Med Chem Res (2014) 23:3005–3018
DOI 10.1007/s00044-013-0880-1

MEDICINAL CHEMISTRY RESEARCH

ORIGINAL RESEARCH

Microwave-assisted synthesis of novel 1,2,3-triazole derivatives and their antimicrobial activity

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Received: 26 August 2013 / Accepted: 13 November 2013 / Published online: 11 December 2013

Abstract An environmentally benign and economic synthesis of 1-[7-(1-benzyl-1*H*-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl]-3-aryl-2-propen-1-ones and 1-[5-(1-benzyl-1*H*-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl]-3-aryl-propen-1-ones is described. The procedure takes place by the 1,3-dipolar cycloaddition (''click-reaction'') between azides and alkynes catalysed by copper (I) salts. The simplicity of this reaction and the ease of formation and purification of the resulting products have opened new opportunities in generating vast arrays of compounds with biological potential. The structures of the synthesized compounds have been established on the basis of physical and spectral data. All the synthesized compounds were tested in vitro for their antibacterial and antifungal activities. Compounds **8a** (R_1=H, R_2=H, R_3=H), **8b** (R_1=H, R_2=CH_3, R_3=H), **8d** (R_1=OCH_3, R_2=OCH_3, R_3=H), **8e** (R_1=OCH_3, R_2=OCH_3, R_3=OCH_3), **13a** (R_1=H, R_2=H, R_3=H), **13d** (R_1=OCH_3, R_2=OCH_3, R_3=H) and **13e** (R_1=OCH_3, R_2=OCH_3, R_3=OCH_3) showed significant antimicrobial properties.

Keywords Microwave irradiation · Click chemistry · 1,2,3-Triazoles · Antimicrobial activity

Electronic supplementary material The online version of this article (doi:10.1007/s00044-013-0880-1) contains supplementary material, which is available to authorized users.

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Introduction

1,2,3-Triazoles and its derivatives have emerged rapidly with the advance of modern heterocyclic chemistry, promising a variety of medicinal applications such as antimicrobial (Demaray *et al.*, 2008) anti-HIV (Lazrek *et al.*, 2001) anticancer (Chen *et al.*, 2011) and antioxidant (Khan *et al.*, 2010) activities.

Chalcones are known to exhibit various biological activities (Alvarez *et al.*, 1994), such as antioxidant (Sathyanarayana *et al.*, 2004), anti-inflammatory (Mukherjee *et al.*, 2001), antimalarial (Hsieh *et al.,* 2000), antileishmanial (Ram *et al.*, 2000) and anticancer (Zhai *et al.*, 1999) activities. Furthermore, they have considerable biological importance, especially as pesticides (Anto *et al.*, 1995). It is known that numbers of chroman derivatives are used as antioxidant for fats and oils (Bergmann and Gericke, 1990; Burrell *et al.*, 1990; Gericke *et al.*, 1991). Among naturally occurring chromans, vitamin E is very effective that suppress cellular membranes phospholipids degradation (Ray *et al.*, 1976) and also exhibits antioxidant, anticancer and cardio protective activities.

During the past decades, the environment consciousness has compelled the chemist to make a new twist on old theme. In this endeavour, Microwave-assisted reactions have made a landmark and significant contributions to preserve the green environment by reducing the waste effluent, remarkable rate enhancement, high yields, greater selectivity and ease of manipulation.

Inspired with the biological profile of 1,2,3 triazoles, chalcones and chroman nuclei, their increasing importance in pharmaceutical and biological fields, and in connection with our (Ashok and Shravani, 2008; Ashok *et al.*, 2012) search on the design and synthesis of pharmacologically important new heterocycles linked to chroman, it was

thought worthwhile to synthesize the titled compounds with a view to obtain certain chemical entities with active pharmacophores in a single molecular framework.

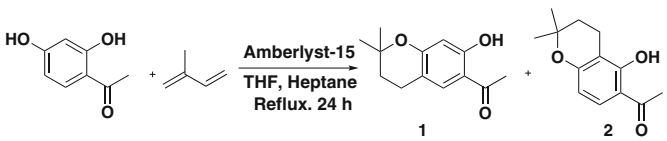
Microwave-assisted organic synthesis is suited to the increased demand in industry because of short reaction times and expanded reaction range, In particular, there is a requirement in the pharmaceutical industry for a higher number of novel chemical entities to be produced.

Results and discussion

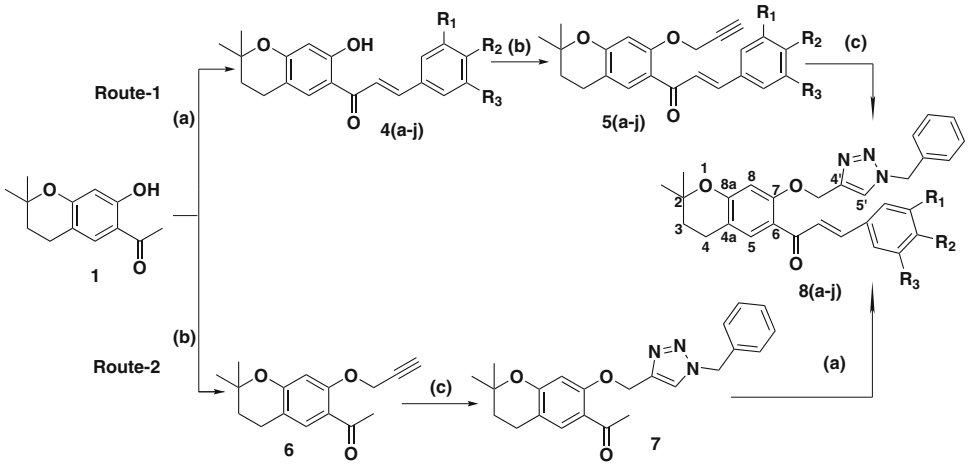
Chemistry

Herein, we wish to report an efficient, practical and high yielding method for the synthesis of compounds **8a–j** and **13a–j.** The starting materials 1-(7-hydroxy-2,2-dimethyl-chroman-6-yl)-ethanone (**1**) and 1-(5-hydroxy-2,2-dimethyl-chroman-6-yl)-ethanone (**2**) were prepared from the mixture of resacetophenone and isoprene using Amberlyst-15 catalyst in THF and heptanes (Kalena *et al.*, 1997) shown in Scheme 1. The synthesis of titled compounds **8a–j** and **13a–j** was accomplished by two synthetic strategies and is shown in Schemes 2 and 3. In route-1 (Scheme 2), the chalcones **4a–j** were synthesized from the mixture of compound **1** and aryl aldehydes in alcoholic KOH under microwave irradiation (MWI), followed by propargylation of chalcones **4a–j** in dry acetone/K_2CO_3 gave compounds **5a–j.** These compounds upon click reaction using CuI in DMF under MWI gave compounds **8a–j.** In route-2 (Scheme 2), compound **6**, prepared by propargylation of compound **1**, followed by click reaction using CuI in DMF under MWI gave compound **7**. Compound **7** on condensation with aryl aldehydes in alcoholic KOH under MWI gave compounds **8a–j** in excellent yields than route-1 shown in Scheme 2. Compounds, **13a–j** were also synthesized by the same procedure as compounds **8a–j** shown in Scheme 3. By comparing the above routes, the target compounds were synthesized in excellent yields in route-2 (Table 3) to give overall yields of 90–95 % in short reaction time. Whereas in route 1, the overall yields are 50–60 % only and took longer time to complete the reaction. Initially, we have investigated the yields of the click reaction using $CuSO_4{\cdot}5H_2O$/sodium ascorbate and CuI in different solvents like *t*-BuOH: H_2O (2:1), THF and DMF under both conventional and MWI. In the above investigation, we produced higher yields using CuI in DMF under MWI (Tables 1, 2, 3).

