina, orientina, quercetina, vitexina), esteroides (β -sitosterol, estigmasterol, campesterol, colesterol), ácidos grasos (hexanoico, octanoico, nonanoico, decanoico, undecanoico, dodecanoico, tridecanoico, mirístico, pentadecanoico, palmítico, palmitoléico, heptadecanoico, esteárico, linoléico, linolénico y araquídico), aminoácidos	Rai (196), Tiwari (197), Easa (198), Bishr (199)
wallichii	antraquinonas (crisofanol, emodina)	Ciulei (200)

BIBLIOGRAFÍA

1. de Bolos A.: Plantas Medicinales En: Soler y Batllé E. Medicamenta. Barcelona: Ed. Labor, 1951.
2. Pérez de Paz PL, Hernández Padrón CE. Plantas medicinales o útiles en la flora canaria. Aplicaciones populares. La Laguna: Ed. Lemus, 1999.
3. Otero JJ. Hierbas Medicinales Canarias. Las Palmas de Gran Canaria: Ed. La Caja de Canarias, 1993.
4. Pérez de Paz PL, Medina Medina I. Catálogo de las plantas medicinales de la flora canaria. Aplicaciones populares. La Laguna: Instituto de Estudios Canarios, 1988.
5. Fassil Y, Bezabeh A, Abegaz B, Botta B, delle Monache G, delle Monache F. Anthracene derivatives from *Rumex abyssinicus*. *Journal of Natural Products* 1985; 48 (1): 148.
6. Midiwo JO, Rukunga GM. Distribution of anthraquinone pigments in *Rumex* species of Kenya. *Phytochemistry* 1985; 24 (6): 1390-1391.
7. Gregg AH. *Rumex acetosa* L. *Tidsskrift for Kemi, Farmaci og Terapi* 1914; 11: 241-244.
8. Purdir IA. The oxalate content of *Rumex acetosa* and *Oxalis acetosella*. *Chemist and Druggist* 1927; 106: 127-128.
9. Sors P. Investigations on the tannin content of native species of *Rumex*. I. Sour dock, the new vegetable tannin. *Collegium* 1930; 324-329.
10. Lyuft A. Experimental cultivation of *Rumex*, sumac and *Bergenia crassifolia*. *Kozhevenno-Obuvnaya Promyshlennost SSR* 1940; 19 (8): 30-31.
11. Aritomi M, Kiyota I, Mazaki T. Flavonoid constituents in leaves of *Rumex acetosa* Linnaeus and *R. japonicus* Houttuyn. *Chemical & Pharmaceutical Bulletin* 1965; 13 (12): 1470-1471.
12. Bagrii OK. Anthraglycoisdes of some *Rumex* species. *Farmatsevtichnii Zhurnal* 1965; 20 (1): 54-57.
13. Salikhov SA, Sagatov SS, Khusnutdinov KK. Comparative biological study of some *Rumex* species in a crop. *Doklady Akademii Nauk UzSSR* 1971; 28 (4): 59-60.
14. Sharma M, Rangaswami S. Chemical components of the roots of *Rumex acetosa*: isolation of α -acetoxyaloe emodin, a new 1,8-dihydroxyanthraquinone derivative. *Indian Journal of Chemistry* 1977; 15B (10): 884-885.
15. Ito H. Antitumor agents from *Rumex acetosa*. Patent No. JP 55157516 1980.
16. He LY, Chen BZ, Xiao PG. Survey, identification and constituent analysis of Chinese herbal medicines from the genus *Rumex*. *Yaoxue Xuebao* 1981; 16 (4): 289-293.
17. Tamano M, Koketsu J. Isolation of hydroxyanthrones from the roots of *Rumex acetosa* Linn. *Agricultural and Biological Chemistry* 1982; 46 (7): 1913-1914.
18. Kato T, Morita Y. Anthraquinone components in *Rumex acetosa* L. *Shoyakugaku Zasshi* 1987; 41 (1): 67-74.
19. Slapkauskaite G, Varnaite R. *Biologijos Mokslai* 1988; 4: 25-28.
20. Ladeji O, Okoye Z. Chemical análisis of sorrel leaf (*Rumex acetosa*). *Food Chemistry* 1993; 48 (2): 205-206.
21. Ladeji O, Okoye Z, Waidu Z. Effect of supplementation of laboratory chow with leaves of *Rumex acetosa* (sorrel) on body weight and serum levels of amino acids and minerals in rats. *Food Chemistry* 1997; 59 (1): 15-17.
22. Pilipenko LN, Kolesnik AA. Lipids of the leafy vegetables *Spinacea oleracea*, *Lactuca sativa* and *Rumex acetosa*. *Khimiya Priorodnykh Soedinenii* 1993; 2: 199-205.
23. Saleh N, El-Hadidi M, Arafa R. Flavonoids and anthraquinones of some Egyptian *Rumex* species (*Polygonaceae*). *Biochemical Systematics and Ecology* 1993; 21 (2): 301-303.
24. Rijnders J, Yang Y, Kamiya Y, Takahashi N, Barendse G, Blom C et al. Ethylene enhances gibberellin levels and petiole sensitivity in flooding-tolerant *Rumex palustris* but not in flooding-intolerant *R. acetosa*. *Planta* 1997; 203 (1): 20-25.
