



ACADEMIC RESEARCH and REVIEWS IN SCIENCE and MATHEMATICS



EDITOR

Assist Prof. Mine SULAK Ph.D



DWJRR

**ACADEMIC RESEARCH AND
REVIEWS IN SCIENCE AND
MATHEMATICS**

EDITOR

Assist Prof. Mine SULAK Ph.D



Academic Research And Reviews in Science and Mathematics
Editor: Assist Prof. Mine SULAK Ph.D

Editor in chief: Berkan Balpetek
Cover and Page Design: Duvar Design
Printing : First Edition-May 2021
Publisher Certificate No: 49837
ISBN: 978-625-7680-71-4

© **Duvar Publishing**
853 Sokak No:13 P.10 Kemeraltı-Konak/Izmir/ Turkey
Phone: 0 232 484 88 68
www.duvar yayinlari.com
duvarkitabevi@gmail.com

Printing and Binding: Vadi Grafik Tasarım ve Reklamcılık Ltd. Şti.
İvedik Org. San. 1420. Cad. No: 58/1
Yenimahalle/ANKARA
Phone: 0 312 395 85 71
Certificate No: 47479

CONTENTS

- Chapter 1** 5
**Morphological Data And A Locality Record Of
Stellagama Stellio (L. 1758) (Squamata: Agamidae)
in TURKEY**
Ufuk BÜLBÜL
Halime KOÇ-GÜR
Hatice ÖZKAN
Engin ZAMAN
- Chapter 2** 21
**A Breeding Population of the Exotic Species
Trachemys scripta (Thunberg in Schoepff, 1792)
in Trabzon Province Of Turkey**
Halime KOÇ-GÜR
Ufuk BÜLBÜL
Bilal KUTRUP
- Chapter 3** 35
**Owerview on Coumarin Chalcone Compounds and
Properties Synthesized in 2020**
Hülya ÇELİK ONAR

– Chapter 1 –

**MORPHOLOGICAL DATA and
A LOCALITY RECORD of
Stellagama stellio (L. 1758)
(SQUAMATA: AGAMIDAE)
in TURKEY**

*Ufuk BÜLBÜL*¹
*Halime KOÇ-GÜR*²
*Hatice ÖZKAN*³
*Engin ZAMAN*⁴

1 Prof. Dr., Karadeniz Technical University, ufukb@ktu.edu.tr

2 Dr., Karadeniz Technical University, koc.halime@gmail.com

3 Karadeniz Technical University, haticeozkan@ktu.edu.tr

4 Elvanpazarcık District, Zonguldak, enginzaman67@hotmail.com

INTRODUCTION

The Roughtail Rock Agama, *Stellagama stellio* is widely distributed in Cyprus, Egypt, Greece, Iraq, Israel, Jordan, Lebanon, Saudi Arabia, Syria, and Turkey. It is also introduced in Malta (Amr et al. 2012). As a result of long years of systematic, phylogenetic and distributional researches (Bird 1936; Bodenheimer 1944; Mertens 1952; Daan 1967; Clark and Clark 1973; Beutler and Frör 1980; Baran and Öz 1985; Baran et al. 1989; Pekmezci 1997; Göçmen et al. 2003; Kumlutaş et al. 2004; Almog et al. 2005; Kete and Yılmaz 2006; Gül et al. 2010; Gül and Tosunoğlu 2011; Özdemir et al. 2011; Baig et al. 2012; Kumlutaş et al. 2015), it was commonly accepted that the species was represented by two subspecies [*S. s. stellio* and *S. s. daani* (Beutler and Frör 1980)] in Turkey.

The records on the distribution of the species in Turkey mainly consist to the coastline of the Aegean, Marmara, and Mediterranean seas and Central and Southeast Anatolia regions (Başoğlu and Baran 1977; Baran et al. 2021). The distribution of the species at the Black Sea region of the country was firstly reported by Baran et al. (1989) from Amasya and Tokat provinces. However, coastal distribution of the species in Black Sea region of Turkey was only reported by Gül et al. (2010) from Sinop province inhabited western Black Sea region of the country. In addition, the occurrence of the species in Zonguldak province was recorded in the Noah's Ark National Biodiversity Database of Ministry of Agriculture and Forestry of Turkey in 2017. The data on this species in Black Sea region of Turkey is so scarce due to insufficient herpetological studies.

The present study provides an additional locality record from Zonguldak province in the western Black Sea region of Turkey and pholidolial and morphometric characters and color-pattern features of *S. stellio* specimens.

Morphological data

During a field survey on 23 June 2019, we observed the individuals (1 ♂, 1 ♀, and 2 Subadult ♀♀) of *S. stellio* in Asma neighborhood of Zonguldak city center (WGS84, N: 41° 26' 86.5'' and E: 31° 49' 73.8'', 30 m a.s.l.). The locality is shown in Fig. 1.



Figure 1. Map showing the distribution of the *Stellagama stellio* in Turkey [The provinces of Çanakkale, Balıkesir, Bursa, İzmir, Manisa, Kütahya, Uşak, Afyonkarahisar, Denizli, Aydın, Muğla, Antalya, Burdur, Isparta, Konya, Karaman, Mersin, Niğde, Ak-saray, Nevşehir, Yozgat, Kayseri, Sivas, Sinop, Adana, Malatya, Kahramanmaraş, Osmaniye, Hatay, Gaziantep, Kilis, Adıyaman, Şanlıurfa, Mardin, Diyarbakır, Batman, Elazığ, Bingöl, Siirt and Şırnak (Baran et al. 2021); the provinces of Amasya and Tokat (Ergül et al. 2014); the province of Bitlis (Akman et al. 2018)]. The star shows the new locality found in the present study.

We did not carry out an organized systematic survey and we did not examine purposely old buildings or ruins of ancient monuments to observe geckoes. Because of their accidental discovery, we observed a small number of the agamid lizards. The lizards were caught on the roadside walls in a downtown street (Fig. 2).



Figure 2. A general view of the habitat where the individuals of *Stellagama stellio* were caught

All specimens were anesthetized with MS-222 solution, fixed with a 10% formaldehyde injection, and deposited in 70% ethanol. They were deposited in the Zoology Research Laboratory of Karadeniz Technical University (Collection number: KZL-379 for Zonguldak-Asma Neighborhood) of the Department of Biology at the Faculty of Science, Karadeniz Technical University.

Mensural and meristic data were recorded by following the systems of Gül et al. (2010) and Kumlutaş et al. (2015). All pholidolial characters were examined under the stereo microscope and all specimens' morphometric features are measured to the nearest 0.1 mm using a digital caliper. The following pholidolial characteristics were evaluated: sublabials (left–right, SLa–SLb), supralabials (left–right, SRLa–SRLb), ventrals (V), subdigital lamellae underneath the fourth toe of the hindlimb (left–right, 4SDLa–4SDLb), subdigital lamellae underneath the third finger of the forelimb (left–right, 3SDLa–3SDLb), scales on the 5th whirl of the tail as of its beginning (ST), ventral glandular scales (VGS), and preanal glandular scales (PGS).

The morphometric measurements in this study following: snout-vent length (SVL), tip of snout to anal cleft; tail length

(TL), anal cleft to tip of tail; head width (HW), at widest point of head; head length (HL), tip of snout to posterior margin of the ear opening; head depth (HD), greatest width of the head; outstretched limb from shoulder joint to tip of toe (FLL, forelimb length); outstretched limb from hip joint to tip of toe (HLL, hindlimb length); the length of dorsal blotch at mid-trunk (DBL, dorsal blotch length); the width of dorsal blotch at mid-trunk (DBW, dorsal blotch width). From morphological measurements following ratios and indexes were computed: TL/SVL, SVL/HL, HL/FLL, head index (HI) $[100 \times \text{HL}/\text{HW}]$, and head length index (HLI) $[100 \times \text{HL}/\text{SVL}]$.

Material: KZL-379/2019, 1 ♂, 1 ♀, and 2 Subadult ♀♀
23.06.2019, Asma, Zonguldak leg. U. BÜLBÜL.

RESULT

Morphological data

Pholidolial characteristics: SRLa and SRLb was 12 (25%) in the male specimen and 11 (75%) in the female and subadult female specimens. SLa was 13 (25%) in the male specimen and 11 (75%) in the female and subadult female specimens while SLb was 13 (25%) in the male specimen, 11 (50%) in the female and first subadult specimens, and 12 (25%) in the second subadult specimen. The numbers of ventral plates were 49, 47, 43, and 41 in the male, female and subadult female specimens, respectively.

Morphometric measurements: Maximum SVL for the male, female and subadult female specimens were 105.26, 96.87, and 64.86 mm, respectively. The highest TLs for male, female, and subadult female specimens were 143.27, 132.64, and 98.03 mm, respectively. The highest HWs were 24.66, 23.19, and 18.37 mm in the male, female, and subadult female specimens, respectively. The maximum HLs for male, female and subadult female specimens were 34.52, 32.19, and 22.93 mm, respectively. Descriptive statistic of pholidolial characteristics and morphometric measurements of specimens are given in Table 1.