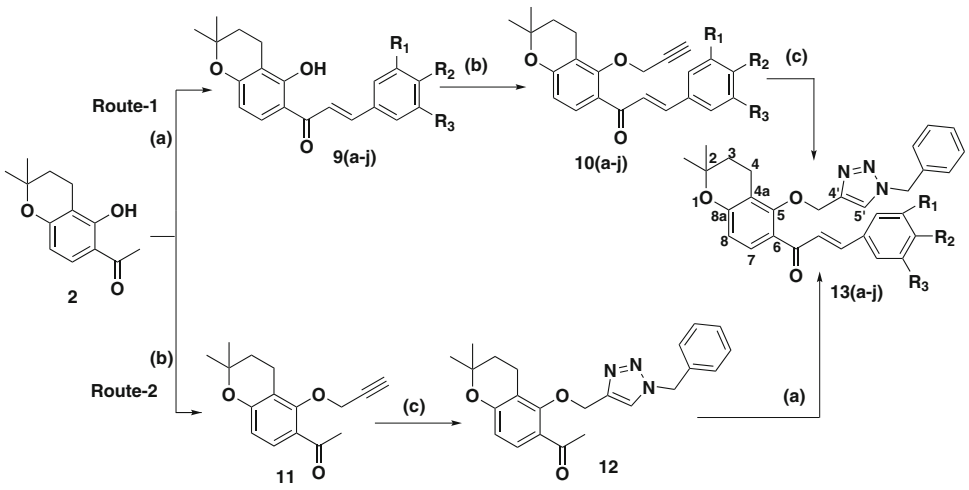
Structures of synthesized compounds (**5**, **6**, **8a–j**, **11, 12**, and **13a–j**) were characterized by IR, ^{1}H NMR, ^{13}C NMR and mass spectral analysis. The ^{1}H NMR spectrum of the representative compound **8a** (dissolved in $CDCl_3$) showed a singlet for Ar–H_5 proton at δ 8.29, another singlet for Ar–H_8 proton at δ 6.51. Two singlets for O–CH_2 and N–CH_2 protons appeared at δ 5.41 and 5.21 respectively. In the ^{13}C NMR spectrum, the signal of C=O carbon appeared at 190.9 ppm, those of O–CH_2 and N–CH_2 C-atoms appeared at 63.0 ppm and 54.0 ppm respectively. From, DEPT 135 O-methylene and *N*-methylene carbons were confirmed by the signals at 63.0 and 54.0 respectively and two methylene



Scheme 1 Synthesis of 1-(7-hydroxy-2,2-dimethyl-chroman-6-yl)-ethanone (**1**) and 1-(5-hydroxy-2,2-dimethyl-chroman-6-yl)-ethanone(**2**)



Scheme 2 Synthesis of 1-[7-(1-Benzyl-1*H*-[1,2,3]triazol-4-ylmethoxy-2,2-dimethyl-chroman-6-yl]-3-aryl-propenone (*Route-1* and *Route-2*)



Scheme 3 Synthesis of 1-[5-(1-Benzyl-1*H*-[1,2,3]triazol-4-ylmethoxy-2,2-dimethyl-chroman-6-yl]-3-aryl-propenone (*Route-1* and *Route-2*). Reagents and conditions: (*a*) Ar–CHO **3**(**a**–**j**), KOH/EtOH, MWI (*b*) propargylbromide, dry acetone, K_2CO_3, reflux. (*c*) Benzylazide, (i) $CuSO_4{\cdot}5H_2O$, Sodiumascorbate, H_2O/*t*-BuOH (2:1), (or) (ii) CuI, DMF or THF, NEt_3 RT or MWI

Table 1 Screening of catalyst and solvent

Entry	Catalyst	Solvent system	Conventional method		MWI	
			Time (h)	Yield (%)[a]	Time (h)	Yield (%)[a]
1	$CuSO_4{\cdot}5H_2O$	*t*-BuOH/H_2O (3:1)	26	52–54	12–15	66–68
2	$CuSO_4{\cdot}5H_2O$	THF	26	56–58	12–15	68–70
3	$CuSO_4{\cdot}5H_2O$	DMF	24	62–64	8–10	75–78
4	CuI	*t*-BuOH/H_2O (3:1)	26	61–64	12–15	70–73
5	CuI	THF	26	65–68	12–15	74–78
6	CuI	DMF	24	72–75	8–10	88–90

MWI microwave irradiation

[a] Isolated yields

Table 2 Comparisons of conventional and microwave irradiation methods

Compound	$CuSO_4{\cdot}5H_2O$				CuI			
	Conventional method		Microwave method		Conventional method		Microwave method	
	Time (h)	Yield (%)[a]	Time (h)	Yield (%)[a]	Time (h)	Yield (%)[a]	Time(h)	Yield (%)[a]
5a	24	62–64	9	75–78	24	72–75	10	88–90
5b	24	60–62	8	72–74	24	70–72	10	86–88
6	18	68–70	6	75–77	18	72–75	8	90–92
9a	24	60–62	9	75–78	24	72–75	10	86–88
9b	24	62–64	8	70–72	24	70–72	10	84–86
11	18	68–70	6	77–79	18	72–75	8	90–92

[a] Isolated yields

carbons C_3 and C_4 were also confirmed by the signals at 32.6 and 21.5 respectively. The GC–MS spectrum exhibited the $[M+H]^+$ peak at *m/z* 480. Thus, on the basis of above studies **8a** has been assigned structure 1-[7-(1-Benzyl-1*H*-[1,2,3]triazol-4-ylmethoxy-2,2-dimethyl-chroman-6-yl]-3-phenyl-propenone.

Microbiology

Antibacterial activity

All the synthesised compounds were screened in vitro for their antibacterial activity against two gram positive

Table 3 Comparison of yields of **8a–j** and **13a–j** of route-1 and route-2

Compound	R_1	R_2	R_3	Route-1 yield (%)[a]	Route-2 yield (%)[a]
8a	H	H	H	58	94
8b	H	CH_3	H	60	93
8c	H	OCH_3	H	55	92
8d	OCH_3	OCH_3	H	50	90
8e	OCH_3	OCH_3	OCH_3	56	92
8f	H	$N(CH_3)_2$	H	60	95
8g	H	Cl	H	60	94
8h	Cl	Cl	H	55	92
8i	H	$CH(CH_3)_2$	H	65	94
8j	NO_2	H	H	50	86
13a	H	H	H	60	94
13b	H	CH_3	H	58	93
13c	H	OCH_3	H	60	94
13d	OCH_3	OCH_3	H	55	90
13e	OCH_3	OCH_3	OCH_3	58	94
13f	H	$N(CH_3)_2$	H	65	93
13g	H	Cl	H	58	94
13h	Cl	Cl	H	56	92
13i	H	$CH(CH_3)_2$	H	64	93
13j	NO_2	H	H	30	88

[a] Isolated yields

bacteria *Staphylococcus aureus* (ATCC-9144), *Bacillus cereus* (ATCC-11778) and two gram negative bacteria *Escherichia coli* (ATCC-8739), *Proteus vulgaris* (ATCC-29213) by the cup-plate agar diffusion method (Revol-Junelles *et al.*, 1996) at different concentrations (50, 100, 150 and 200 μg/mL). Nutrient agar medium was used for the antibacterial screening. The Zone of inhibition (in mm) was compared with standard drug Streptomycin sulphate. The results are tabulated in Tables 4 and 5.

The investigation of antibacterial screening revealed that compounds **8a** and **13a** exhibited maximum zone of inhibition, indicates that compounds without substitutions on phenyl ring (benzaldehyde) showed prominent potency against all bacteria. compounds **8b–e**, **8h**, **8i**, **13b–e**, **13h**, and **13i** showed moderate zone of inhibition, indicate that compounds with substitutions at R_1 and R_2 positions on phenyl ring with electron donating groups enhances the antibacterial activity. Compounds with substitution at R_1 position with OCH_3 and Cl groups showed maximum zone of inhibition and compounds with substitution at R_2 position with CH_3, OCH_3 and Cl groups showed maximum zone of inhibition. Compounds **8f**, **8g**, **8i**, **13f**, **13g**, and **13i** showed poor zone of inhibition against all bacterial strains, indicate that compounds with substitution at R_2 position with $N(CH_3)_2$ and $CH(CH_3)_2$ groups diminishes the antibacterial potency.

Compounds **8a** (14 mm), **8d** (14 mm), **8e** (13.5 mm) **13a** (13 mm) and **13e** (13 mm) showed maximum zone of inhibition compare with standard drug streptomycin (15 mm) against *S. aureus*. Compound **8e** (13 mm) showed maximum potency compare with standard (16 mm) against *B. cereus*. Compounds **8a** (14.5 mm), **8d** (16 mm) and **8e** (16 mm) showed high potency compare with standard (17 mm) against *E. coli*. Compounds **8a** (13.5 mm) and **8d** (14 mm) exhibited maximum inhibition compare with standard (16 mm) against *P. vulgaris.*

Antifungal activity

All the synthesised compounds were screened in vitro for their antifungal activity against *Aspergillus Niger* (ATCC-9029), *Candida albicans* (ATCC-2091) and *Aspergillus foetidus* (NCIM-505). Sabouraud's agar medium was used for the antifungal screening. Zone of inhibition (in mm) was compared with standard drug Nystatin. The results are tabulated in Table 6.