25. Xiong J. Use of hybrid *rumex acetosa*. Patent No. CN 1227219 1999.
26. Xiong J. Use of hybrid *rumex acetosa* l. in production of wheat flour-containing product. Patent No. WO 9958473 1999.
27. Stokes TS, Mander LN, Croker SJ, Twitchin B, Hanke DE. 3 β , 13-dihydroxylated C20 gibberellins from inflorescences of *Rumex acetosa* L. *Phytochemistry* 2003; 62 (2): 165-174.
28. Orlandini C. The natural poisoning of hens by acid sorrel (*Rumex Acetosella*) and experiments on poisoning by oxalic acid and potassium binoxalate. *Bolletino della Societa Eustachiana* 1933; 31: 217-229.
29. Brazdova V, Krmelova V, Rada K, Starhova H. Anthracene derivatives in *Rumex* species. II. Anthraquinone content in some *Rumex* species. *Scientia Pharmaceutica* 1967; 35 (2): 116-119.
30. Martinod P, Hidalgo J, Guevara C, Medina M, Artega M. Study on anthraquinones in *Rumex acetosella* L. (*Acederilla*). *Politécnica* 1978; 4 (1): 34-44.
31. Jelic G, Culafic L, Kapor S, Neskovic M. Endogenous cytokinins in the vegetative and reproductive phases of development in the dioecious plant *Rumex acetosella* L. *Plant Growth Regulation* 1988; 71 (1): 53-58.
32. Culafic LJ, Tesevic V, Dokovic D, Kozomara B. Endogenous cytokinins in flowers of male and female clones of *Rumex acetosella* L. *Physiol. Biochem. Cytokinins Plants* 1992; 381-383.
33. Choe SG, Hwang BY, Kim MS, Oh GJ, Lee KS, Ro JS. Chemical components of *Rumex acetosella* L. *Saengyak Hakhoechi* 1998; 29 (3): 209-216.
34. Helsper JP, Loewus FA. Metabolism of L-threonic acid in *Rumex acutus* L. *Plant Physiology* 1982; 69 (6): 1365-1368.
35. Schlemmer F, Gentner O. Pharmaceutical-chemical investigations on *Rumex alpinus* L. and *Rumex patientia* L. *Arch. Pharm.* 1940; 278: 252-283.
36. Czetsch-Lindenwald H. *Rumex alpinus* and *Rumex hydrolapathum* as raw materials for the preparation of galenicals. *Deut. Heilpflanze* 1943; 9: 99-101.
37. Budzik VD. The quantitative determination of oxymethylantraquinones in the rhizomes, roots and fruits of *Rumex alpinus*. *Trudy Lvov Med. Inst.* 1957; 12: 136-140.
38. Budzik VD. Accumulation of free and bound (hydroxymethyl) anthraquinone in *Rumex alpinus*. *Farmatsevtichnii Zhurnal* 1961; 16 (6): 52-55.
39. Lukic PB. Anthraquinone content in the rhizome and root of *Rumex alpinus*. *Planta Medica* 1959; 7: 400-405.
40. Adam L. Chemical and biological study of *Rumex alpinus*. *Orv. Szemle* 1962; 8: 292-296.
41. Adam L, Hints M, Kisgyorgy Z. Commercial exploitation of *Rumex alpinus*. I. Distribution of anthracene derivatives in the plant organs and factors influencing the quality of the drug. *Farmacia* 1965; 13 (3): 143-148.
42. Adam L, Hints M, Kisgyorgy Z. The valorization of the plant *Rumex alpinus*. II. Dynamics of anthracene derivatives and tannin accumulation in the subterranean organs of the plant. *Farmacia* 1965; 13 (7): 411-416.
43. Bagrii OK. Isolation and investigation of glycosides from *Rumex alpinus*. *Farmatsevtichnii Zhurnal* 1963; 18 (3): 47-52.
44. Krmelova V, Starhova H. Anthraglycoisdes in some *Rumex*

- species. Acta Facultatis Pharmaceuticae Universitatis Comenianae 1969; 17: 123-126.
45. Bauch HJ, Labadie RP, Leistner E. Biosynthesis of nepodin (2-acetyl-methylnaphthalene-1,8-diol) in *Rumex alpinus*. Journal of the Chemical Society 1975; 7: 689-692.
 46. Csajtai M. Comparative investigation of the anthraglycoside content of preparations from Hungarian rheum and rumex varieties. Gyogyyszereszet 1975; 19 (9): 333-335.
 47. Babulka P. Study on the rhizomes and roots of alpine dock (*Rumex alpinus* L.). Acta Pharmaceutica Hungarica 1980; 50 (4): 177-182.
 48. Elmazova L. Anthraquinone composition of some *Rumex* species. Farmatsiya 1980; 30 (4): 38-41.
 49. Van den Berg AJ, Labadie RP. The production of acetate derived hydroxyanthraquinones, -dianthrones, -naphthalenes and -benzenes in tissue cultures from *Rumex alpinus*. Planta Medica 1981; 41 (2): 169-173.
 50. Chubinidze GD, Turabelidze DG, Tsitsishvili VG, Kikoladze VS. Carbon-13 NMR study of anthraquinone derivatives from *Rumex alpinus*. Khimiya Prirodnikh Soedinenii 1987; 6: 908-909.
 51. Demirezer LO. Quantitative determination of some *Rumex* species with regards of anthraquinone derivatives. Pharmazie 1994; 49 (12): 936-937.