Table 1. Comparison of some pholidolial characteristics and morphometric measurements of our specimens with those given by Gül et al. (2010) and Kumlutaş et al. (2015). For abbreviations, see text.

Character	This Study (Zonguldak specimens)		1 st Subadult ♀ / 2 nd Subadult ♀	Mean Values of 3 ♀♀ and 2 ♂♂ from Sinop	Kumlutaş et al. (2015)				1 ♀ from Yozgat	Mean Values of 2 ♀♀ from Sivas	
	1 ♀	1 ♂			4 ♀ and 1 ♂ from Bursa	11-11	13- 13	11-12			13-13
SLa-SLb	13-13	11-11	11-11/11-12	11.2	12-12	11-11	13- 13	11-12	13-13	11-12	11-11
SRLa-SRLb	12-12	11-11	11-11/11-11	11.6	12-12	12-13	13- 12	11-11	13-14	11-12	11-11
V	49	47	43/41	43.8	47	44	40	41	42	35	39
4SDLa-b	22-22	21-21	21-21/21-21	23.2	21-22	19-19	18/-	19-19	18-18	19-18	17-17
3SDLa-b	18-17	18-17	17-17/17-17	19	16-17	18-15	15- 15	14-15	15-15	15-15	16-15
ST	17	15	15/15	16.8	16	17	17	15	16	14	16
VGS	-	48	-/-	-	-	-	-	-	49	-	-
PGS	-	53	-/-	-	-	-	-	-	52	-	-
SVL	105.26	96.87	64.86/60.79	98.50	115	112	63	108	120	110	101

The continuation of Table 1

	This Study (Zonguldak specimens)			Gül et al. (2010)	Kumlutaş et al. (2015)						
					162	160	95	150	-	110	127
TL	143.27	132.64	98.03/92.87	129.67	37.9	37.9	21.7	33.8	44.1	35.4	33.7
HL	34.52	32.19	22.93/21.14	27.41	25.9	23.6	15.1	23.0	28.5	24	21.1
HW	24.66	23.19	18.37/18.31	21.72	56.9	53.8	29.7	53.6	52.5	50.4	45.6
FLL	53.82	49.46	29.42/28.44	49.48	79.2	74.7	46.5	75.2	83.1	70.5	66.7
HLL	68.11	65.01	48.64/45.74	68.89	-	-	-	-	-	-	-
HLL/FLL	1.26	1.31	1.65/1.61	1.39	14.0	12.9	9.4	12.1	15.3	14.3	11.9
HD	14.0	12.51	9.91/8.91	-	10.30	11.60	5.30	9.20	10	10.90	11.60
DBL	10.29	9.94	7.04/6.17	-	8.30	6.50	5.20	9.20	8.40	6.80	7.05
DBW	8.43	8.07	6.46/5.51	-	1.4	1.4	1.5	1.4	-	1.0	1.3
TL/SVL	1.36	1.36	1.51/1.52	1.37	3.0	3.0	2.9	3.2	2.8	3.1	3.0
SVL/HL	3.04	3.0	2.82/2.87	3.62	146	161	143	147	155	147	158
HI	140	139	125/116	126.17	33.0	33.8	34.4	31.3	36.8	32.2	33.3
HLI	32.8	33.2	35.3/34.7	27.71							

Color-Pattern: In the specimens of *S. stellio*, the color of the back side was usually blackish-gray. There was a blue coloration on the scales of dorsum in all specimens. The color of the dorsal blotches was yellowish brown. In all specimens, the color of the head (except the brown color in front and on the eye lids) and forelimbs was light blue while it was dark blue for the hindlimbs. The color of the tails was light brown and there were dark blue (black) colored bands on the tails of all specimens. The color of ventral was yellowish brown in all specimens (Fig. 3).



Figure 3. A general view of a male individual of *Stellagama stellio* in the population of Asma Neighborhood

In 2017, the occurrence of the species in Zonguldak province was recorded in the Noah's Ark National Biodiversity Database of Ministry of Agriculture and Forestry of Turkey. In the present study, we reported an additional locality record of *S. stellio* for Zonguldak province and morphological characteristics belonged to individuals of the species. Except from Zonguldak province, the species was only reported by Gül et al. (2010) from Sinop

province at Sinop castle and Sarıkum in western Black Sea coast of Turkey. These findings indicate that if comprehensive field studies will be performed, the species can be found in all other provinces along the Black Sea coast of Turkey.

Regarding to coloration of dorsal ground, blue coloration on the scales of dorsum, top and lateral sides of the head, our specimens are identical to *S. s. daani* (Beutler and Frör 1980; Baran and Öz 1985; Gül and Tosunoğlu et al. 2011; Kumlutaş et al. 2015). In addition, pholidolial characteristics and morphometric measurements of our specimens were found similar to the specimens of *S. s. daani* used in the studies of Gül et al. (2010) and Kumlutaş et al. (2015), except slightly higher number of V in the Zonguldak specimens of our study.

The new locality records of Turkish lizards are the subject of a growing number of studies in recent years (Tok et al. 2012; Bozkurt et al. 2015; Ilgaz et al. 2016; Bülbül et al. 2019; Candan et al. 2020). The results of the present study and literature data clearly show that if more field observations are carried out, the occurrence of *Stellagama stellio* in other provinces of the Black Sea coast will be revealed.

The number of the specimens in our western Black Sea coast specimens was low. More specimens should be investigated to evaluate the similarity of the Zonguldak population with other Anatolian populations.

REFERENCES

1. Akman B., Yıldız M.Z., Özcan A.F., Bozkurt M.A., İğci N. and Göçmen B. 2018. On the Herpetofauna of the East Anatolian Province of Bitlis (Turkey) (Amphibia; Reptilia). *Herpetozoa*, 31(1/2): 69–82.
2. Almog A., Bonen H., Herman K. and Werner Y.L. 2005. Subspeciation or None? The Hardun in the Aegean (Reptilia: Sauria: Agamidae: *Laudakia stellio*). *Journal of Natural History*, 39(7): 567–586.
3. Amr Z.S.S., Al Johany A.M.H., Akarsu F., Üzüm N., Kumlutaş Y., Baha El Din S., Lymberakis P., Hraoui-Bloquet S., Uğurtaş İ.H., Werner Y.L., Disi A.M., Tok V., Sevinç M., Sadek R., Crochet P.H., Kaska Y. Avcı A. and Yenyurt C. 2012. *Stellagama stellio*. The IUCN Red List of Threatened Species 2012: e.T157247A743714. <https://dx.doi.org/10.2305/IUCN.UK.2012.RLTS.T157247A743714.en>. Downloaded on 11 April 2021.
4. Baig K.J., Wagner P., Ananjeva N.B. and Böhme W. 2012. A Morphology-Based Taxonomic Revision of *Laudakia* Gray, 1845 (Squamata: Agamidae). *Vertebrate Zoology*, 62(2): 213–260.
5. Baran İ. and Öz M. 1985. Anadolu *Agama stellio* (Agamidae, Reptilia) Populasyonlarının Taksonomik Araştırılması [A Taxonomic Investigation of Anatolian *Agama stellio* Populations (Agamidae, Reptilia)]. *Doğa Bilim Dergisi*, 92(2): 161–169.
6. Baran İ., Kasperek M. and Öz M. 1989. On the Distribution of Four Species of *Agama* (Agamidae) in Turkey. *Zoology in the Middle East*, 3: 37–48.
7. Baran İ., Ilgaz Ç., Avcı A., Olgun K. and Kumlutaş Y. 2021. Türkiye Amfibi ve Sürüngenleri (The Amphibians and Reptiles of Turkey), Palme Yayınevi, Ankara.

8. Başođlu M. and Baran İ. 1977. Türkiye Sürüngenleri, Kısım I, Kaplumbağalar ve Kertenkeleler (The Reptiles of Turkey, Part I, Turtles and Lizards). Ege Üniversitesi Fen Fakültesi Kitaplar Serisi, İzmir.
9. Beutler A. and Frör E. 1980. Die Amphibien und Reptilien der Nordkykladen (Griechenland). Mitteilungen der Zoologischen Gesellschaft Braunau München, 3: 269–272.
10. Bird C.G. 1936. The Distribution of Reptiles and Amphibians in Asiatic Turkey, With Notes on a Collection from the Vilayets of Adana, Gaziantep, and Malatya. Annals and Magazine of Natural History, 10(18): 257–281.
11. Bodenheimer F.S. 1944. Introduction into Knowledge of the Amphibia and Reptilia of Turkey. Review of Faculty of Science, University of İstanbul, 9: 1–78.
12. Bozkurt E., Avcı A. and Yılmaz C. 2015. A new locality record of *Chalcides ocellatus* (Forskal 1775)(Sauria: Scincidae) from Southeastern Anatolia, Turkey. Turkish Journal of Zoology, 39: 344–348.
13. Bülbül U., Koç H., Özkan H., Öztürk İ. and Kutrup B. 2019. New Locality Record of *Lacerta agilis* (Squamata: Lacertidae) in Turkey. Turkish Journal of Biodiversity, 2(2): 52–56.
14. Candan K., Gül S., Kumlutaş Y., Yıldırım E. and Ilgaz Ç. 2020. New Locality Record of the Red-Bellied Lizard, *Darevskia parvula* (Lantz & Cyrén 1913) s.l., from Eastern Anatolia, Turkey. Journal of the Institute of Science and Technology, 10(4): 2400–2405.
15. Clark R.J. and Clark E.D. 1973. Report on A Collection of Amphibians and Reptiles from Turkey. Occasional Papers of the California Academy of Science, 104: 1–62.