Antifungal activity studies revealed that the compounds **8a**, **8d** and **8e** showed maximum zone of inhibition, compounds **8b**, **8f**, **8g**, **13a**, **13d**, **13e** and **13g** showed moderate zone of inhibition and compounds **8c**, **8h**, **8i**, **8j**, **13b**, **13c**, **13f**, **13h**, **13i** and **13j** showed poor antifungal potency. This study indicates that compounds without substitution on phenyl ring showed maximum potency and compounds with substitutions with Cl, OCH_3 and CH_3 groups showed moderate zone of inhibition.

Compounds **8a**, **8d**, **8e**, **13d** and **13e** exhibited maximum zone of inhibition against *A. Niger.* Compounds **8a**, **8e**, **8f** and **13g** showed maximum zone of inhibition against

Table 4 Antibacterial activity of compounds **8a–j** and **13a–j** against two gram positive bacteria

Compound	Zone of inhibition at different concentrations after 24 h (mm)							
	S. aureus (ATCC-9144)				*B. cereus* (ATCC-11778)			
	50 (μg/mL)	100 (μg/mL)	150 (μg/mL)	200 (μg/mL)	50 (μg/mL)	100 (μg/mL)	150 (μg/mL)	200 (μg/mL)
8a	14.0	17.5	19.0	20.5	12.5	14.0	15.0	17.0
8b	13.0	16.0	18.0	19.5	10.0	12.0	13.0	13.5
8c	11.0	13.5	15.0	16.0	9.0	10.5	12.0	13.0
8d	12.5	15.0	17.5	19.0	11.0	12.0	14.0	15.5
8e	11.5	14.0	15.0	17.0	13.0	16.0	18.0	20.0
8f	12.0	15.5	17.0	18.5	10.5	13.0	15.0	16.0
8g	11.0	13.0	14.5	16.0	8.0	10.0	11.0	14.0
8h	13.5	17.0	18.0	20.0	13.0	15.0	17.5	19.0
8i	14.0	18.0	19.0	21.0	12.0	13.5	15.5	18.0
8j	10.0	12.0	13.0	15.0	7.0	9.0	10.0	12.5
13a	12.5	14.0	15.5	17.0	9.0	11.5	13.0	14.5
13b	11.0	13.5	14.5	16.5	10.5	12.0	14.0	16.0
13c	10.0	12.5	14.0	15.5	7.5	8.5	10.0	11.5
13d	13.0	16.0	17.0	19.0	11.0	13.0	14.5	16.0
13e	13.0	16.5	16.5	19.5	11.0	12.5	14.0	15.5
13f	9.5	12.0	14.0	16.0	8.0	10.5	12.0	14.0
13g	11.5	14.0	16.0	17.5	9.5	11.0	13.0	14.5
13h	9.5	12.0	13.5	15.0	10.0	10.5	12.5	13.0
13i	11.0	13.0	14.0	16.5	11.0	12.5	13.5	14.0
13j	12.0	15.0	17.5	18.5	9.0	10.0	11.5	13.0
Std	15.0	19.0	22.0	25.0	16.0	20.0	23.0	26.0

Std streptomycin sulphate

C. albicans. Compounds **8a** and **8e** showed maximum zone of inhibition against *A. foetidus.*

Biological assay

Antimicrobial activity

The test solutions of the samples were prepared in dimethylformamide (DMF). The antibiotics: *Streptomycin sulphate* was used as standard for antibacterial screening and *Nystatin* was used as a standard for antifungal screening. The antibacterial standard was dissolved in sterile-distilled water. The antifungal standard was dissolved in buffered 70 % propanol.

The microorganisms employed in this study were two gram positive bacteria such as *S. aureus* (ATCC-9144) and *B. cereus* (ATCC-11778) and two gram negative bacteria such as *Escherichia coli* (ATCC-8739) and *P. vulgaris* (ATCC-29213) and fungal strains like *A. niger* (ATCC-9029), *Candica albicans* (ATCC-2091) and *A. foetidus* (NCIM-505).

Nutrient broth (pH −7.2) was used for the preparation of inoculum of bacteria. Nutrient agar medium was used for the antibacterial screening, contained 20.0 g of agar in addition to the composition of nutrient broth. For antifungal screening, inoculum was prepared by transferring a loopful of fungal stock culture to 100 mL of conical flask containing 50 mL of Sabouraud's broth. The composition of the broth was Glucose 40 g, Peptone 10 g, distilled water 1,000 mL. Sabouraud's agar medium was used for the antifungal screening, contained 20.0 g of agar in addition to the composition of Sabouraud's broth.

For antibacterial screening, the agar medium was sterilized by autoclaving at 120 °C for 15 min. The Petri plates and pipettes were sterilized by dry heat in a hot-air oven at 150 °C for 1 h. About 20 mL of the molten agar medium was poured in each of sterilized Petri plates and 0.5 mL of 24 h old broth cultures of bacterial strains were added to the respective Petri plates. The contents of the Petri plates were mixed thoroughly by rotary motion. After solidification of the medium, four cups (diameter 8 mm) were made with the help of a sterile borer at equal distances.

For antifungal activity, the corning sterile Petri plates were used for investigation. About 20 mL of the molten Sabouraud's agar medium was poured in each of sterilized Petri plates and 0.5 mL of 24 h old broth cultures of fungal strains was added to the respective Petri plates. The contents of the Petri plates were mixed thoroughly by rotary motion. After

Table 5 Antibacterial activity of compounds **8a–j** and **13a–j** against two gram negative bacteria

Compound	Zone of inhibition at different concentrations after 24 h (mm)							
	E. coli (ATCC-8739)				*P. vulgaris* (ATCC-2913)			
	50 (μg/mL)	100 (μg/mL)	150 (μg/mL)	200 (μg/mL)	50 (μg/mL)	100 (μg/mL)	150 (μg/mL)	200 (μg/mL)
8a	14.0	16.0	19.0	22.0	13.5	16.0	18.0	20.5
8b	13.5	17.0	18.0	20.5	11.5	15.0	17.0	20.0
8c	12.0	13.5	15.0	17.0	10.0	13.0	14.0	15.5
8d	13.0	15.0	16.0	18.0	12.5	13.0	15.0	16.0
8e	12.5	13.0	15.5	17.0	10.0	12.0	13.0	15.0
8f	14.0	16.0	18.0	19.0	13.0	15.0	19.0	22.0
8g	13.0	14.0	17.0	18.5	12.0	14.5	16.0	18.5
8h	16.0	17.5	19.0	21.5	11.5	12.5	15.0	17.0
8i	15.0	16.0	18.5	20.0	14.0	16.0	18.0	20.0
8j	11.0	12.5	15.0	17.0	8.0	10.0	11.5	13.0
13a	10.5	11.5	13.0	15.5	9.0	10.0	12.0	14.0
13b	12.0	14.0	16.0	18.0	10.5	12.0	14.0	16.0
13c	9.0	11.0	12.5	14.0	7.5	9.0	11.0	12.5
13d	12.5	14.5	16.5	18.0	11.0	12.5	14.5	16.0
13e	12.0	15.0	16.0	19.0	10.5	12.0	15.0	15.0
13f	10.0	12.0	14.0	16.5	8.5	10.5	12.5	14.0
13g	11.5	13.0	15.0	17.0	10.0	12.0	13.5	15.0
13h	10.0	11.5	14.5	14.0	10.0	11.0	12.0	13.5
13i	11.5	13.5	14.5	16.5	11.5	12.0	13.0	14.5
13j	10.5	12.0	13.5	15.0	9.0	10.5	12.0	14.5
Std	17.0	21.0	25.0	27.0	16.0	19.0	22.0	26.0

Std streptomycin sulphate

solidification of the medium, four cups (diameter 8 mm) were made with the help of a sterile borer at equal distances.

Accurately measured 0.1 mL of four different concentrations (50, 100, 150 and 200 μg/mL) of test samples and 0.1 mL of four different concentrations of standard antibiotics (50, 100, 150 and 200 μg/mL) were added into the cups and labelled accordingly. The plates were kept undisturbed in a cool place for 1 h to allow the solutions to diffuse into the medium. The nutrient agar plates were then incubated at 37 °C for 24 h for antibacterial activity. For antifungal activity, the Sabouraud's agar plates were then incubated at 28 °C for 48 h.

The presence of definite zone of inhibition surrounding the cups indicated antimicrobial activity. The diameter of the zone of inhibition was recorded. The experiments were performed, at least in triplicate.