 52. Rada K, Starhova H, Brazdova V, Krmelova V. Anthracene derivatives in some *Rumex* species. III. Cesko-Slovenska Farmacie 1967; 16 (7): 349-351.
 53. Rada K, Hrochova V, Starhova H, Brazdova V. Anthraquinone derivatives in some *Rumex* species. Acta Facultatis Pharmaceuticae Universitatis Comenianae 1974; 25: 153-175.
 54. Rada K, Hrochova V. Anthraquinone in some *Rumex* species. Herba Hungarica 1975; 14 (2-3): 7-14.
 55. El-Fattah H, El-Dahmy S, Abdel-Aal M, Halim AF, Abdel-Halim, O. Phenolic constituents from *Rumex bucephalophorus* growing in Libya. Zagazig Journal of Pharmaceutical Sciences 1994; 3 (1): 88-91.
 56. Kerem Z, Regev-Shoshani G, Flaishman M, Sivan L. Resveratrol and two monomethylated stilbenes from Israeli *Rumex bucephalophorus* and their antioxidant potential. Journal of Natural Products 2003; 66 (9): 1270-1272.
 57. Hasan A, Ahmed I, Jay M, Voirin B. Flavonoid glycosides and an anthraquinone from *Rumex chalepensis*. Phytochemistry 1995; 39 (5): 1211-1213.
 58. Hasan A, Ahmed I. Antibacterial activity of flavonoid glycosides from the leaves of *Rumex chalepensis*. Fitoterapia 1996; 67 (2): 182-183.
 59. Hasan A, Ahmed I, Khan MA. A new anthraquinone glycoside from *Rumex chalepensis*. Fitoterapia 1997; 68 (2): 140-142.
 60. Fang Z, Yu J. Study on hemostatic constituent in *Xue Dang Gui* (*Rumex chalepensis* Mill). Zhongcaoyao 1982; 13 (7): 6-7.
 61. Khazanovich RL. Examination of horse sorrel, *Rumex confertus* Willd: chemical analysis. Farmatsiya 1940; 12: 24-28.
 62. Khazanovich RL. Analysis of sorrel (*Rumex confertus* Willd). III. Analysis of the anthraglycosides. Farmatsiya 1941; 2: 30-35.
 63. Chumbalov TK, Mukhamed'yarova MM. Chemical composition of *Rumex confertus*. Khim. Sostava Rast. 1962; 51-59.
 64. Chumbalov TK, Mukhamed'yarova MM. Study of the chemical composition of roots of *Rumex confertus* by paper chromatography. Khim. i Khim. Teknol. 1964; 2: 209-211.
 65. Bagrii OK, Krivenchuk PE. Glycoside isolated from *Rumex confertus* roots. III. Farmatsevtichnii Zhurnal 1964; 19 (2): 80-84.
 66. Bargman LI. Polyphenol compounds of *Rumex confertus* growing in the Tashkent area. Tashk. Gos. Med. Inst. 1972; 51-52.
 67. Sayed MD, Balbaa SI, Afifi MS. Anthraquinone content of certain *Rumex* species growing in Egypt. Egyptian Journal of Pharmaceutical Sciences 1974; 15 (1): 1-10.
 68. Stanescu U, Grigorescu E. Plant tissue culture and possible applications in pharmaceutical practice. IV. Isolation and characterization of some secondary metabolites from *Rumex confertus* Willd. tissue cultures. Chrysophanic acid. Revista Medico-Chirurgicala 1974; 78 (4): 937-940.
 69. Stanescu U, Grigorescu E. Plant tissue culture and possible applications in pharmaceutical practice. V. Isolation and characterization of some secondary metabolites from *Rumex confertus* Willd. tissue cultures. Palmitic acid. Revista Medico-Chirurgicala 1974; 78 (4): 941-946.
 70. Grigorescu E, Stanescu U. Appearance of a palmitic acid lipopigment in the in vitro cultures of *Rumex confertus* Willd. Plantes Medicinales et Phytotherapie 1976; 10 (3): 192-198.
 71. Mukhamed'yarova MM, Chumbalov TK. Flavonoids of *Rumex confertus*. Khimiya Prirodnikh Soedinenii 1979; 6: 853.
 72. Khomova TV, Gusakova SD, Glushenkova AI. Lipids of *Rumex confertus*. Khimiya Prirodnikh Soedinenii 1989; 2: 284-285.
 73. Glukhovetskaya ZV, Sirenko GT, Khaleeva OL. The polysaccharide complex of horse sorrel (*Rumex confertus*). Farmatsevtichnii Zhurnal 1991; 1: 78-80.
 74. Danilova NA, Belyakov KV, Popov DM. Identification and quantitative determination of anthracene derivatives in roots of *Rumex confertus*. Farmatsiya 2000; 49 (5-6): 26-28.
 75. Niculescu GH, Lascar-Constantinescu E, Avram L. The utilization of *Rumex conglomeratus*. Farmacia 1959; 7: 361-368.
 76. Rada K, Brazdova V. Anthracene derivatives in some *Rumex* species (*R. conglomeratus*, *R. hymenosepalus*, *R. orientalis*). Cesko-Slovenska Farmacie 1972; 21 (7): 302-305.