16. Daan S. 1967. Variation and Taxonomy of the Hardun, *Agama stellio* (Linnaeus 1758) (Reptilia, Agamidae). Beaufortia, 14: 109–134.
17. Ergül T., Özdemir N., Gül Ç. and Tosunoğlu M. 2014. Variation in Body Size and Age Structure of *Stellagama stellio* (L. 1758) (Reptilia: Agamidae) from Turkey. Acta Zoologica Bulgarica, 66(1): 65–72.
18. Göçmen B., Tosunoğlu M. and Taşkavak E. 2003. A Taxonomic Comparison of the Hardun *Laudakia stellio* (Reptilia: Agamidae) Populations of Southern Turkey (Hatay) and Cyprus. Zoology in the Middle East, 28: 25–32.
19. Gül Ç., Dinçaslan Y. and Tosunoğlu M. 2010. A New Locality of the Starred Agama *Laudakia stellio* (Linnaeus 1758) From Sinop, North Anatolia. Herpetozoa, 23(1/2): 98–100.
20. Gül Ç. and Tosunoğlu M. 2011. External Morphological and Osteological Features of Turkish Populations of *Laudakia stellio* (Linnaeus 1758) (Squamata: Sauria: Agamidae). Herpetozoa, 24(1/2): 73–88.
21. Ilgaz Ç., Kumlutaş Y. and Candan K. 2016. A new locality record for *Phoenicolacerta laevis* (Gray 1838) (Squamata: Lacertidae) in western Anatolia. Turkish Journal of Zoology, 40: 129–135.
22. Kete R. and Yılmaz İ. 2006. Antakya ve Gaziantep Bölgesinde Yaşayan *Laudakia stellio* (Linnaeus, 1758) (Agamidae, Lacertilia) Üzerine Morfolojik Taksonomik Bir Araştırma [A Morphological Taxonomical Investigation on the Lizard *Laudakia stellio* (Linnaeus 1758) (Agamidae, Lacertilia) Distributing in Antakya and Gaziantep Regions]. Anadolu Üniversitesi Bilim ve Teknoloji Dergisi, 7(2): 377–386.
23. Kumlutaş Y., Öz M., Durmuş H., Tunç M.R., Özdemir

- A. and Düşen S. 2004. On Some Lizard Species of the Western Taurus Range. Turkish Journal of Zoology, 28: 225–236.
24. Kumlutaş Y., Uğurtaş İ.H., Koyun M. and Ilgaz Ç. 2015. A New Locality Records of *Stellagama stellio* (Linnaeus 1758) (Sauria: Agamidae) in Anatolia. Russian Journal of Herpetology, 22(2): 149–153.
25. Mertens R. 1952. Amphibien und Reptilien aus der Türkei. Review of Faculty of Science, University of İstanbul, 17: 41–45.
26. Özdemir N., Gül Ç. and Tosunoğlu M. 2011. Genomic Variation within *Laudakia stellio* (Linnaeus 1758) (Sauria: Agamidae) in Turkey, Based on Analyses of Mitochondrial 12SrRNA Sequences. Journal of Animal and Veterinary Advances, 10(4): 415–420.
27. Pekmezci E. 1997. Investigations on the Populations of the *Laudakia stellio* (Reptilia, Agamidae) in Turkey, Distributed in İzmir and Gaziantep. M. Sc. Thesis, Dokuz Eylül University, İzmir.
28. Tok C.V., Tosunoğlu M., Ayaz D., Çiçek K. and Mutlu H.S. 2012. New Records of the Anatolian Worm Lizard, *Blanus strauchi* (Bedriaga 1884), from Turkey (Squamata: Amphisbaenia: Blanidae). Herpetozoa, 24(3/4): 107–111.

– Chapter 2 –

**A BREEDING POPULATION OF THE
EXOTIC SPECIES *Trachemys scripta*
(THUNBERG IN SCHOEPFE, 1792) in
TRABZON PROVINCE of TURKEY**

*Halime KOÇ-GÜR*⁵
*Ufuk BÜLBÜL*⁶
*Bilal KUTRUP*⁷

5.Dr., Karadeniz Technical University, koc.halime@gmail.com

6. Prof. Dr., Karadeniz Technical University, ufukb@ktu.edu.tr

7 Prof. Dr., Karadeniz Technical University, kutrup@ktu.edu.tr

INTRODUCTION

Turkey is located at the junction of three continents, that extending throughout the Anatolian Peninsula and Thrace. Because of its location, it has various topographical, geomorphological structures (Demirsoy 2002; Eken et al. 2005), various vegetation types and different climatic conditions (Şahin and Afsar 2018). When all these factors are considered together, it is clearly seen Turkey is hosted a wide variety of animal species ecology (Demirsoy 2002).

Turkey also is the only country which almost entirely contains three (the Caucasus, Irano-Anatolian, and Mediterranean of the World's 34 biodiversity hotspots (Mittermeier et al. 2004). Thus, it has one of the most important amphibian and reptile faunas in west of the Palearctic region (Baran and Atatür 1998; Sindaco et al. 2000). Many studies which contained lists of amphibian and reptile species were performed in specific areas of Turkey (Bird 1936; Kumlutaş et al. 2001; Ilgaz and Kumlutaş 2005; Afsar and Tok 2011; Eser and Erismis 2014; Sarıkaya et al. 2017). In addition, every year new amphibian and reptile species are defined and sometimes new locality records are found. In other words, the herpetofauna of Turkey is still not fully determined (Kumlutaş et al. 2007; Bülbül et al. 2016).

On the other hand, the existing species may also disappear while new species are discovered and new locality records are taken. The new protection areas should be created for biodiversity conservation (Noss 1996; Bruner et al. 2001). However it may not always be easy to protect the species in the protected areas although the protected areas are increased (Pressey et al. 2015). Among the main reasons for this situations, the most notable ones are anthropogenic factors (Laurance et al. 2012) and the spreading of exotic species. In addition, there are the exotic species in most ecosystems of the world (Pyšek and Richardson 2010).

There are many ways entering the stable populations or protected areas for exotic species: habitat fragmentation, insufficient protection, human activities etc. (Spear et al. 2013). After joining a population in any way, the exotic species may first appear to be harmless. However, they may begin to pressure native species and they may cause irreversible destruction in the community structure, in later times (Uysal et al. 2018).

The numbers of amphibians and reptiles as exotic species have been increased exponentially through the past years. At the same time, the numbers of turtle - as exotic species - are greater than other taxa (Kraus 2009).

The red-eared slider turtle, *Trachemys scripta* (Thunberg in Schoepff 1792), is known one of the worst exotic species in the world (Lowe et al. 2000). *T. scripta* was reported as an exotic species in all continents: Asia (Chen and Lue 1998), Europe (Luiselli et al. 1997), America (Thomson et al. 2010), Africa (Newberry 1984) and Oceania (Burgin 2006).

In Turkey, scientific studies which mentioned about *T. scripta* as an exotic species are limited. Çiçek and Ayaz (2015) were identified the presence of the first breeding population of *T. scripta* in Turkey. In addition, Uysal et al. (2018) were reported the presence of the species in Çanakkale province of Turkey.

The individuals of *T. scripta* has been released or escaped into natural or semi-natural wetlands in many locates of the world (Scalera 2006). Sera Lake is one of the the natural wetland in Turkey. It is a landslide embankment lake which located in the borders of Akçaabat district of Trabzon province in Turkey. The lake was formed as a result of the accumulation of large rocks that broke off from the slopes of the valley located near the lake in 1950 due to excessive rainfall. There are very much individuals of the common carp, *Cyprinus carpio* (L. 1758), in the stagnant parts of the Sera Lake where the turtles are located.

The freshwater crayfish (*Astacus leptodactylus*) was thrown into the lake. Later, the number of the individuals of this species was increased greatly.

In this study, we reported the presence of a breeding population of *T. scripta* population in a natural wetland (Sera Lake from northeastern of Turkey).

RESULT

Two adult and one subadult individuals of *T. scripta* were observed in Sera Lake (from Trabzon province of Turkey) and the photos of these pond turtles were taken (Fig. 1 and 2) in 17 October 2020. The same day, we also observed four more adult individuals of *T. scripta*.