Experimental

Materials

All the reagents and solvents were purchased from commercial sources. Analytical TLC was performed on Merck precoated 60 F254 silica gel plates. Visualization was done by exposing to iodine vapour and UV. IR spectra (υ_{max} in cm^{-1}) were recorded on a Shimadzu FT-IR 8400 S spectrometer. The melting points were taken in open capillary tubes on a *Stuart* SMP3 melting-point apparatus and are uncorrected. ^{1}H, ^{13}C NMR spectra were recorded in $CDCl_3$ on a Bruker AVANCE-400 spectrometer using TMS as an internal standard. (Chemical shift in δ, ppm). Mass spectra were scanned on a shimadzu GCMS-QP 1000 spectrometer (shimadzu, Tokyo, Japan).

General procedures

Synthesis of 1-(2,2-dimethyl-7-prop-2-ynyloxy-chroman-6-yl)-ethanone (**6**)

Anhydrous K_2CO_3 (0.94 g, 6.80 mmol, 1.5 eq) was added to 1-(7-hydroxy-2,2-dimethyl-chroman-6-yl)-ethanone (1 g, 4.50 mmol, 1.0 eq) dissolved in 5 mL dry acetone. Propargyl bromide 80 % in toluene (0.64 g, 5.40 mmol, 1.2 eq) was added to the mixture. The reaction mixture was refluxed for about 8 h. After completion of the reaction (monitored by TLC), the solvent was removed under

Table 6 Antifungal activity of compounds **8a–j** and **13a–j**

Compound	Zone of inhibition at different concentrations after 24 h (mm)											
	A. niger (ATCC-9029)				*C. albicans* (ATCC-2091)				*A. foetidus* (NCIM-505)			
	50 (μg/mL)	100 (μg/mL)	150 (μg/mL)	200 (μg/mL)	50 (μg/mL)	100 (μg/mL)	150 (μg/mL)	200 (μg/mL)	50 (μg/mL)	100 (μg/mL)	150 (μg/mL)	200 (μg/mL)
8a	13.0	15.0	16.5	19.0	12.0	13.0	15.0	17.5	12.5	14.0	15.0	17.0
8b	12.0	13.0	15.0	17.0	10.5	12.0	13.0	15.0	10.0	11.5	12.5	14.0
8c	10.0	11.5	13.0	15.0	11.0	12.5	14.0	16.0	10.5	12.0	14.0	15.5
8d	13.5	15.5	17.0	19.5	11.5	12.5	14.0	16.0	11.0	12.0	13.5	15.0
8d	14.0	16.0	17.5	20.0	12.5	13.5	16.0	18.0	12.0	14.0	15.5	17.5
8f	11.5	13.5	15.0	16.5	12.0	14.0	15.5	18.0	11.5	13.5	15.0	17.5
8g	11.0	12.5	14.5	16.0	10.0	11.0	13.0	15.5	9.5	10.5	13.0	14.5
8h	10.0	11.0	13.0	14.0	9.0	10.0	12.0	14.0	8.5	10.0	11.5	13.0
8i	10.5	12.0	13.0	15.0	11.5	13.0	14.5	18.0	11.0	12.5	14.0	16.0
8j	9.0	11.0	12.5	14.0	8.5	10.0	11.5	13.0	8.0	9.5	11.0	12.5
13a	12.0	13.5	15.5	17.0	11.0	12.0	13.0	14.5	10.5	11.5	13.0	14.0
13b	9.5	10.5	12.0	13.0	9.0	10.5	12.0	14.0	8.5	10.5	12.0	13.5
13c	10.0	11.0	13.5	15.0	11.5	13.5	14.5	16.0	11.0	13.0	14.0	15.5
13d	12.0	15.5	16.5	18.5	11.0	12.0	14.0	15.5	10.5	12.5	14.5	15.0
13e	12.0	13.5	15.0	16.5	10.5	12.0	13.5	15.0	10.0	11.0	12.5	14.0
13f	10.5	12.0	13.5	15.0	10.0	11.5	13.0	15.5	9.5	11.0	12.5	14.0
13g	11.0	13.0	14.0	16.0	12.0	13.5	14.5	16.0	11.5	13.0	14.0	15.5
13h	9.5	11.5	13.0	15.0	9.5	11.0	12.5	12.5	10.0	11.5	12.5	13.0
13i	10.5	12.5	13.5	16.5	12.0	12.0	13.5	14.5	9.5	11.0	12.0	13.5
13j	8.0	10.5	12.0	13.5	9.5	11.0	12.5	14.5	9.0	10.0	11.5	13.5
Std	17.0	18.0	20.0	22.0	15.0	16.0	18.0	21.0	15.0	17.0	19.0	20.0

Std nystatin

reduced pressure and added 30 mL ice cold water, then extracted with EtOAc and dried over anhydrous Na_2SO_4. Crude was purified by column chromatography using hexane/EtOAc (4:1) as eluent to give compound **6**.

Pale yellow solid; m.p.: 60–62 °C; IR (KBr) cm^{-1}: 3,294 (C≡C–H), 3,135 (Ar–H), 2,210 (C≡C), 1,648 (C=O), 1,226 (Ar–C), and 1,118 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.63 (s, 1H, Ar–H_5), 6.42 (s, 1H, Ar–H_8), 4.72 (d, 2H, O–CH_2), 2.73 (t, $J = 6.67$ Hz, 2H, CH_2), 2.60 (s, 3H, CH_3), 2.54 (t, 1H, C≡C–H), 1.80 (t, $J = 6.73$ Hz, 2H, CH_2), 1.36 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 197.7 (C=O), 159.0 (C_{8a}), 157.3 (C_7), 132.4 (C_5), 120.8 (C_6), 114.1 (C_{4a}), 101.3 (C_8), 77.9 (C_2), 75.9 (C≡C–H), 75.7 (C≡C–H), 56.2 (O–CH_2), 32.6 (C_3), 32.0 (CH_3), 26.8 (2×CH_3), 21.4 (C_4); MS $[M+H]^+$: 259.

Synthesis of 1-[7-(1-benzyl-1*H*-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl)-ethanone (**7**) using $CuSO_4{\cdot}5H_2O$/Sodium ascorbate under conventional conditions

$CuSO_4{\cdot}5H_2O$ (0.05 g, 0.37 mmol) and sodium ascorbate (0.22 g, 1.10 mmol) were added to a mixture of Benzyl azide (1.0 g, 7.5 mmol) and 1-(2,2-dimethyl-7-prop-2-ynyloxy-chroman-6-yl)-ethanone (1.90 g, 7.50 mmol) **6** dissolved in *t*-BuOH:H_2O (1:1, v/v) (5 mL) and was stirred under room temperature for 24 h. After completion of the reaction (monitored by TLC), the resulting mixture was poured into ice cold water (20 mL), extracted with 30 mL EtOAc, washed twice with saturated solution of NH_4Cl, twice with brine and dried over Na_2SO_4. The organic layer was concentrated in vacuo and the residue was purified by column chromatography on silica gel eluted with hexane/EtOAc (2:1) to give compound **7**.

Synthesis of 1-[7-(1-benzyl-1*H*-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl)-ethanone (**7**) using $CuSO_4{\cdot}5H_2O$/Sodium ascorbate under microwave irradiation

A mixture of Benzyl azide (1.0 g, 7.5 mmol), 1-(2,2-dimethyl-7-prop-2-ynyloxy-chroman-6-yl)-ethanone (1.90 g, 7.50 mmol) **6**, $CuSO_4{\cdot}5H_2O$ (0.05 g, 0.37 mmol) and sodium ascarbate (0.22 g, 1.1 mmol) dissolved in *t*-BuOH:H_2O (1:1, v/v) (5 mL) was subjected to microwave irradiation at 180 watts for 8–010 min. After completion of the reaction

(monitored by TLC), the resulting mixture was poured into ice cold water (20 mL), extracted with 30 mL EtOAc, washed twice with saturated solution of NH_4Cl, twice with brine and dried over Na_2SO_4. The organic layer was concentrated in vacuo and the residue was purified by column chromatography on silica gel eluted with hexane/EtOAc (2:1) to give compound **7**.

Synthesis of 1-[7-(1-benzyl-1*H*-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl)-ethanone (**7**) using CuI under conventional conditions

A mixture of Benzyl azide (1.0 g, 7.5 mmol), 1-(2,2-dimethyl-7-prop-2-ynyloxy-chroman-6-yl)-ethanone (1.90 g, 7.50 mmol) **6**, triethylamine (0.90 g, 9.00 mmol) and CuI (0.14 g, 0.75 mmol) in DMF (5 mL) was stirred under room temperature for 24 h. After completion of the reaction (monitored by TLC), the resulting mixture was poured into ice cold water (20 mL), extracted with 30 mL EtOAc, washed twice with saturated solution of NH_4Cl, twice with brine and dried over Na_2SO_4. The organic layer was concentrated in vacuo and the residue was purified by column chromatography on silica gel eluted with hexane/EtOAc (2:1) to give compound **7**.