 77. García JL, Rodríguez B. Flavonoids of *Rumex conglomeratus*. Anales de Química 1978; 74 (12): 1570-1572.
 78. Beal GD, Okey RE. A proximate analysis of *Rumex crispus* and a comparison of its hydroxymethylanthraquinone with those from certain other drugs. Journal of The American Chemical Society 1919; 41: 693-706.
 79. Murayama Y, Itagaki T. Constituents of the root of *Rumex crispus* L. var. *japonicus* Makino. II. Yakugaku Zasshi 1921; 470: 327-330.
 80. Peyer W, Weber U. *Rumex* fruits as tannin carriers. Pharmazeutische Zentralhalle fuer Deutschland 1941; 82: 181-186.
 81. Domsy I. Lipide portions of *Rumex crispus*. Ann. Arbor Mich. 1959; 1166.
 82. Raffo JJ, Molfino CE. Estudio fitoquímico de la raíz de *Rumex crispus*. Revista Farmacéutica 1962; 104: 151-155.
 83. Koukol J, Dugger WM Jr. Anthocyanin formation as a response to ozone and smog treatment in *Rumex crispus*. Plant Physiology 1967; 42 (7): 1023-1024.
 84. Sparrow AH, Furuya M, Schwemmer S. Effects of x- and gamma radiation on anthocyanin content in leaves of *Rumex* and other plant genera. Radiat. Biol. 1968; 8 (1): 7-16.
 85. Leveau AM, Durand MA. Anthracene derivatives in *Rumex crispus* var *Major*. Comptes Rendus des Seances de la Societe de Biologie et de ses Filiales 1969; 163 (12): 2662-2665.
 86. de Siquiera NC, Brasil G, Bauer L, Sant'ana BM. Hidroxiantraquinonas en *Rumex crispus* L. del sur de Rio Grande. Revista do Centro de Ciencias Biomédicas 1977; 5 (3-4): 69-74.
 87. Alan R, Padem H. Research on the composition of *Rumex crispus* L., *Atriplex patula* L., *Polygonum aviculare* L., *Prangos uechtritzii* Boiss., and *Tragopogon reticulatus* Boiss., used in

- human nutrition in Erzurum, Turkey. *Turk Tarim ve Ormancilik Dergisi* 1990; 14 (2): 48-57.
88. Panciera R, Martin T, Burrows GE, Taylor D, Rice LE. Acute oxalate poisoning attributable to ingestion of curly dock (*Rumex crispus*) in sheep. *Journal of the American Veterinary Medical Association* 1990; 196 (12): 1981-1984.
 89. Dabi-Lengyel E, Jambor E, Danos B, Tetenyi P. Chemical composition and biological activity of the *Rumex crispus* L. crop. *Herba Hungarica* 1991; 30 (1-2): 91-97.
 90. Demirezer LO. Concentrations of anthraquinone glycosides of *Rumex crispus* during different getation stages. *Journal of Biosciences* 1994; 49 (7-8): 404-406.
 91. Demirezer LO. Anthraquinone derivatives in *Rumex gracilescens* and *R. crispus*. *Pharmazie* 1994; 49 (5): 378-379.
 92. Demirezer LO, Kuruuezuem A. Determination of the cytotoxicity of *Rumex crispus* during the vegetation period using a brine shrimp bioassay. *Zeitschrift fuer Naturforschung C: Biosciences* 1995; 50 (5/6): 461-462.
 93. Wiese B, Quiroga OE, Vigo MS, Nolasco SM. Chemical composition of *Rumex crispus* L. seed. *Journal of the American Oil Chemists' Society* 1995; 72 (9): 1077-1078.
 94. Gunaydin K, Topcu G, Ion RM. 1,5-Dihydroxyanthraquinones and an anthrone from roots of *Rumex crispus*. *Natural Product Letters* 2002; 16 (1): 65-70.
 95. Erturk S, Ozbas M, Imre S. Anthraquinone pigments from *Rumex cristatus*. *Acta Pharmaceutical Turcica* 2001; 43 (1): 21-22.
 96. El-Fattah HA. Anthraquinones and C-flavonoids of *Rumex cyprius* Murb. *Mansoura Journal of Pharmaceutical Sciences* 1989; 6 (1): 141-148.
 97. Nanba T, Kadota S, Shimomura K, Lida K, Yamabe Y. Cosmetics containing extracts of *Rumex cyprius*. Patent No. JP 08067615 1994.
 98. Al-Nuri MA, Za'tar NA, Abu-Eid MA, Hannoun MA, Al-Jondi WJ, Hussein A et al. Emodin, a naturally occurring anthraquinone: its isolation and spectrophotometric determination in *Rumex cyprius* plant. *Spectroscopy Letters* 1996; 29 (8): 1539-1543.
 99. Elkeiy MA, Sayed MD, Moustafa MA. The anthraquinone contents of *Rumex* species. *J. Pharm. Sci. U. Arab Rep.* 1964; 5: 209-219.
 100. Bhadoria BK, Gupta RK. Chemical investigation of *Rumex dentatus* Linn. *Journal of the Indian Chemical Society* 1977; 54 (12): 1200-1201.
 101. Khan AS. Composition of the fatty acid fraction of *Cardaria chalepense* and *Rumex dentatus*. *Science International* 1991; 3 (4): 285-286.