Figure 1. A general view of an adult individual in Sera Lake from Turkey



Figure 2. A general view of an adult and a subadult individual in Sera Lake from Turkey

However, we could not take their photos. These results showed that there was a breeding population in this lake more advanced than a single individual which was left here and survived. The field study was performed during a day time (between 2 and 4 p.m). The air temperature was 24.5 C° at the beginning time of the study and 21.5 C° at the ending. The turtles were observed in a locality (GPS data, N: $40^{\circ} 59' 08.4''$ and E: $39^{\circ} 36' 86.3''$, 84 m a.s.l (Fig. 3).



Figure 3. A general view of Sera Lake from Trabzon province

Our research determines for the first time that *T. scripta* can live in the Sera Lake which is situated north-east of Turkey. The individuals of *T. scripta* detected as an exotic species in the study area among the other native species. The local people said that they have seen the turtles here for years and have not seen who left these turtles here. The habitat in which the individuals were found are located in the urban areas. The surrounding of the lake has been turned into a National Park and the habitat is generally composed of deciduous trees (Fig. 4).



Figure 4. A general view the habitat of *Trachemys scripta*

The residential areas in Turkey are generally located around water sources. New locality records of the fresh water species are very rich in wetlands, which located intertwined with the residential areas (Uysal et al. 2008). Uysal et al. (2018) detected 8 individuals of the species in Çanakkale province from Turkey. Compatible with (Uysal et al. 2018), the locality record detected in our study was observed in an area close to residential areas in Trabzon province from Turkey.

Distributions of *T. scripta* because of the releases or escapes from the pet trade were reported in some localities (Taiwan, Spain, Sri Lanka, Guam, Bermuda, Reunion, Polynesia, Malaysia, Bahrain, Guadeloupe, Italy, South Africa, Martinique, Singa-

pore, Brazil, Arabia, Israel, New Zealand, Korea, Thailand, Panama, Japan e.t.c.) [Ernst et al. 1994; Luiselli et al. 1997; Chen and Lue 1998; Lindeman 1999; Cadi and Joly 2003; Cadi and Joly 2004; Teillac-Deschamps and Prevot-Julliard 2006; Thomson et al. 2010; Stone 2010; Ficetola et al. 2012]. In other words, many turtles were released in natural freshwater ecosystems (Luiselli et al. 1997) around the world. In populations, females are generally more common than males. The adult female individuals are generally larger and heavier than adult males.

Cadi and Joly (2003 and 2004) and Ficetola et al. (2012) reported that the individuals of *T. scripta* are competing with the individuals of *Emys orbicularis* and *Mauremys leprosa* for nesting sites, basking and food. Although individuals of *M. leprosa* has no distribution in Turkey's fresh waters, distribution of *Emys orbicularis* into fresh waters are available in Turkey.

According to Lindeman (1999) the large turtle species were dominant than the smaller turtles for the competitions between the individuals of *T. scripta* and other Emydid turtles for sunbathing regions. As reported by Stone (2010) in the relevant study on *T. scripta* and *P. rubriventris* in a freshwater Pennsylvania: The reason why *T. scripta* individuals are not dominant than other turtle species in fresh waters may be that the population of *T. scripta* do not have sufficient density yet.

In addition, *T. scripta* is one of the omnivorous species (Ernst et al. 1994) and the populations with high densities of omnivorous species can affect macroinvertebrates, aquatic vegetation and even amphibian communities (Teillac-deschamps and Prevot-julliard 2006).

In 2009, Rödder et al. modeled a potential distribution of *T. scripta*. They considered some essential physiological and reproductive characteristics for the model. Their model showed the distribution of *T. scripta* in North, Central and South America,

Europe, West and Central Africa, the East African coast, eastern Asia, and the eastern and western parts of Australia, and Turkey.

Although the distribution of the species were detected in Turkey, very few records on this subject are available. It is important to determine the localities of the individuals of the *T. scripta* and the population density in the fresh water in Turkey. We reported here the occurrence of a breeding and crowded population of *T. scripta* in Sera Lake of Trabzon province. This population needs to be followed up with long-term observations. In this way, necessary measures can be taken without increasing their numbers and harming the native species.

REFERENCES

1. Afsar M. and Tok C.V. 2011. The herpetofauna of the Sultan Mountains (Afyon-Konya-Isparta), Turkey. Turkish Journal of Zoology, 35(4): 491–501.
2. Baran İ. and Atatür M.K. 1998. Turkish Herpetofauna (Amphibians and Reptiles). Republic of Turkey, Ministry of Environment, Ankara (in Turkish).
3. Bird C.G. 1936. The Distribution of Reptiles and Amphibians in Asiatic Turkey, With Notes on a Collection from the Vilayets of Adana, Gaziantep, and Malatya. Annals and Magazine of Natural History, 10(18): 257–281.
4. Bruner A.G., Gullison R.E., Rice R.E. and Da Fonseca G.A.B. 2001. Effectiveness of Parks in Protecting Tropical Biodiversity. Science, 291:125–128.
5. Burgin S. 2006. Confirmation of An Established Population of Exotic Turtles in Urban Sydney. Australian Journal of Zoology, 33: 379–384.
6. Bülbül U., Kurnaz M., Eroglu A.I., Szymura J.M., Koç H. and Kutrup B. 2016. First Record of *Bombina variegata* (L., 1758) (Anura: Bombinatoridae) from Turkey. Turkish Journal of Zoology, 40: 630–636.
7. Cadi A. and Joly P. 2003. Competition For Basking Places Between The Endangered European Pond Turtle (*Emys orbicularis galloitalica*) and The Introduced Red-Eared Slider (*Trachemys scripta elegans*). Canadian Journal of Zoology, 81: 1392–1398.
8. Cadi A. and Joly P. 2004. Impact of The Introduction of The Red-Eared Slider (*Trachemys scripta elegans*) on Survival Rates of The European Pond Turtle (*Emys orbicularis*). Biodiversity and Conservation, 13: 2511–2518.

9. Chen T.H. and Lue K.Y. 1998. Ecological Notes on Feral Populations of *Trachemys scripta elegans* in Northern Taiwan. *Chelonian Conservation and Biology*, 3: 87–90.
10. Çiçek K. and Ayaz D. 2015. Does The Red-Eared Slider (*Trachemys scripta elegans*) Breed in Turkey? *Hyla*, 2015 (1): 4–10.
11. Demirsoy A. 2002. Genel ve Türkiye Zoocoğrafyası. Third Ed., Meteksan, Ankara (in Turkish).
12. Eken G., Evans M., Kilic T., Gem E., Balkiz Ö., Özbağdatlı N. and Karacetin E. 2005. Irano-Anatolian hotspot. In: Mittermeier R.A., Gil. P.R., Hoffman M., Pilgrim J., Brooks T., Mittermeier C.G., Lamoreux J., Gustavo A.B. da Fonseca, Editor. Hotspots revisited: Earth's biologically richest and most endangered terrestrial ecoregions Washington, DC: Conservation International.
13. Ernst C.H., Lovich J.E. and Barbour R.W. 1994. Turtles of The United States and Canada. Smithsonian Institution Press, Washington, D.C., pp. 578.
14. Eser Ö. and Erismiş U.C. 2014. Research on the Herpetofauna of Başkomutan Historical National Park, Afyonkarahisar, Turkey. *Biharean Biologist*, 8(2): 98–101.
15. Ficetola G.F., Rödder D. and Padoa-Schioppa E. 2012. *Trachemys scripta* (Slider terrapin). In: Handbook of Global Freshwater Invasive Species. pp. 331-339. In: Francis, R. (Eds.) Earthscan, Taylor and Francis Group Abingdon, UK.
16. Ilgaz Ç. and Kumlutaş Y. 2005. The Amphibian and Reptile Species of İğneada (Kırklareli) and Its Vicinity. *Pakistan Jurnal of Biological Sciences*, 8(4): 558–560.
17. Kraus F. 2009. Alien Reptiles and Amphibians: A Scientific Compendium and Analysis (Invading Nature

- Springer Series in Invasion Ecology), Springer-Verlag.
18. Kumlutaş Y., Ilgaz Ç. and Durmuş S.H. 2001. Herpetofauna of Spil Mountain Manisa and Its Vicinity: Results of Field Surveys. *Anadolu University Journal of Science and Technology*, 2: 63–66.
 19. Kumlutaş Y., Arıkan H., Ilgaz Ç. and Kaska Y. 2007. A New Subspecies, *Eumeces schneiderii barani* N. ssp (Reptilia: Sauria: Scincidae) from Turkey. *Zootaxa*, 1387: 27–38.
 20. Laurance W.F., Useche D.C., Rendeiro J., Kalka M., Bradshaw C.J., Sloan S.P., Laurance S.G., Campbell M., Abernethy K., Alvarez P. and Arroyo-Rodriguez V. 2012. Averting Biodiversity Collapse in Tropical Forest Protected Areas. *Nature*, 489: 290–294.
 21. Lindeman P.V. 1999. Aggressive Interactions During Basking Among Four Species of Emydid Turtles. *Journal of Herpetology*, 33: 214–219.
 22. Lowe S., Browne M., Boudjelas S. and de Poorter M. 2000. 100 of the World’s Worst Invasive Alien Species: A selection from the Global Invasive Species Database. The Invasive Species Specialist Group (ISSG) of the World Conservation Union (IUCN).
 23. Luiselli L., Capula M., Capzzi D., Philippi E., Trujillo V., Jesus and Ani Baldi C. 1997. Problems For Conservation of Pond Turtles (*Emys orbicularis*) in Central Italy: Is The Introduced Red-Eared Turtle (*Trachemys scripta*) A Serious Threat? *Chelonian Conservation and Biology*, 2: 417–419.
 24. Mittermeier R.A., Gil P.R., Hoffmann M., Pilgrim J., Brooks T., Mittermeier C.G., Lamoreux J. and da Fonseca G.A.B. 2004. “Hotspots Revisited. Earth’s Biologically Richest and Most Endangered Terrestrial Ecoregions”,