Synthesis of 1-[7-(1-benzyl-1*H*-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl)-ethanone (**7**) using CuI under microwave irradiation

A mixture of Benzyl azide (1.0 g, 7.50 mmol), 1-(2,2-dimethyl-7-prop-2-ynyloxy-chroman-6-yl)-ethanone (1.90 g, 7.50 mmol) **6**, triethylamine (0.90 g, 9.00 mmol) and CuI (0.14 g, 0.75 mmol) in DMF (5 mL) was subjected to microwave irradiation at 180 watts for 8–10 min. After completion of the reaction (monitored by TLC), the resulting mixture was poured into ice cold water (20 mL), extracted with 30 mL EtOAc, washed twice with saturated solution of NH_4Cl, twice with brine and dried over Na_2SO_4. The organic layer was concentrated in vacuo and the residue was purified by column chromatography on silica gel eluted with hexane/EtOAc (2:1) to give compound **7**.

White solid; m.p.: 95–97 °C; IR (KBr) cm^{-1}: 3,138 (Ar–H), 1,648 (C=O), 1,455 (N=N), 1,226 (Ar–C), 1,182 (C–N) and 1,118 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.60 (s, 1H, Ar–H_5), 7.53 (s, 1H, triazole-H), 7.42–7.35 (m, 3H, Ar–H), 7.28 (m, 2H, Ar–H), 6.44 (s, 1H, Ar–H_8), 5.56 (s, 2H, O–CH_2), 5.19 (s, 2H, N–CH_2), 2.72 (t, $J = 6.67$ Hz, 2H, CH_2), 2.45 (s, 3H, CH_3), 1.79 (t, $J = 6.73$ Hz, 2H, CH_2), 1.34 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 198.2 (C=O), 159.0 (C_{8a}), 157.0 (C_7), 144.1 (1,2,3-triazole $C_{4'}$), 134.5–124.1 (6C, Ar–C), 128.0 (C_5), 123.4 (1,2,3-triazole $C_{5'}$), 127.5 (C_5), 120.8 (C_6), 114.1 (C_{4a}), 101.3 (C_8), 75.2, 67.1 (O–CH_2), 54.2 (N–CH_2), 31.9 (C_3), 29.7 ($\underline{C}H_3$), 26.7 (2×$\underline{C}H_3$), 21.4 (C_4); MS $[M+H]^+$: 392.

*1-(2,2-Dimethyl-7-prop-2-ynyloxy-chroman-6-yl)-3-tolyl-propenone (**5c**)*

Pale yellow solid; m.p.:159–162 °C; IR (KBr) cm^{-1}: 3,294 (C≡C–H), 3,138 (Ar–H), 2,210 (C≡C), 1,648 (C=O), 1,615 (C=C), 1,226 (Ar–C), and 1,118 (Ar–O). ^{1}H NMR (400 MHz, $CDCl_3$): 7.68–7.64 (d, 1H, $J = 15.76$ Hz, H_β), 7.58–7.55 (m, 2H, H_α, Ar–H_5), 7.52–7.51 (m, 2H, Ar–H), 7.18–7.17 (d, 2H, $J = 7.68$ Hz, Ar–H), 6.45 (s, 1H, Ar–H_8), 4.71 (s, 2H, O–CH_2), 2.74 (t, $J = 6.67$ Hz, 2H, CH_2), 2.53 (s, 1H, C≡C–H), 2.36 (s, 3H, CH_3–), 1.81 (t, $J = 6.73$ Hz, 2H, CH_2), 1.35 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 191.2 (C=O), 158.6 (C_{8a}), 156.6 (C_7), 141.1 (HC=$\underline{C}$H), 132.8 (C_5), 132.7–127.0 (6C, Ar–C), 122.0 (H$\underline{C}$=CH), 114.1 (C_{4a}), 109.8 (C_6), 101.3 (C_8), 78.1 (C_2), 75.9 ($\underline{C}$≡C–H), 75.7 (C≡$\underline{C}$–H), 56.2 (O–CH_2), 32.6 (C_3), 32.7 ($\underline{C}H_3$), 26.9 (2×$\underline{C}H_3$), 21.4 (C_4); MS $[M+H]^+$: 361.

*1-(2,2-Dimethyl-5-prop-2-ynyloxy-chroman-6-yl)-3-tolyl-propenone (**10c**)*

Pale yellow solid; m.p.: 59–62 °C; IR (KBr) cm^{-1}: 3,294 (C≡C–H), 3,138 (Ar–H), 2,210 (C≡C), 1,648 (C=O), 1,615 (C=C), 1,226 (Ar–C), and 1,118 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.63 (d, 1H, $J = 15.76$ Hz, H_β), 7.58–7.51 (m, 4H, Ar–H_5, Ar–H), 7.18–7.12 (d, 2H, $J = 7.68$ Hz, Ar–H), 6.45 (s, 1H, Ar–H_8), 4.71 (s, 2H, O–CH_2), 2.74 (t, $J = 6.67$ Hz, 2H, CH_2), 2.53 (s, 1H, C≡C–H), 2.36 (s, 3H, CH_3–), 1.81 (t, $J = 6.73$ Hz, 2H, CH_2), 1.35 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 191.3 (C=O), 159.0 (C_{8a}), 157.3 (C_5), 143.6 (HC=$\underline{C}$H), 137.3–126.6 (6C, Ar–C), 124.7 (C_7), 115.9 (H$\underline{C}$=CH), 113.9 (C_6), 109.9 (C_{4a}), 107.0 (C_8), 77.9 (C_2), 75.9 ($\underline{C}$≡C–H), 75.7 (C≡$\underline{C}$–H), 63.2 (O–CH_2), 32.0 (C_3), 26.7 (2×$\underline{C}H_3$), 20.9 ($\underline{C}H_3$), 17.5 (C_4); MS $[M+H]^+$: 361.

*1-(2,2-Dimethyl-5-prop-2-ynyloxy-chroman-6-yl)-ethanone (**11**)*

Pale yellow solid; m.p.: 60–62 °C; IR (KBr) cm^{-1}: 3,294 (C≡C–H), 3,135 (Ar–H), 2,210 (C≡C), 1,648 (C=O), 1,226 (Ar–C), and 1,118 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.63 (d, $J = 8.78$ Hz, 1H, Ar–H_7), 6.42 (d, $J = 8.78$ Hz, 1H, Ar–H_8), 4.73 (d, 2H, O–CH_2), 2.73 (t, $J = 6.67$ Hz, 2H, CH_2), 2.60 (s, 3H, CH_3), 2.55 (t, 1H, C≡C–H), 1.80 (t, $J = 6.73$ Hz, 2H, CH_2), 1.36 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 197.7 (C=O), 159.0 (C_{8a}), 157.3 (C_5), 127.6 (C_7), 109.3 (C_{4a}), 108.9 (C_8), 102.8 (C_6), 77.9 (C_2), 75.9 ($\underline{C}$≡C–H), 75.7

(C≡C–H), 56.2 (O–CH_2), 32.6 (C_3), 32.0 (CH_3), 26.8 (2×CH_3), 17.5 (C_4); MS $[M+H]^+$: 259.

*1-[5-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl]-ethanone (**12**)*

White solid, m.p.: 95–98 °C; IR (KBr) cm^{-1}: 3,138 (Ar–H), 1,648 (C=O), 1,455 (N=N), 1,226 (Ar–C), 1,182 (C–N) and 1,118 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.62 (s, 1H, triazole-H), 7.54–7.51 (d, $J = 8.78$ Hz, 1H, Ar–H_7), 7.45–7.37 (m, 4H, Ar–H), 7.28 (m, 1H, Ar–H), 6.63–6.60 (d, $J = 8.78$ Hz, 1H, Ar–H), 5.54 (s, 2H, O–CH_2), 5.02 (s, 2H, N–CH_2), 2.77 (t, $J = 6.67$ Hz, 2H, CH_2), 2.54 (s, 3H, CH_3), 1.74 (t, $J = 6.73$ Hz, 2H, CH_2), 1.34 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 198.2 (C=O), 159.0 (C_{8a}), 157.0 (C_5), 144.1 (1,2,3-triazole $C_{4'}$), 134.5–128.1 (6C, Ar–C), 128.7 (C_7), 124.1 (1,2,3-triazole $C_{5'}$), 116.4 (C_{4a}), 113.6 (C_8), 102.8 (C_6), 75.2 (C_2), 67.1 (O–CH_2), 54.2 (N–CH_2), 31.9 (C_3), 29.7 (CH_3), 26.7 (2×CH_3), 17.4 (C_4); MS $[M+H]^+$: 392.