 102. Liu SY, Sporer F, Wink M, Jourdan J, Henning R, Li YL, Ruppel A. Anthraquinones in *Rheum plamatum* and *Rumex dentatus* (polygonaceae) and phorbol esters in *Jatropha curcas* (Euphorbiaceae) with molluscicidal activity against the schistosomiasis vector snails *Oncomelania*, *Biomphalaria* and *Bulinus*. *Tropical Medicine & International Health* 1997; 2 (2): 179-188.
 103. Guo LH, Zhu R, Hui Y, Wang L. Chemical constituents of *Rumex dictyocarpus*. *Xi'an Yike Daxue Xuebao* 1990; 11 (4): 346-348.
 104. Grznar K, Rada K. Isolation and identification of anthraquinone derivatives from the leaves of some *Rumex* species. *Farmaceuticky Obzor* 1978; 47 (5): 195-199.
 105. Tutin F, Clewer HWB. Constituents of *Rumex ecklonianus*. *Proc. Chem. Soc.* 1910; 25: 302.
 106. Demirezer LO, Strietzel I, Zecek A. Anthraquinones from *Rumex gracilescens* Rech. *Hacettepe Universitesi Eczacilik Fakultesi Dergisi* 1995; 15 (2): 77-79.
 107. Kang Y, Wang Z, Li J, Liu L. Isolation and identification of two anthraquinones from *Rumex gmelini* Turcz. *Zhongguo Zhongyao Zazhi* 1996; 21 (12): 741-742.
 108. Wang Z, Cai X, Kang Y, Wei F. Structure of 2 compounds from the root of *Rumex gmelini*. *Zhongcaoyao* 1996; 27 (12): 714-716.
 109. Tiwari RD, Sinha KS. Chemical examination of *Rumex hastatus* D. Don. *Indian Journal of Chemistry* 1980; 19B (6): 531-532.
 110. Makkar HPS, Singh B, Vats SK, Sood RP. Total phenols, tannins and condensed tannins in different parts of *Rumex hastatus*. *Bioresource Technology* 1993; 45 (1): 69-71.
 111. Xiong J. An application of Lumeikesi hybrid rumex in production of fertilizer. Patent No. WO 9958473 1999.
 112. Czetsch-Lindenwald H, Kuntze F. The usefulness of the great water dock (*Rumex hydrolapatum* Huds) for technical tanning purposes. *Collegium* 1943; 140-145.
 113. Olszewski HZ, Kubis A, Szykielewski A. Effects of stabilization of bacteriostatic properties of dry extracts from leaves of *Juglans regia* and from roots and rhizomes of *Rumex hydrolapathum*. *Acta Polon. Pharm.* 1964; 21 (1): 65-69.
 114. Labadie RP, Scheffer JJ, Svendsen AB. Anthracene derivatives in *Rumex hydrolapathum*. I. *Pharmaceutisch Weekblad* 1972; 107 (34): 535-539.
 115. Labadie RP, Otten J, Svendsen AB. Anthracene derivatives in *Rumex hydrolapathum*. *Pharmaceutisch Weekblad* 1972; 107 (35): 541-547.
 116. Cole J, Buchalter L. Isolation of a potential antitumor fraction from *Rumex hymenosepalus*. *Journal of Pharmaceutical Sciences* 1965; 54 (9): 1376-1378.
 117. Buchalter L, Cole J. Isolation of a potential antitumor fraction from *Rumex hymenosepalus*. II. *Journal of Pharmaceutical Sciences* 1967; 56 (8): 1033-1034.
 118. Buchalter L. Isolation and identification of emodin (1,3,8-trihydroxy-methylanthraquinone) from *Rumex hymenosepalus*, family polygonaceae. *Journal of Pharmaceutical Sciences* 1969; 58 (7): 904.
 119. Flores JE, León GE, Gutiérrez C, Cantua S. Novel method for simultaneous extraction of tannin extracts and starches from Canaigre roots, *Rumex hymenosepalus* Torr. *Journal of the American Leather Chemists Association* 1986; 81 (12): 389-393.
 120. Domínguez S, Rombold C, Espinosa G, García M, Dora E. Identificación de emodina, crisofanol y physcion de las raíces de canagria, *Rumex hymenosepalus* Torr. *Revista Latinoamericana de Química* 1991; 22 (1-2): 45-46.
 121. Ruthsatz B. Effect of various kinds of nitrogen fertilizers on the acid level and water economy in *Fagopyrum esculentum* and *Rumex intermedius*. *Morphologie und Geobotanik* 1967; 157 (1): 36-55.
 122. Odani T, Shin H, Kubo M. Studies on the antifungal substance of crude drugs. I. The root of *Rumex japonicus* Houtt. *Shoyakugaku Zasshi* 1977; 31 (2): 151-154.
 123. Endo S, Kubozoe K, Kitamura Ch, Shibuya F, Mitsuhashi T. Seed oils of *Rumex japonicus*, *Salvia officinalis* and *Ophiopogon japonicus*. *Sugaku Shizen Kagaku* 1978; 30: 77-80.
 124. Miyazawa M, Tanaka S, Kameoka H. The constituents of the essential oil from *Rumex japonicus* Houtt. *Yakugaku Zasshi* 1981; 101 (7): 660-662.
 125. Miyazawa M, Kameoka H, Musizin. A new antioxidant isolated from *Rumex japonicus*. *Chemistry Express* 1991; 6 (5): 343-346.