- Cemex, SA, Agrupación Sierra Madre, SC.
25. Newberry R. 1984. The American Red-Eared Terrapin in South Africa. *African Wildlife*, 38: 186–189.
 26. Noss R.F. 1996. *National Parks and Protected Areas: Their Role in Environmental Protection*. Blackwell Science; Cambridge, *Protected areas: How Much Is Enough?*
 27. Pressey R.L., Visconti P. and Ferraro P.J. 2015. Making Parks Make A Difference: Poor Alignment of Policy, Planning and Management with Protected-Area Impact, and Ways Forward. *Philosophical Transactions of the Royal Society of London, Series B*. 370: 20140280.
 28. Pyšek P. and Richardson D. 2010. Invasive Species, Environmental Change and Management, and Health. *Annual Review of Environment and Resources*, 35: 25–55.
 29. Rödder D., Schmidtlein S., Veith M. and Lötters S. 2009. Alien Invasive Slider Turtle In Unpredicted Habitat: A Matter of Niche Shift or of Predictors Studied? *PLoS ONE* 4: 7843.
 30. Sarıkaya B., Yıldız M.Z. and Sezen G. 2017. The Herpetofauna of Adana Province (Turkey). *Commagene Journal of Biology*, 1(1): 1–11.
 31. Scalera R. 2006. *Trachemys scripta*. From: DAISIE (Delivering Alien Invasive Species Inventories for Europe). <www.europe-aliens.org>. Accessed: 23 February 2015.
 32. Sindaco R., Venchy A., Carpaneto G.M. and Bologna M.A. 2000. The Reptiles of Anatolia: A Checklist and Zoogeographical Analysis. *Biogeographia*, Rome, 441–554.
 33. Spear D., Foxcroft L.C., Bezuidenhout H. and McGeoch M.A. 2013. Human Population Density Explains Alien Species Richness In Protected Areas. *Biological*

- Conservation, 159: 137–147.
34. Stone J.E. 2010. Distribution and Abundance of Non-Native Red-Eared Slider Turtles (*Trachemys scripta elegans*) and Native Red-Bellied Turtles (*Pseudemys rubriventris*), Drexel University. Master of Science in Environmental Science. Master Thesis.
 35. Şahin M.K. and Afsar M. 2018. Evaluation of The Reptilian Fauna in Amasya Province, Turkey with New Locality Records. Gazi University Journal of Science, 31(4): 1007–1020.
 36. Teillac-Deschamps P. and Prevot-Julliard A.C. 2006. Impact of Exotic Slider Turtles on Freshwater Communities: An Experimental Approach. pp. 162–163. In: First European Congress of Conservation Biology. Society for Conservation Biology, Heger, Hungary.
 37. Thomson R.C., Spinks P.Q. and Shaffer H.B. 2010. Distribution and Abundance of Invasive Red-Eared Sliders (*Trachemys scripta elegans*) in California's Sacramento River Basin and Possible Impacts on Native Western Pond Turtles (*Emys marmorata*). Chelonian Conservation and Biology, 9(2): 297–302.
 38. Uysal İ., Tosunoğlu M., Yalçın Özdilek Ş. and Gül Ç. 2018. A Record and Distribution of Exotic Species *Trachemys scripta* in the Streams of Çanakkale (Turkey). Turkish Journal of Bioscience and Collections, 2(2): 12–19.

– Chapter 3 –

OVERVIEW ON COUMARIN CHALCONE COMPOUNDS AND PROPERTIES SYNTHESIZED IN 2020

Hülya ÇELİK ONAR⁸

⁸ İstanbul University-Cerrahpaşa, Engineering Faculty, Chemistry Department, Organic Chemistry Division Avcılar, İstanbul, Turkey,
hcelik@iuc.edu.tr

Chalcones, generally composed of two aromatic rings connected α , β -unsaturated carbonyl system which a three-carbon, are naturally found in vegetables, fruits, teas and other plants and are involved in the biosynthesis of isoflavonoids and flavonoids in plants (Rashid et al., 2019). They are very important class because of medicinal and pharmacological properties like anticancer (Modzelewska et al., 2006), antitumor (Jin et al., 2013), anti-diabetics (Ugwu et al., 2015), anti-HIV (Rizvi et al., 2012), antioxidants (Mazzone et al., 2015), antiulcer (Sashidhara et al., 2015), antimalarial (Raj et al., 2015), cardiovascular (Mahapatra and Bharti, 2016), anti-tubercular (Mujahid et al., 2015), antibacterial (Mujahid et al., 2015), antifungal (Zheng et al., 2015), antiviral (Zhou et al., 2018), anti-inflammatory (Mahapatra et al., 2017), anticonvulsant (Sharma et al., 2013), antidiuretic (Rizvi et al., 2012). Naturally derived chalcones are usually yellow, orange and brown colored crystalline solids.

Coumarin composed of benzene and 2-pyrone rings is a bicyclic heterocyclic compound and is also a broad natural class. Coumarin derivatives show a lot of pharmacological activities (Sashidhara et al., 2013; Emami and Dadashpour, 2015), such as anticarcinogenic (Basanagouda et al., 2014), antiviral (Curini et al., 2003), anticholinesterase (Kurt et al., 2015), anti-inflammatory (Fylaktakidou et al., 2004), antithrombotic (Peng et al., 2013), antioxidant (Kostova et al., 2011), hepatoprotective (Atmaca et al., 2011), , antimicrobial (Ostrov et al., 2007), antituberculosis (Manvar et al., 2011), antihyperlipidemic (Yuce et al., 2009) and monoamine oxidase-B inhibitors (Hammuda et al., 2016) activities.

Since chalcones and coumarins can be prepared synthetically and have a variety of biological activities, they have attracted great interest for possible therapeutic uses. (Wang et al., 2020). As expected, modified chalcones and coumarin-chalcone hybrids

are also It has been reported to have a lot of pharmacological activities such as anticancer, antimalarial, antimicrobial and antioxidant properties (Xiao et al.2020).

11 new coumarin-chalcone compounds containing the urea group were synthesized by Kurt et al, and the antitumor effects of these hybrids on the in vitro growth of CHO (Chinese hamster ovary) cell, H4IIE (rat hepatoma) and HepG2 (human hepatocellular carcinoma) were investigated (Figure 1). Sorafenib is positive control in this study. Among the synthesized compounds, compounds k and j showed better activity against H4IIE and HepG2, respectively, compared to Sorafenib. In this study; It has been reported that compounds k and j can be potent antitumor agents (Kurt et al., 2020).

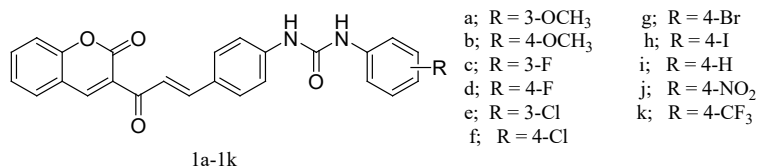
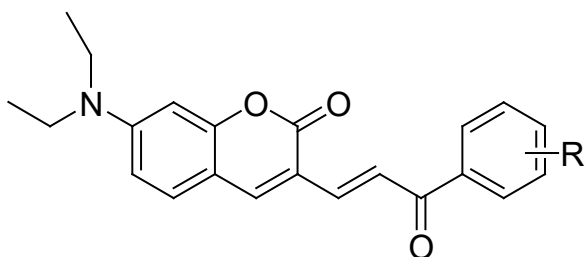


Figure 1. New coumaryl-chalcone substituted urea derivatives from Kurt et al.

In this study, 14 new coumarin-chalcone compounds were synthesized and evaluated for TrxR inhibitors. Xanthohumol was used as a positive control in the study. Many of the synthesized compounds are reported to exhibit more anticancer activity than Xanthohumol. It has been suggested that from these compounds, particularly 2b, it may be a good therapeutic TrxR inhibitor for the treatment of human cancer (Wanga et al., 2020).