*Synthesis of 1-[7-(1-benzyl-1H-[1,2,3]triazol-4-ylmethoxy-2,2-dimethyl-chroman-6-yl]-3-phenyl-propenone (**8**)*

To a mixture of 1-[7-(1-benzyl-1*H*-[1,2,3]triazol-4-yl-methoxy-2,2-dimethyl-chroman-6-yl]-ethanone (0.1 g, 0.25 mmol) **7** and aryl aldehydes (0.25 mmol, 1 eq) **3a–j** in EtOH (5 mL), pellets of KOH (0.01 g, 1.2 eq) was added and subjected to microwave irradiation at 180 watts 2-4 min. The progress of the reaction was monitored by TLC. After completion of reaction, it was poured into crushed ice, carefully neutralized with 3 N HCl and extracted with EtOAc (15 mL). The organic layer was concentrated in vacuo and purified by column chromatography on silica gel eluted with hexane/EtOAc (3:1) to give compound **8**.

*1-[7-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy-2,2-dimethyl-chroman-6-yl]-3-phenyl-propenone (**8a**)*

Pale yellow solid; m.p.: 130–132 °C; IR (KBr) cm^{-1}: 3,138 (Ar–H), 1,648 (C=O), 1,615 (C=C), 1,455 (N=N), 1,226 (Ar–C), 1,182 (C–N) and 1,118 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 8.29 (s, 1H, Ar–H_5), 8.16–8.11 (d, 1H, $J = 15.96$ Hz, H_β), 7.79–7.51 (m, 7H, H_α, Ar–H), 7.20–7.12 (m, 3H, Ar–H), 7.11–7.09 (m, 2H, Ar–H), 6.51 (s, 1H, Ar–H_8), 5.41 (s, 2H, O–CH_2), 5.21 (s, 2H, N–CH_2), 2.76 (t, $J = 7.02$ Hz, 2H, CH_2), 1.83 (t, $J = 7.02$ Hz, 2H, CH_2), 1.37 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 190.9 (C=O), 160.5 (C_{8a}), 158.9 (C_7), 143.6 (HC=CH), 142.6 (1,2,3-triazole $C_{4'}$), 135.1–124.7 (12C, Ar–C), 130.2 (C_5), 123.6 (1,2,3-triazole $C_{5'}$), 118.7 (HC=CH), 115.9 (C_{4a}), 110.9 (C_6), 100.8 (C_8), 75.2 (C_2), 63.2 (O–CH_2), 54.0 (N–CH_2), 32.0 (C_3), 26.7 (2×CH_3), 21.8 (C_4); MS $[M+H]^+$: 480.

*1-[7-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy-2,2-dimethyl-chroman-6-yl]-3-p-tolyl-propenone (**8b**)*

Pale yellow solid; m.p.: 155–157 °C; IR (KBr) cm^{-1}: 3,133 (Ar–H), 1,649 (C=O), 1,613 (C=C), 1,455 (N=N), 1,231 (Ar–C), 1,141 (C–N) and 1,117 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.60 (m, 3H, $J = 17.13$ Hz, H_β, Ar–H), 7.51 (s, 1H, Ar–H_5), 7.45–7.30 (m, 5H, Ar–H), 7.18 (m, 2H, Ar–H), 7.0 (d, 2H, Ar–H), 6.51 (s, 1H, Ar–H_8), 5.20 (s, 4H, O–CH_2, N–CH_2), 2.77 (t, $J = 6.67$ Hz, 2H, CH_2), 2.40 (s, 1H, CH_3), 1.83 (t, $J = 6.73$ Hz, 2H, CH_2), 1.38 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 190.9 (C=O), 160.5 (C_{8a}), 158.9 (C_7), 143.6 (HC=CH), 142.4 (1,2,3-triazole $C_{4'}$), 137.6–126.9 (12C, Ar–C), 130.2 (C_5), 122.6 (1,2,3-triazole $C_{5'}$), 121.7 (HC=CH), 115.9 (C_{4a}), 110.9 (C_7), 101.2 (C_8), 75.2 (C_2), 63.1 (O–CH_2), 54.0 (N–CH_2), 32.7 (C_3), 26.8 (2×CH_3), 22.4 (C_4), 21.5 (CH_3); MS $[M+H]^+$: 494.

*1-[7-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy-2,2-dimethyl-chroman-6-yl]-3-(4-methoxy-phenyl-propenone (**8c**)*

Pale yellow solid; m.p.: 133–135 °C; IR (KBr) cm^{-1}: 3,135 (Ar–H), 1,649 (C=O), 1,616 (C=C), 1,459 (N=N), 1,255 (Ar–C), 1,145 (C–N) and 1,118 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.53–7.51 (m, 2H, H_β, Ar–H_5), 7.41–7.31 (m, 4H, H_α, Ar–H), 7.10–7.07 (m, 2H, Ar–H), 6.91 (d, 2H, Ar–H), 6.46 (s, 1H, Ar–H_8), 5.33 (d, 2H, O–CH_2), 4.96 (d, 2H, N–CH_2), 3.86 (s, 1H, OCH_3), 2.75 (t, $J = 6.67$ Hz, 2H, CH_2), 1.82 (t, $J = 6.73$ Hz, 2H, CH_2), 1.36 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 190.3 (C=O), 160.5 (C_{8a}), 159.8 (1C, Ar–C), 158.9 (C_7), 143.6 (HC=CH), 142.6 (1,2,3-triazole $C_{4'}$), 135.1–124.7 (9C, Ar–C), 130.2 (C_5), 123.6 (1,2,3-triazole $C_{5'}$), 118.7 (HC=CH), 115.9 (C_{4a}), 114.5 (2C, Ar–C), 110.9 (C_6), 100.8 (C_8), 75.2 (C_2), 63.0 (O–CH_2), 56.5 (N–CH_2), 54.8 (O–CH_3), 32.0 (C_3), 26.7 (2×CH_3), 21.8 (C_4). MS $[M+H]^+$: 510.

*1-[7-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy-2,2-dimethyl-chroman-6-yl]-3-(3,4-dimethoxy-phenyl)-propenone (**8d**)*

Pale yellow solid; m.p.: 122–124 °C; IR (KBr) cm^{-1}: 3,064 (Ar–H), 1,668 (C=O), 1,606 (C=C), 1,461 (N=N), 1,265 (Ar–C), 1,141 (C–N) and 1,119 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.61–7.54 (m, 3H, H_β, Ar–H_5, Ar–H), 7.43–7.38 (m, 3H, Ar–H), 7.24–7.23 (m, 4H, H_α, Ar–H), 7.11–7.01 (m, 3H, Ar–H), 6.88–6.85 (d,

$J = 8.16$ Hz, 1H, Ar–H), 6.47 (s, 1H, Ar–H_8), 5.25 (s, 2H, O–CH_2), 5.20 (s, 2H, N–CH_2), 3.92 (d, $J = 17.37$ Hz, 6H, 2×CH_3), 2.74 (t, $J = 6.79$ Hz, 2H, CH_2), 1.82 (t, $J = 6.79$ Hz, 2H, CH_2), 1.34 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 190.3 (C=O), 160.5 (C_{8a}), 158.9 (C_7), 149.3 (2C, Ar–C), 143.6 (HC=CH), 142.6 (1,2,3-triazole $C_{4'}$), 135.1–124.7 (8C, Ar–C), 130.2 (C_5), 123.6 (1,2,3-triazole $C_{5'}$), 118.7 (HC=CH), 115.9 (C_{4a}), 112.5 (2C, Ar–C), 110.9 (C_6), 100.8 (C_8), 75.2 (C_2), 63.2 (O–CH_2), 56.5 (N–CH_2), 54.8 (2×O–CH_3), 32.0 (C_3), 26.7 (2×CH_3), 21.8 (C_4); MS $[M+H]^+$: 540.