126. Itabashi M, Takamura N. Nutritional compositions of the leaves of *Petasites japonicus* Miq., *Ligularia tussilaginea* Makino, *Arctium lappa* L. and *Rumex japonicus* Houttuyn. *Nippon Shokuhin Kogyo Gakkaishi* 1985; 32 (2): 1201-23.
127. Nishina A, Kubota K, Kameoka H, Osawa T. Antioxidizing component, musizin, in *Rumex japonicus* Houtt. *Journal of the American Oil Chemists' Society* 1991; 68 (10): 735-739.
128. Nishina A, Suzuki H. Naphthoquinone derivative of *Rumex japonicus* and *Rheum* as microbicide for foods. Patent No. JP 05238983 1993.
129. Kim DK, Choi SU, Ryu SY, Lee KR, Zee OP. Cytotoxic constituents of *Rumex japonicus*. *Yakhak Hoechi* 1998; 42 (3): 233-237.
130. Zee OP, Kim DK, Kwong HCh, Lee KR. A new epoxynaphthoquinol from *Rumex japonicus*. *Archives of Pharmacological Research* 1998; 21 (4): 485-486.
131. Sun X, Zhou X, Zhu L, Wei B. Influence of different active components of *Rumex japonicus* Hott on agonist-induced contraction of thoracic aorta. *Nanjing Yike Daxue Xuebao* 1999; 19 (6): 488-490.
132. Li YP, Takamiyagi A, Ramzi ST, Nonaka S. Inhibitory effect of *Rumex japonicus* Houtt on the porphyrin photooxidative reaction. *Journal of Dermatology* 2000; 27 (12): 761-768.
133. Xu ZW. Study on chemical constituents of *Rumex japonicus* var. *hadrocarpus*. *Zhongyao Tongbao* 1981; 6 (2): 29-30.
134. Omarova MA, Artamonova NA, Chasovitina GM. Chemical composition of the hybrid *Rumex K-1*. *Chemistry of Natural Compounds* 1998; 34 (4): 426-428.
135. Khodzhaeva MA, Turakhzhaev MT, Saifulaev KI, Shakhidoyatov KM. Chemical composition of the aerial part of *Rumex K-1*. *Chemistry of Natural Compounds* 2002; 38 (6): 524-526.
136. El-Fattah HA, Gohar A, El-Dahmy S, Hubaishi A. Phytochemical investigation of *Rumex luninistrum*. *Acta Pharmaceutica Hungarica* 1994; 64 (3): 83-85.
137. Agarwal JS, Rastogi RP, Srivastava OP. In vitro toxicity of constituents of *Rumex maritimus* Linn. To ringworm fungi. *Current Science* 1976; 45 (17): 619-620.
138. Ahmed M, Datta B, Rouf ASS. Anthraquinone, chromone and flavone derivatives from *Rumex maritimus*. *Pharmazie* 1991; 46 (7): 548-549.
139. Suri JL, Dhar KL, Atal CK. Chemical components of *Rumex nepalensis* Spreng. *Journal of the Indian Chemical Society* 1976; 53 (11): 1158-1159.
140. Khetwal KS, Manral K, Pathak RP. Constituents of the aerial parts of *Rumex nepalensis* Spreng. *Indian Drugs* 1987; 24 (7): 328-329.
141. Sharma M, Rangaswami S, Sharma P. Crystalline chemical components of the roots of *Rumex nepalensis* Wall. *Indian Journal of Chemistry* 1978; 16B: 289-291.
142. Shalaby AF, Etman MA, Reda K, Shams HMA. Phytochemical studies on *Rumex nervosus* Vahl growing naturally in Yemen. *Journal of the Faculty of Science Riyadh University* 1979; 10: 57-83.
143. Veronesi B. Anthraquinones in *Rumex obtusifolius* var. *Agrestis*. *Atti della Società dei Naturalisti e Matematici di Modena* 1974; 78: 97-108.
144. Wilkinson S. Alpha-picoline from *Rumex obtusifolius* L. *Nature* 1958; 181 (4609): 636-637.
145. Bowman RE, Falshaw CP, Franklin CS, Johnson AW, King TJ. 2-acetyl-3-methyl-1,8-naphthalenediol and its 8-glucoside, constituents of the broad-leaved dock, *Rumex obtusifolius*. *Journal of the Chemical Society* 1963; 1340-1342.
146. Brazdova V, Hrochova V, Rada K, Starhova H. Anthracene derivatives in some species of the genus *Rumex*. IV. *Cesko-Slovenska Farmacie* 1969; 18 (7): 337-340.
147. Felipe GM, Gherardi, E, Penteadó LBK, Annes VCS, Sene CM. Detection of gibberellins during germination of *Rumex obtusifolius*. *Arquivos do Instituto Biológico* 1970; 37 (3): 177-187.
148. Van Staden J, Wareing PF. Effect of light on endogenous cytokinin levels in seeds of *Rumex obtusifolius*. *Planta* 1972; 104 (2) 126-133.
149. Haslett B, Bailey ChJ, Ramshaw JAM, Scawen MD, Boulter D. The amino acid sequence of plastocyanin from *Rumex obtusifolius*. *Phytochemistry* 1978; 17 (4): 615-617.
150. Voigtlaender G, Lang V, Kuehbauch W. Metabolism of reserve carbohydrates of *Rumex obtusifolius* and *Polygonum bistorta*. *Landwirtschaftliche Forschung* 1976; 29 (2): 109-117.