2a-2n

- | | |
|---|---|
| a; R = 3,4-(OCH ₃) ₂ | h; R = 4-Br |
| b; R = 3-OH-4-OCH ₃ | i; R = 4-C ₄ H ₉ |
| c; R = 3-OCH ₃ | j; R = 2,4-Cl ₂ |
| d; R = 4-CH ₃ | k; R = 3-OH |
| e; R = 2-CH ₃ | l; R = 4-OC ₂ H ₅ |
| f; R = 3-CH ₃ | m; R = 4-NO ₂ |
| g; R = 4-F | n; R = 4-NH ₂ |

Figure 2. Coumarin-chalcone hybrids synthesized by Wanga et al.

In another study, Veras et al. synthesized the **4-MET** compound (Coumarin chalcone hybrid) and evaluated mutagenic / antimutagenic and recombinogenic / anti-recombinogenic activities in *Drosophila melanogaster* using the SMART test. As a result of the study, it was stated that 4-MET was not toxic to *D. melanogaster* at the organism level or was not genotoxic / recombinogenic as stated in the SMART test, but protected *D. melanogaster* somatic cells against genotoxicity / recombinogenicity caused by MMC. It has been stated that 4-MET is one of the agents that can be used in chemopreventive treatments (Veras et al., 2020).

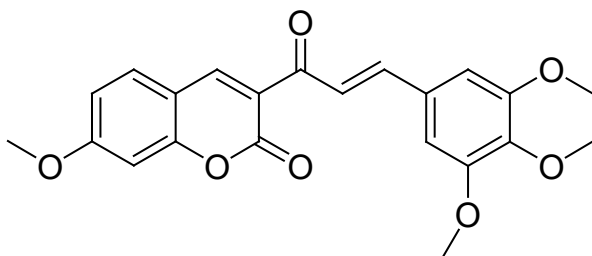


Figure 3. 4-MET(7-Methoxy-3-(E)-3-(3,4,5-trimethoxyphenyl)acryloyl)-2H-chromen-2-one

Four series coumarin-chalcone hybrids (**DPCU 1–13**, **DPCT 1–13**, **DCCU 1–13** and **DCCT 1–13**) were synthesized with good yield (54-78%) and evaluated against insulin receptor (IIR3) using VLife MDS 4.6 software. The docking scores of coumarin-chalcone hybrids were compared with the internal ligand (ANP) and the standard drug metformin. It was stated that DCCU 13 and DCCT 13 showed a minimum binding score of -83.15 and -82.72, respectively and they show better activity against to insulin receptor (IIR3) (Kumar Konidala et al., 2020).

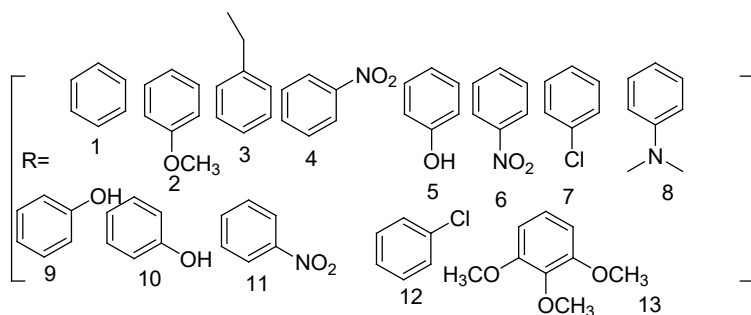
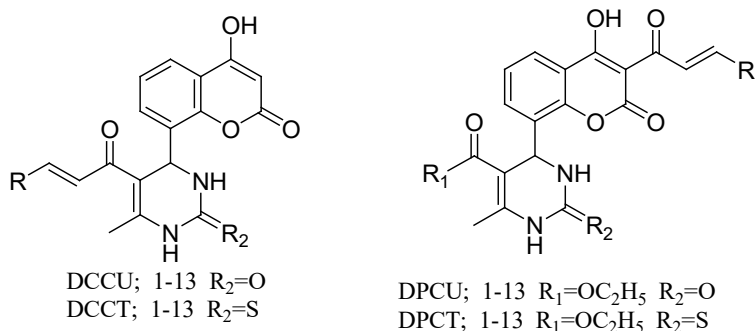
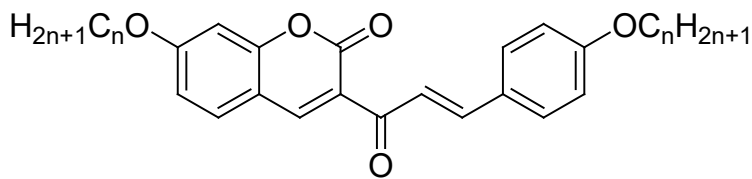


Figure 4. Synthesized coumarin-chalcone hybrids (DPCU 1–13, DPCT 1–13, DCCU 1–13 and DCCT 1–13)

Working areas with liquid crystal material, such as liquid crystal thermometers, biological sensors, etc for every day is increasing (Andrienko, 2018; Lagerwall and Scalia, 2012). The increasing areas of use have made it necessary to discover new liquid crystal materials, especially new liquid crystal materials from the thermotropic class (Singh and Dunmur, 2002). It has been reported by both Kang and Kang and Buchs et al. that polymeric and non-polymeric coumarin derivatives have liquid crystalline properties (Kang & Kang, 2015; Buchs et al., 2014).

Durgapal and et al. have synthesized a new homologous series of n.alkoxycoumarin- chalcone derivatives. The effect of chalcone on mesophase appearance and stability was studied using DSC and POM. Series up to n = 7 showed only the nematic phase, while the coumarin-chalcone compound with n = 8 (**11f**) showed two phases. The focal conical phase is indicative of the smectic A phase and the nematic phase with different textures, and this has been further confirmed by the DSC study. Other members of the series with n = 9 and above showed only the focal conical smectic A phase (Durgapal et al., 2020).



11a-11k

a; n=2	d; n=6	g; n=10	j; n=16
b; n=4	e; n=7	h; n=12	k; n=18
c; n=5	f; n=8	i; n=14	

Figure 5. Coumarin-chalcone derivatives with liquid crystalline properties

In this study, two coumarin-chalcone derivatives were synthesized and examined using MTT assay against to T47D cells and HeLa cells as anticancer activity. However, it is stated that these synthesized compounds show a low activity (Suwito et al., 2020).

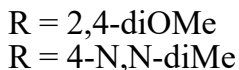
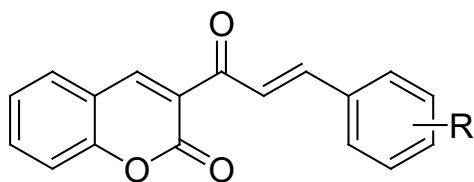


Figure 6. Synthesized coumarin-chalcone derivatives by Suwito et al.

Хуссьен et al., synthesized two coumarin chalcone derivatives and identified both of them by ¹H NMR, ¹³C NMR, UV and FTIR. It was stated that they can be used as fluorescent dyes for synthetic fibres (*Хуссьен* et al., 2020).

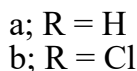
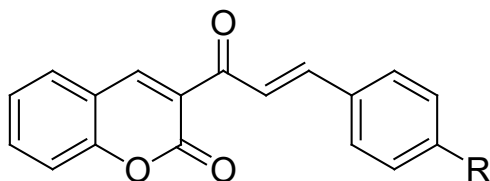


Figure 7. Synthesized coumarin-chalcone derivatives by *Хуссьен et al.*

Adenosine receptors (ARs) play an important role in diseases such as Alzheimer's, Parkinson's, epilepsy, and schizophrenia. In this study, eight coumarin-chalcone hybrids synthesized and evaluated binding affinity for four subtypes of human ARs. The experimental results showed that the methoxy substituted

compounds (3,4) allowed higher hA3 binding, while the hydroxy substituted samples (5-8) allowed moderate hA1 binding. It was stated that 4 and 7 of the synthesized compounds had the highest activity (Vazquez-Rodriguez et al., 2020)

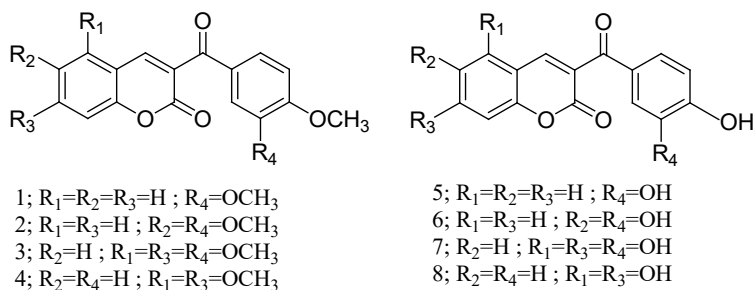
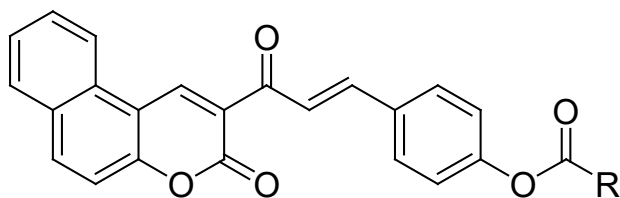


Figure 8. Synthesized coumarin-chalcone hybrids for the activity of hARs

The seven coumarin-chalcone derivatives were synthesized by Jaber and co-workers. Anticancer activity was evaluated against SK-LU-1 and MCF-7 cancer cells. For this, the MTT test was used. Antibacterial and antifungal activities were examined against *Staphylococcus aureus*, *Escherichia coli*, *Candida albicans* and *Aspergillus niger* using broth dilution method. Compounds with the best anticancer, antibacterial, and antifungal activities were noted to be compounds with groups OMe, Cl, F, and NH (Jaber et al., 2020).