*1-[7-(1-Benzyl-1 H-[1,2,3] triazol-4-ylmethoxy-2,2-dimethyl-chroman-6-yl]-3-(3,4,5-trimethoxy-phenyl)-propenone (**8e**)*

Pale yellow solid; m.p.: 70–72 °C; IR (KBr) cm^{-1}: 3,138 (Ar–H), 1,653 (C=O), 1,615 (C=C), 1,455 (N=N), 1,279 (Ar–C), 1,182 (C–N) and 1,118 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.56 (s, 1H, Ar–H_5), 7.51 (s, 1H, Ar–H), 7.46–7.40 (d, $J = 15.86$ Hz, 1H, H_β), 7.38 (s, 1H, Ar–H), 7.28–7.21 (m, 3H, H_α, Ar–H), 7.03–7.00 (dd, 1H, Ar–H), 6.75 (s, 2H, Ar–H), 6.47 (s, 1H, Ar–H_8), 5.26 (s, 2H, O–CH_2), 5.19 (s, 2H, N–CH_2), 3.88 (s, 3H, 1×O–CH_3), 3.85 (s, 6H, 2×O–CH_3), 2.76 (t, $J = 6.78$ Hz, 2H, CH_2), 1.82 (t, $J = 6.13$ Hz, 2H, CH_2), 1.36 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 190.9 (C=O), 171.2 (C_{8a}), 158.9 (C_7), 156.9 (2C, Ar–C), 143.6 (HC=CH), 142.6 (1,2,3-triazole $C_{4'}$), 135.1–125.4 (7C, Ar–C), 130.2 (C_5), 123.6 (1,2,3-triazole $C_{5'}$), 118.7 (HC=CH), 115.9 (C_{4a}), 110.9 (C_6), 104.3 (2C, Ar–C), 100.8 (C_8), 75.7 (C_2), 63.2 (O–CH_2), 60.9 (1×O–CH_3), 56.2 (N–CH_2), 56.0 (2×O–CH_3), 32.0 (C_3), 26.7 (2×CH_3), 21.8 (C_4); MS $[M+H]^+$:570.

*1-[7-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy-2,2-dimethyl-chroman-6-yl]-3-(4-dimethylamino-phenyl)-propenone (**8f**)*

Yellow solid; m.p.: 113–115 °C; IR (KBr) cm^{-1}: 3,137 (Ar–H), 1,647 (C=O), 1,606 (C=C), 1,491 (N=N), 1,275 (Ar–C), 1,140 (C–N) and 1,116 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.64–7.60 (d, $J = 15.99$ Hz, 1H, H_β), 7.54 (s, 1H, Ar–H_5), 7.42–7.40 (m, 3H, Ar–H), 7.34–7.26 (m, 4H, H_α, Ar–H), 7.04–7.02 (d, $J = 6.99$ Hz, 2H, Ar–H), 6.69–6.67 (d, $J = 7.99$ Hz, 2H, Ar–H), 6.47 (s, 1H, Ar–H_8), 5.22 (s, 4H, O–CH_2, N–CH_2), 3.03 (s, 6H, 2×CH_3), 2.77 (t, $J = 6.99$ Hz, 2H, CH_2), 1.83 (t, $J = 6.99$ Hz, 2H, CH_2), 1.38 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 191.4 (C=O), 159.1 (C_{8a}), 158.2 (C_7), 151.9 (1C, Ar–C), 144.0 (HC=CH), 143.8 (1,2,3-triazole $C_{4'}$), 135.1–125.4 (9C, Ar–C), 130.2 (C_5), 123.6 (1,2,3-triazole $C_{5'}$), 118.7 (HC=CH), 115.9 (C_{4a}), 112.7 (2C, Ar–C), 110.9 (C_6), 100.8 (C_8), 75.7 (C_2), 63.2 (O–CH_2), 56.2 (N–CH_2), 40.1 (2×N–CH_3), 32.0 (C_3), 26.7 (2×CH_3), 21.8 (C_4); MS $[M+H]^+$: 523.

*1-[7-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy-2,2-dimethyl-chroman-6-yl]-3-(4-chloro-phenyl)-propenone (**8g**)*

Pale yellow solid; m.p.: 152–154 °C; IR (KBr) cm^{-1}: 3,136 (Ar–H), 1,653 (C=O), 1,569 (C=C), 1,491 (N=N), 1,281 (Ar–C), 1,142 (C–N) and 1,118 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.60–7.54 (m, 3H, H_β, Ar–H_5), 7.39–7.30 (m, 8H, H_α, Ar–H), 7.08–7.06 (dd, 2H, Ar–H), 6.49 (s, 1H, Ar–H_8), 5.32 (s, 2H, O–CH_2), 5.19 (s, 2H, N–CH_2), 2.76 (t, $J = 7.02$ Hz, 2H, CH_2), 1.82 (t, $J = 7.02$ Hz, 2H, CH_2), 1.36 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 190.5 (C=O), 171.1 (C_{8a}), 159.1 (C_7), 143.6 (HC=CH), 141.1 (1,2,3-triazole $C_{4'}$), 135.1–124.7 (12C, Ar–C), 130.2 (C_5), 123.6 (1,2,3-triazole $C_{5'}$), 118.7 (HC=CH), 115.9 (C_{4a}), 110.9 (C_6), 100.8 (C_8), 75.2 (C_2), 63.0 (O–CH_2), 54.1 (N–CH_2), 32.0 (C_3), 26.8 (2×CH_3), 21.1 (C_4); MS $[M+H]^+$: 514.

*1-[7-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy-2,2-dimethyl-chroman-6-yl]-3-(3,4-dichloro-phenyl)-propenone (**8h**)*

Pale yellow solid; m.p.: 95–97 °C; IR (KBr) cm^{-1}: 3,139 (Ar–H), 1,660 (C=O), 1,568 (C=C), 1,491 (N=N), 1,287 (Ar–C), 1,157 (C–N) and 1,109 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.61 (s, 1H, Ar–H_5),7.55–7.54 (d, $J = 15.99$ Hz, 2H, H_β, Ar–H), 7.49–7.41 (m, 3H, H_α, Ar–H), 7.31–7.29 (m, 4H, Ar–H), 7.13–7.11 (d, $J = 6.99$ Hz, 2H, Ar–H), 6.49 (s, 1H, Ar–H_8), 5.40 (s, 2H, O–CH_2), 5.21 (s, 2H, N–CH_2), 2.77 (t, $J = 6.99$ Hz, 2H, CH_2), 1.84 (t, $J = 6.99$ Hz, 2H, CH_2), 1.38 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 197.1 (C=O), 171.1 (C_{8a}), 159.2 (C_7), 143.5 (HC=CH), 141.0 (1,2,3-triazole $C_{4'}$), 135.2–124.7 (12C, Ar–C), 130.8 (C_5), 123.6 (1,2,3-triazole $C_{5'}$), 118.7 (HC=CH), 115.9 (C_{4a}), 110.9 (C_6), 100.8 (C_8), 75.3 (C_2), 63.2 (O–CH_2), 54.1 (N–CH_2), 31.9 (C_3), 26.7 (2×CH_3), 21.1 (C_4); MS $[M+H]^+$:549.

*1-[7-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy-2,2-dimethyl-chroman-6-yl]-3-(4-isopropyl-phenyl)-propenone (**8i**)*

Pale yellow solid; m.p.: 115–117 °C; IR (KBr) cm^{-1}: 3,135 (Ar–H), 1,665 (C=O), 1,609 (C=C), 1,468 (N=N), 1,211 (Ar–C), 1,176 (C–N) and 1,121 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.59–7.52 (m, 2H, H_β, Ar–

H_5), 7.46–7.43 (d, $J = 15.86$ Hz, 1H, H_α), 7.40–7.36 (m, 4H, Ar–H), 7.26–7.20 (m, 4H, Ar–H), 6.98–6.95 (dd, 2H, Ar–H), 6.46 (s, 1H, Ar–H_8), 5.20 (s, 2H, O–CH_2), 5.17 (s, 2H, N–CH_2), 2.98–2.89 (m, 1H, C–H), 2.76 (t, $J = 6.67$ Hz, 2H, CH_2), 1.82 (t, $J = 6.67$ Hz, 2H, CH_2), 1.36 (s, 6H, 2×CH_3), 1.27 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 190.2 (C=O), 163.2 (C_{8a}), 158.8 (C_7), 150.5 (1C, Ar–C), 143.6 (HC=CH), 142.9 (1,2,3-triazole $C_{4'}$), 135.1–124.7 (11C, Ar–C), 130.2 (C_5), 123.6 (1,2,3-triazole $C_{5'}$), 118.7 (HC=CH), 115.9 (C_{4a}), 110.9 (C_6), 100.8 (C_8), 75.2 (C_2), 63.2 (O–CH_2), 53.9 (N–CH_2), 34.1 (CH–2×CH_3), 32.0 (C_3), 26.8 (2×CH_3), 23.8 (CH–2×CH_3), 21.1 (C_4); MS $[M+H]^+$: 522.