151. Kasai T, Okuda M, Sakamura S. Gamma-glutamyl peptides, 3-(2-furoyl)-alanine and ascorbalamic acid in roots of *Rumex obtusifolius* L. *Agricultural and Biological Chemistry* 1980; 44 (11): 2723-2724.
152. Arellano C. Identificación de antraquinonas de *Rumex obtusifolius* L. *Revista Peruana de Bioquímica* 1988; 8 (2): 20-21.
153. Nashiki M, Suyama T, Meguro R, Kato T. In vitro dry matter digestibility and chemical composition of *Rumex obtusifolius* L. in pastures. *Zasso Kenkyu* 1991; 36 (2): 118-125.
154. Nashiki M, Meguro R, Fukuda E. Effect of cutting on carbohydrate content of *Rumex obtusifolius* L. *Zasso Kenkyu* 1998; 43 (3): 274-276.
155. Sharma M, Sharma P, Rangaswami S. Orientalone, a new 1,4-naphthoquinone from *Rumex orientalis*. *Indian Journal of Chemistry* 1977; 15B (6): 544-545.
156. Suri JL, Dhar KL, Atal CK. Chemical constituents of *Rumex orientalis* Bernh. *Journal of the Indian Chemical Society* 1978; 55 (3): 292-293.
157. Muskat E. Influence of temperature on the vitamin C content of english spinach (*Rumex patientia* L.) during growth. *Experientia* 1963; 19: 355-357.
158. Rada K, Starhova H. Anthracene derivatives in *Rumex* species. II. Active substances in *Rumex patientia* of different origin. *Pharmazie* 1967; 22 (9): 521-524.
159. Zhang Y. Removal of nitrogen and zinc from wastewater by *Rumex patientia* L. and plant nutrient composition. *Ziran Kexueban* 1988; 8 (3): 36-39.
160. Su YZ, Gao LM, Zheng XD, Zheng SZ, Shen XW. Anthraquinones from *Polygonum rumex patientia* L. *Ziran Kexueban* 2000; 36 (3): 47-49.
161. Su YZ, Gao LM, Zheng XD, Zheng SZ, Shen XW. Flavonoids from *Polygonum rumex patientia* L. *Ziran Kexueban* 2000; 36 (3): 50-52.
162. Demirezer LO, Kuruuzum A, Bergere I, Schiewe HJ, Zeeck A. Five naphthalene glycosides from the roots of *Rumex patientia*. *Phytochemistry* 2001; 56 (4): 399-402.
163. Demirezer LO, Kuruuzum A, Bergere I, Schiewe HJ, Zeeck A. The structures of antioxidant and cytotoxic agents from natural source: anthraquinones and tanins from roots of *Rumex patientia*. *Phytochemistry* 2001; 58 (8): 1213-1217.
164. Kuruuzum A, Demirezer LO, Bergere I, Zeeck A. Two new chlorinated naphthalene glycosides from *Rumex patientia*. *Journal of Natural Products* 2001; 64 (5): 688-690.
165. Yuan Y, Chen W, Zheng S, Yang G, Zhang W, Zhang H. Studies on chemical constituents in root of *Rumex patientia* L. *Zhongguo Zhongyao Zazhi* 2001; 26 (4): 256-258.
166. Gao LM, Wei XM, Zheng SZ, Shen XW, Su, YZ. Studies on chemical constituents of *Rumex patientia*. *Zhongcaoyao* 2002; 33 (3): 207-209.

167. Gusakova SD, Khomova TV, Glushenkova AI. Lipids from fruits of *Rumex paulsenianus*. *Khimiya Prirodnikh Soedinenii* 1990; 5: 604-611.
168. Gusakova SD, Khomova TV, Glushenkova AI. Oxygenated acids in storage lipids of *Rumex paulsenianus*. *Khimiya Prirodnikh Soedinenii* 1991; 6: 762-765.
169. Salama HMH. Two crystalline compounds from *Rumex pictus* Forssk. *Egyptian Journal of Botany* 1999; 36 (2): 235-244.
170. Salama HMH. Dipertenoid alkaloids from *Rumex pictus*. *Egyptian Journal of Botany* 1999; 37 (1): 85-92.
171. Salama HMH. Flavonoid glycosides from *Rumex pictus*. *Egyptian Journal of Botany* 2000; 39 (1): 41-52.
172. Emmanuel EJ. Pharmacochemical study of the root of *Rumex pulcher* L. *Apotheker-Zeitung* 1917; 55: 589-628.
173. Back A, Bittner S, Richmond AE. Effect of abscisic acid on the metabolism of kinetin in detached leaves of *Rumex pulcher*. *Journal of Experimental Botany* 1972; 23 (76): 744-750.
174. Harborne JB, Mokhtari N. Two sulfated anthraquinone derivatives in *Rumex pulcher*. *Phytochemistry* 1977; 16 (8): 1314-1315.
175. Taraskina KV, Chumbalov TK, Kuznetsova LK. Anthraquinone dyes of *Rumex rechingerianus*. *Khimiya Prirodnikh Soedinenii* 1968; 4 (3): 188-189.
176. Vysochina GI, Gontar EM. Hydroxymethylanthraquinones from underground organs of *Rumex rechingerianus* Losinsk. *Rastitel'nye Resursy* 1976; 12 (3): 394-397.