5 - 11

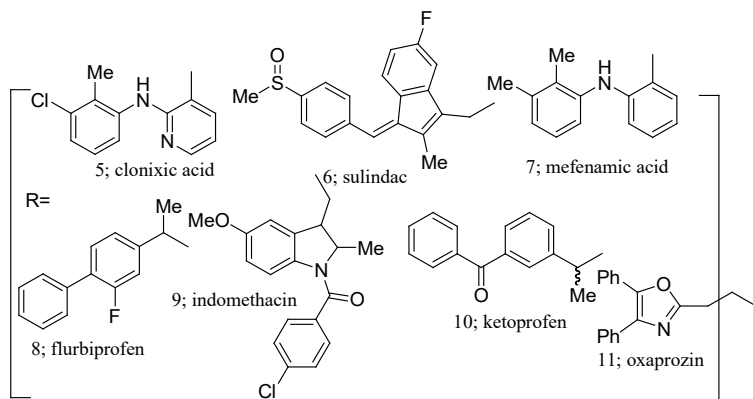
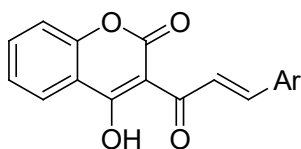


Figure 9. Synthesized coumarin-chalcone derivatives by Jaber et al.

Sahoo and co-workers synthesized nine coumarin-chalcone derivatives and tested against several bacterial strains for the antibacterial activities. Gentamisin used as a standard. It showed the best antibacterial activity **4i** among the synthesized compounds (Sahoo et al., 2021).



4a - 4i

Ar= a; C₆H₅- b; 4-F C₆H₄- c; 4-OCH₃ C₆H₄- d; 4-CH₃ C₆H₄-
 e; 4-Br C₆H₄- f; 4-NO₂ C₆H₄- g; 3,4,5-OCH₃ C₆H₂-
 h; naphthyl- i; 4-dimethylamino phenyl-

Figure 10. Coumarin chalcone derivatives for antibacterial activity

Thirteen novel coumarin-chalcone compounds were synthesized in this study. Mesoporous CoCl₂NN'PhBIA / Al-SBA-15 was used for the first time as a catalyst in the synthesis. This catalyst is the original organic-inorganic hybrid. The catalyst is recyclable under sonication condition and can be used as a very effective catalyst. The syntheses were carried out in a short time and with high yield in the presence of new catalyst and ultrasonic irradiation technique (Akbarzadeh and Safaei-Ghomi, 2020).

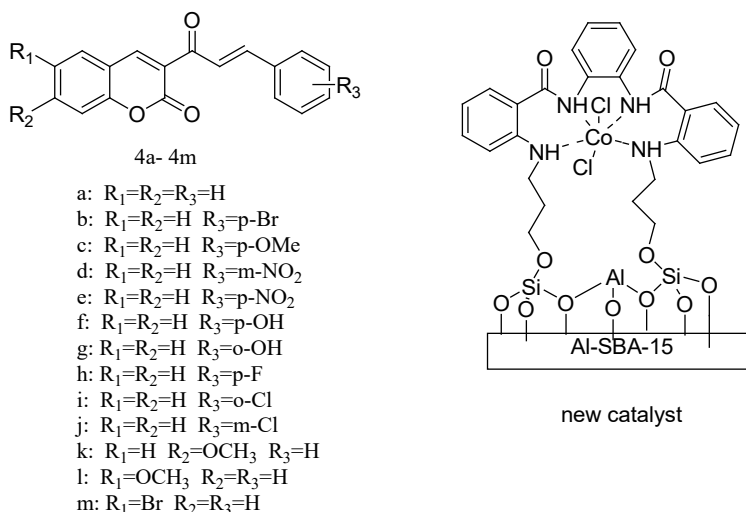


Figure 11. Synthesized coumarin-chalcone compounds with $CoCl_2 \cdot NN'PhBIA/AL-SBA-15$ as a catalyst

The use of colorimetric or fluorescent chemosensors is important for detecting contaminants and metal ions. It is believed that the excess aluminum in our body causes diseases such as Alzheimer's and Parkinson's, while copper deficiency causes many ailments such as anemia and low white blood cell count. And the increase in magnesium is also blamed for diseases such as diabetes, hypertension, epilepsy and Alzheimer's. In this study, a new chemosensor L (Coumarin-chalcone hybrid) was synthesized. It was stated that this sensor showed a good selectivity for Al^{3+} and Cu^{2+} determination colorimetrically and for Al^{3+} and Mg^{2+} in ethanol as fluorescence. (Zhang et al., 2020).

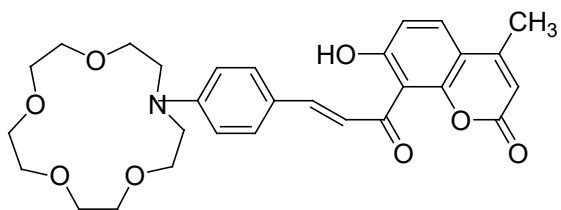


Figure 12. Chemosensor L

REFERENCES

1. Akbarzadeh, Z., Safaei-Ghomi, J. (2020). Ultrasound assisted eco-friendly synthesis of 3-cinnamoyl coumarins using N,N'-(1,2-phenylene)bis(2-aminobenzamide) dichloro cobalt immobilized on mesoporous Al-SBA-15 as a new and recyclable catalyst. *Green Chemistry Letters And Reviews*. 13(2), 141–154.
2. Andrienko, D. (2018). Introduction to liquid crystals, *J.Mol.Liq.* 267, 520–541.
3. Atmaca, M., Bilgin, H.M., Obay, B.D., Diken, H., Kelle, M., Kale, E. (2011). The hepatoprotective effect of coumarin and coumarin derivates on carbon tetrachloride-induced hepatic injury by antioxidative activities in rats. *J. Physiol. Biochem.* 67, 569–576.
4. Basanagouda, M., Jambagi, V.B., Barigidad, N.N., Laxmeshwar, S.S., Devaru, V., Narayanachar, (2014). Synthesis, structure-activity relationship of iodinated-4-aryloxymethyl-coumarins as potential anti-cancer and anti-mycobacterial agents. *Eur. J. Med. Chem.* 74, 225–233.
5. Buchs, J., Gäbler, M., Janietz, D., Sawade, H. (2014). Coumarin-based emissive liquid crystals. *Liq.Cryst.*41, 1605–1618.
6. Curini, M., Epifano, F., Maltese, F., Marcotullio, M.C., Gonzales, S.P., Rodriguez, J.C. (2003). Synthesis of collinin, an antiviral coumarin. *Aust. J. Chem.* 56, 59–60.
7. Durgapal, S.D., Soni, R., Soman, S.S., Prajapati, A.K. (2020). Synthesis and mesomorphic properties of coumarin derivatives with chalcone and imine linkages. *Journal of Molecular Liquids.* 297, 111920-11931.
8. Emami, S., Dadashpour, S. (2015). Current developments of coumarin based anti-cancer agents in medicinal

- chemistry. *Eur. J. Med. Chem.* 102, 611–630.
9. Fylaktakidou, K.C., Hadjipavlou-Litina, D.J., Litinas, K.E., Nicolaides, D.N. (2004). Natural and synthetic coumarin derivatives with anti-inflammatory/antioxidant activities. *Curr. Pharm. Design.* 10, 3813–3833.
 10. Hammuda, A., Shalaby, R., Rovida, S., Edmondson, D.E., Binda, C., Khalil, A. (2016). Design and synthesis of novel chalcones as potent selective monoamine oxidase-B inhibitors. *Eur. J. Med. Chem.* 114, 162–169.
 11. Jaber, Q.A.H., Abdul-Ridab, N.A., Adnan, Sh. (2020). Boosting 3H-Benzo[f]chromen-3-one Chalcone with Anti-inflammatory Drugs: Synthesis, Characterization, and Evaluation of Cytotoxicity and Antimicrobial Activity. *Russian Journal of Organic Chemistry.* 56(9), 1622–1627.
 12. Jin, C., Liang, Y.J., He, H., Fu, L. (2013). Synthesis and antitumor activity of novel chalcone derivatives. *Biomed. Pharmacother.* 67(3), 215-217.
 13. Kang, H., Kang, D. (2015). Photo alignment behavior on polystyrene films containing coumarin moieties. *Mol. Cryst.Liq.Cryst.* 623, 45–55.
 14. Kostova, I., Bhatia, S., Grigorov, P., Balkansky, S., Parmar, V.S., Prasad, A.K., Saso, L. (2011). Coumarins as antioxidants. *Curr. Med. Chem.* 18, 3929–3951.
 15. Kumar Konidala, S., Kotra, V., Chandra Sekhara Reddy Danduga, R., Kumar Kola, P. (2020). Coumarin-Chalcone Hybrids targeting Insulin receptor: Design, Synthesis, Anti-diabetic activity, and Molecular docking. *Bioorganic Chemistry*, 104207-104228.
 16. Kurt, B.Z., Gazioglu, I., Sonmez, F., Kucukislamoglu, M. (2015). Synthesis, antioxidant and anticholinesterase activities of novel coumarylthiazole derivatives. *Bioorg.*

Chem. 59, 80–90.

17. Kurt, B.Z., Kandas, N.O., Dag, A., Sonmez, F., Kucukislamoglu, M. (2020). Synthesis and biological evaluation of novel coumarin-chalcone derivatives containing urea moiety as potential anticancer agents. *Arabian Journal of Chemistry*. 13, 1120–1129.
18. Lagerwall, J.P.F., Scalia, G.A. (2012). New era of liquid crystal research: applications of liquid crystals in soft matter nano-, bio- and micro technology. *Curr. Appl. Phys.* 12, 1387–1412.
19. Mahapatra, D.K., Bharti, S.K. (2016). Therapeutic potential of chalcones as cardiovascular agents. *Life Sci*. 148, 154-172.
20. Mahapatra, D.K., Bharti, S.K., Asati, V. (2017). Chalcone derivatives: Anti-inflammatory potential and molecular targets perspectives. *Curr. Top. Med. Chem.* 17(28), 3146-3169.
21. Manvar, A., Bavishi, A., Radadiya, A., Patel, J., Vora, V., Dodia, N., Rawal, K., Shah, A. (2011). Diversity oriented design of various hydrazides and their in vitro evaluation against *Mycobacterium tuberculosis* H37(Rv) strains. *Bioorg. Med. Chem. Lett.* 21, 4728–4731.
22. Mazzone, G., Malaj, N., Galano, A., Russo, N., Toscano, M. (2015). Antioxidant properties of several coumarin–chalcone hybrids from theoretical insights. *RSC Adv.* 5(1), 565-575.
23. Modzelewska, A., Pettit, C., Achanta, G., Davidson, N.E., Huang, P., Khan, S.R. (2006). Anticancer activities of novel chalcone and bis-chalcone derivatives. *Bioorg. Med. Chem.* 14(10), 3491-3495.
24. Mujahid, M., Yogeewari, P., Sriram, D., Basavanag, U.M., Díaz-Cervantes, E., Córdoba- Bahena, L.,

- Robles, J., Gonnade, R.G., Karthikeyan, M., Vyas, R., Muthukrishnan, M. (2015). Spirochromone-chalcone conjugates as antitubercular agents: synthesis, bio evaluation and molecular modeling studies. *RSC Adv.* 5(129), 106448-10660.
25. Ostrov, D.A., Prada, J.A.H., Corsino, P.E., Finton, K.A., Le, N., Rowe, T.C. (2007). Discovery of novel DNA gyrase inhibitors by high-throughput virtual screening. *Antimicrob. Agents. Chem.* 51, 3688–3698.
26. Peng, X.M., Damu, G.L.V., Zhou, C.H. (2013). Current developments of coumarin compounds in medicinal chemistry. *Curr. Pharm. Des.* 19, 3884–3930.
27. Raj, R., Saini, A., Gut, J., Rosenthal, P.J., Kumar, V. (2015). Synthesis and in vitro antiplasmodial and evaluation of 7-chloroquinoline–chalcone, 7-chloroquinoline–ferrocenylchalcone conjugates. *Eur. J. Med. Chem.* 95, 230-239.
28. Rashid, H., Xu, Y.M., Ahmad, N., Muhammad, Y., Wang, L.S. (2019). Promising antiinflammatory effects of chalcones via inhibition of cyclooxygenase, prostaglandin E2, inducible NO synthase and nuclear factor kb activities. *Bioorg. Chem.* 87, 335-365.
29. Rizvi, S.U., Siddiqui, H.L., Johns, M., Detorio, M., Schinazi, R.F. (2012). Anti-HIV-1 and cytotoxicity studies of piperidyl-thienyl chalcones and their 2-pyrazoline derivatives. *Med. Chem. Res.* 21(11), 3741-3749.
30. Sahoo, C.R., Sahoo, J., Mahapatra, M., Lenka, D., Sahu, P.K., Dehury, B., Padhy, R.N., Paidsetty, S.K. (2021). Coumarin derivatives as promising antibacterial agent(s). *Arabian Journal of Chemistry.* 14, 102922-102980.
31. Sashidhara, K.V., Palnati, G.R., Sonkar, R., Avula, S.R., Awasthi, C., Bhatia, G. (2013). Coumarin chalcone

- fibrates: a new structural class of lipid lowering agents. *Eur. J. Med. Chem.* 64, 422–431.
32. Sashidhara, K.V., Avula, S.R., Mishra, V., Palnati, G.R., Singh, L.R., Singh, N., Chhonker, Y.S., Swami, P., Bhatta, R.S. (2015). Identification of quinoline-chalcone hybrids as potential antiulcer agents. *Eur. J. Med. Chem.* 89, 638-653.
 33. Sharma, C.S., Shekhawat, K.S., Chauhan, C.S., Kumar, N. (2013). Synthesis and anticonvulsant activity of some chalcone derivatives. *J. Chem. Pharm. Res.* 5(10), 450-454.
 34. Singh, S., Dunmur, A. (2002). *Liquid Crystals: Fundamentals*, World Scientific Publishing Co.Pte. Ltd., London.
 35. Suwito, H., Hardiyanti, H.D., Haq, K., Kristanti, A.N., Furghoniyyah, U., Rahmawati, A.N., Ayuningtyas, D.R. (2020). Synthesis, Anticancer Activity, and Apoptosis Mechanism of
 36. Some Chalcone Derivatives. *AIP Conference Proceedings* 2237, 020073.
 37. Ugwu, D.I., Ezema, B.E., Okoro, U.C., Eze, F.U., Ekoh, O.C., Egbujor, M.C., Ugwuja, D.I. (2015). Syntheses and pharmacological applications of chalcones: a review. *Int. J. Chem. Sci.* 13(1), 459-500.
 38. Vazquez-Rodriguez, S., Vilar, S., Kachler, S., Klotz, K.N., Uriarte, E., Borges, F., Matos, M.J. (2020). Adenosine Receptor Ligands: Coumarin–Chalcone Hybrids as Modulating Agents on the Activity of hARs. *Molecules.* 25, 4306-4320.
 39. Vêras, J.H., do Vale, C.R., da Silva Lima, D.C., dos Anjos, M.M., Bernardes, A., de Moraes Filho, A.V., Chen-Chen, L. (2020). Modulating effect of a hydroxychalcone and

- a novel coumarin–chalcone hybrid against mitomycin-induced genotoxicity in somatic cells of *Drosophila melanogaster*. *Drug and Chemical Toxicology*. 1–10.
40. Хуссьен, Ф.А., мирза, П., Мадвар, Р., Hussien, F.A., Merza, J., Madwar, R. 2020. Synthesis and characterization of two coumarin fluorescent dyes containing a chalcone moiety. *Научно-практический электронный журнал Аллея Науки» №3(42)*.
 41. Wang , T., Peng , T., Wen, X., Wang, G., Liu , S., Sun , Y., Zhang , S., Wang, L. (2020). Design, Synthesis and Evaluation of 3-Substituted Coumarin Derivatives as Anti-Inflammatory Agents. *Chem Pharm Bull*. 68 (5), 443–446.
 42. Wanga, Y., Zhangb, W., Donga, J., Gaoa, J. (2020). Design, synthesis and bioactivity evaluation of coumarin-chalcone hybrids as potential anticancer agents. *Bioorganic Chemistry*. 95, 103530-103537.
 43. Xiao, Y., Wang , Y.K., Xiao , X.R., Zhao , Q., Huang , J.F., Zhu , W.F., Li , F. (2020). Metabolic profiling of coumarins by the combination of UPLC-MS-based metabolomics and multiple mass defect filter. *Xenobiotica*, 50 (9), 1076-1084.
 44. Yuce, B., Danis, O., Ogan, A., Sener, G., Bulut, M., Yarat, A. (2009). Antioxidative and lipid lowering effects of 7,8-dihydroxy-3-(4-methylphenyl) coumarin in hyperlipidemic rats. *Arzneimittel-Forsch*. 59, 129–134.
 45. Zhang, Q., Ma, R., Li, Z., Liu, Z. (2020). A multi-responsive crown ether-based colorimetric/fluorescent chemosensor for highly selective detection of Al³⁺, Cu²⁺ and Mg²⁺. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*. 228, 117857-117870.
 46. Zheng, Y., Wang, X., Gao, S., Ma, M., Ren, G., Liu, H.,