177. Vysochina GI, Gontar EM. Dynamics of the content and composition of hydroxymethylanthraquinones in *Rumex rechingerianus*. *Rastitel'nye Resursy* 1977; 13 (1): 68-71.
178. Gontar EM, Vysochina GI. Anthraquinones in the underground organs of *Rumex rechingerianus* Losinsk. of various colors. *Rastitel'nye Resursy* 1980; 16 (1): 101-104.
179. Demirezer LO, Kuruzum A. Rapid and simple biological activity screening of some *Rumex* species. Evaluation of bioguided fractions of *R. scutatus* and pure compounds. *Zeitschrift fuer Naturforschung* 1997; 52 (9/10): 665-669.
180. Volkhonskaya TA, Minaeva VG, Kiseleva AV, Gorbaleva GN. Flavonoids from cultivated *Rumex thyrsoiflorus*. *Dikorastushchei Flory Sib.* 1970; 206-212.
181. Chumbalov TK, Mukhamed'yarova MM. Tannic substances of *Rumex tianschanicus*. *Sostava Rastit. Syr'ya* 1962; 37-44.
182. Yakubov AM, Zakirov KZ, Sagatov SS, Shapiro LV. The distribution of Koper, manganese and molybdenum in soils and the plants *Polygonum corarium* and *Rumex tianschanicus*. *Uzbekskii Biologicheskii Zhurnal* 1963; 7 (3): 12-17.
183. Yakubov AM, Shapiro LV, Sagatov SS. Influence of trace elements on the accumulation of tannins in *Polygonum corarium* and *Rumex tianschanicus*. *Khim.-Tekhnol. i Biol. Nauk* 1965; 191-199.
184. Lysenko AI. Effect of manganese fertilizer on the growth and development of *Rumex tianschanicus*. *Rastitel'nye Resursy* 1966; 2 (3): 367-372.
185. Lysenko AI. Effect of manganese supplement on the accumulation of tannins in *Rumex tianschanicus* (third and fourth year of vegetation). *Obschch. Khim. Biokhim.* 1970; 21-30.
186. Pershukova AM, Levanidov LY. Effect of manganese trace element fertilizers on the composition of polyphenolic compounds of *Rumex tianschanicus*. *Tomsk Univ.* 1973; 93-94.
187. Pipinys J, Smaliukas D. Biological and biochemical characteristics of *Rumex tianschanicus*. 2. Dynamics and distribution of pigments and ascorbic acid in the organs above ground. *Biologijos Mokslai* 1974; 3: 43-49.
188. Pipinys J, Atkociunaite V. Biological and biochemical characteristics of *Rumex tianschanicus*. 4. Accumulation of manganese, iron, zinc, copper and boron in leaves, stems and roots. *Biologijos Mokslai* 1978; 3: 43-50.
189. Vitkus A, Pipinys J, Smaliukas D. Biological and biochemical characteristics of *Rumex tianschanicus*. 1. Dynamics of the level of chemical substances. *Biologijos Mokslai* 1974; 2: 55-63.
190. Smaliukas D, Pipinys J, Vitkus A. Biological and biochemical characteristics of *Rumex tianschanicus*. 3. Growth of overground material and roots and accumulation of carbohydrates and tannins in them. *Fizine Geografija* 1975; 3: 31-40.
191. Zaitsev BV, Pushkarev GN. Chemical composition of *Rumex tianschanicus* Losinsk. Growing in the forest-steppe zone of Western Siberia. *Sibirskii Vestnik Sel'skokhozyaistvennoi Nauki* 1980; 10 (2): 89-92.
192. Klyshev LK, Pershukova AM, Antonova N. Phytochemical investigation of *Rumex tianschanicus*. *Seriya Biologicheskaya* 1987; 6: 17-19.
193. Pribytkova LN, Muzychkina, RA. Water-soluble substances of *Rumex tianschanicus* and their biological activity. *Sovrem. Probl. Farmatsii* 1989; 80-82.
194. Zaghoul MG, El-Fattah HA. Anthraquinones and flavonoids from *Rumex tingitanus* growing in Libya. *Journal of Pharmaceutical Sciences* 1999; 8 (2): 54-58.
195. Dickie CW, Hamann MH, Carroll WD, Chow FH. Oxalate (*Rumex venosus*) poisoning in cattle. *Journal of the American Veterinary Medical Association* 1978; 173 (1): 73-74.
196. Rai J, Thakar KA. Chemical investigation of *Rumex vesicarius*. *Indian Journal of Chemistry* 1979; 8 (11): 1046-1047.
197. Tiwari KP, Rathore YKS. Amino acid contents in *Rumex vesicarius*. *Vijnana Parishad Anusandhan Patrika* 1977; 20 (1): 65-66.
198. Easa HAS, Rizk AF, Hussieny HA. Constituents of plants growing in Qatar. Part XXVI. Phytochemical investigation of *Rumex vesicarius*. *International Journal of Chemistry* 1995; 6 (1 & 2): 21-25.
199. Bishr MM, Al-Gindy AR, Khorrami HA. Pharmacognostical study of *Rumex vesicarius* L. herb grown in Kuwait. *Alexandria Journal of Pharmaceutical Sciences* 1998; 12 (1): 53-59.
200. Ciulei I, Istudor V. Chemical study of the species *Rumex wallichii*. *Farmacia* 1973; 21 (2): 85-88.