*1-[7-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy-2,2-dimethyl-chroman-6-yl]-3-(3-nitro-phenyl)-propenone (**8j**)*

Pale yellow solid; m.p.: 100–102 °C; IR (KBr) cm^{-1}: 3,140 (Ar–H), 1,653 (C=O), 1,615 (C=C), 1,455 (N=N), 1,279 (Ar–C), 1,182 (C–N) and 1,118 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.80–7.75 (m, 2H, Ar–H), 7.54–7.52 (d, $J = 16.30$ Hz, 1H, H_β), 7.46 (s, 1H, Ar–H_5), 7.43–7.31 (m, 4H, H_α, Ar–H), 7.21–7.15 (m, 2H, Ar–H), 7.11–7.08 (d, 1H, Ar–H), 6.98–9.95 (m, 2H, Ar–H), 6.46 (s, 1H, Ar–H_8), 5.20 (s, 2H, O–CH_2), 5.17 (s, 2H, N–CH_2), 2.76 (t, $J = 6.67$ Hz, 2H, CH_2), 1.82 (t, $J = 6.73$ Hz, 2H, CH_2), 1.36 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 189.9 (C=O), 163.2 (C_{8a}), 159.4 (C_7), 148.6 (1C, Ar–C), 143.6 (HC=CH), 142.9 (1,2,3-triazole $C_{4'}$), 139.6–124.7 (11C, Ar–C), 130.2 (C_5), 123.6 (1,2,3-triazole $C_{5'}$), 118.7 (HC=CH), 115.9 (C_{4a}), 110.9 (C_6), 100.8 (C_8), 75.2 (C_2), 63.0 (O–CH_2), 53.9 (N–CH_2), 32.0 (C_3), 26.8 (2×CH_3), 21.1 (C_4); MS $[M+H]^+$: 525.

*1-[5-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl]-3-phenyl-propenone (**13a**)*

White solid; m.p.: 98–100 °C; IR (KBr) cm^{-1}: 3,139 (Ar–H), 1,661 (C=O), 1,594 (C=C), 1,453 (N=N), 1,226 (Ar–C), 1,165 (C–N) and 1,119 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.71–7.67 (d, 2H, H_β, Ar–H_7,), 7.58–7.53 (m, 4H, H_α, Ar–H), 7.40 (m, 4H, Ar–H), 7.26 (m, 2H, Ar–H), 7.10–7.07 (d, 2H, Ar–H), 6.68–6.65 (d, $J = 9.09$ Hz, 1H, Ar–H_8), 5.31 (s, 2H, O–CH_2), 4.96 (s, 2H, N–CH_2), 2.80 (t, $J = 7.02$ Hz, 2H, CH_2), 1.76 (t, $J = 7.02$ Hz, 2H, CH_2), 1.33 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 190.9 (C=O), 158.9 (C_{8a}), 157.1 (C_5), 143.6 (1,2,3-triazole $C_{4'}$), 142.6 (HC=CH), 135.1–126.6 (12C, Ar–C), 124.7 (C_7), 123.6 (1,2,3-triazole $C_{5'}$), 115.9 (HC=CH), 113.9 (C_6), 109.9 (C_{4a}), 107.0 (C_8), 75.2 (C_2), 67.7 (O–CH_2), 54.0 (N–CH_2), 32.0 (C_3), 26.7 (2×CH_3), 17.5 (C_4); MS $[M+H]^+$: 480.

*1-[5-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl]-3-p-tolyl-propenone (**13b**)*

Pale yellow solid; m.p.: 98–100 °C; IR (KBr) cm^{-1}: 3,152 (Ar–H), 1,645 (C=O), 1,592 (C=C), 1,495 (N=N), 1,222 (Ar–C), 1,164 (C–N) and 1,118 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.70 (d, $J = 15.67$ Hz, 1H, H_β), 7.65–7.45 (m, 5H, Ar–H_7, H_α, Ar–H), 7.33–7.32 (m, 3H, Ar–H), 7.20–7.17 (d, $J = 8.10$ Hz, 2H, Ar–H), 7.09–7.08 (m, 2H, Ar–H), 6.69–6.66 (d, $J = 8.87$ Hz, 1H, Ar–H_8), 5.32 (s, 2H, O–CH_2), 4.96 (s, 2H, N–CH_2), 2.81 (t, $J = 6.06$ Hz, 2H, CH_2), 2.3 (s, 1H, CH_3), 1.8 (t, $J = 6.67$ Hz, 2H, CH_2), 1.33 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 190.9 (C=O), 160.5 (C_{8a}), 158.9 (C_5), 143.6 (1,2,3-triazole $C_{4'}$), 142.6 (HC=CH), 137.3–126.6 (12C, Ar–C), 124.7 (C_7), 123.6 (1,2,3-triazole $C_{5'}$), 115.9 (HC=CH), 113.9 (C_6), 109.9 (C_{4a}), 107.0 (C_8), 75.2 (C_2), 67.8 (O–CH_2), 54.0 (N–CH_2), 32.0 (C_3), 26.7 (2×CH_3), 21.3 (CH_3), 17.5 (C_4); MS $[M+H]^+$: 494.

*1-[5-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl]-3-(4-methoxy-phenyl)-propenone (**13c**)*

Pale yellow solid; m.p.: 90–92 °C; IR (KBr) cm^{-1}: 3,140 (Ar–H), 1,649 (C=O), 1,605 (C=C), 1,485 (N=N), 1,221 (Ar–C), 1,172 (C–N) and 1,108 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.67 (d, 1H, Ar–H_7), 7.55 (dd, $J = 12.16$ Hz, 1H, H_β), 7.40 (d, $J = 6.74$ Hz, Ar–H), 7.29 (m, Ar–H), 7.08 (dd, $J = 12.27$ Hz, 1H, H_α), 6.7 (d, 1H, Ar–H_8), 5.31 (s, 2H, O–CH_2), 5.21 (s, 2H, N–CH_2), 2.81 (t, $J = 6.67$ Hz, 2H, CH_2), 1.76 (t, $J = 6.66$ Hz, 2H, CH_2), 1.33 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 190.3 (C=O), 160.5 (C_{8a}), 158.9 (C_5), 157.2 (1C, Ar–C), 143.6 (1,2,3-triazole $C_{4'}$), 142.6 (HC=CH), 134.3–126.6 (9C, Ar–C), 124.7 (C_7), 123.6 (1,2,3-triazole $C_{5'}$), 115.9 (HC=CH), 114.8 (2C, Ar–C), 113.9 (C_6), 109.9 (C_{4a}), 107.0 (C_8), 75.2 (C_2), 67.2 (O–CH_2), 54.0 (N–CH_2), 52.8 (O–CH_3), 32.0 (C_3), 26.7 (2×CH_3), 17.5 (C_4); MS $[M+H]^+$: 510.

*1-[5-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl]-3-(3,4-dimethoxy-phenyl)-propenone (**13d**)*

White solid; m.p.: 92–95 °C; IR (KBr) cm^{-1}: 3,050 (Ar–H), 1,658 (C=O), 1,611 (C=C), 1,476 (N=N), 1,227 (Ar–C), 1,180 (C–N) and 1,121 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.66–7.62 (d, $J = 16.06$ Hz, 1H, H_β), 7.55–7.53 (d, $J = 9.03$ Hz, 1H, Ar–H_7), 7.51–7.26 (m, 3H, H_α, Ar–H), 7.10–6.86 (m, 5H, Ar–H), 6.84–6.67 (d, 1H, Ar–H), 6.64–6.63 (d, $J = 9.03$ Hz, 1H, Ar–H_8), 5.34 (s, 2H, O–CH_2), 5.02 (s, 2H, N–CH_2), 3.88 (s, 6H, 2×CH_3),

2.80 (t, $J = 7.02$ Hz, 2H, CH_2), 1.76 (t, $J = 7.02$ Hz, 2H, CH_2), 1.30 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 190.3 (C=O), 160.5 (C_{8a}), 158.9 (C_5), 150.1 (2C, Ar–C), 143.6 (1,2,3-triazole $C_{4'}$), 142.6 (HC=CH), 134.3–125.2 (8C, Ar–C), 124.7 (C_7), 123.6 (1,2,3-triazole $C_{5'}$), 115.9 (HC=CH), 113.9 (C_6), 111.8 (2C, Ar–C), 109.9 (C_{4a}), 107.0 (C_8), 75.2 (C_2), 67.7 (O–CH_2), 54.0 (N–CH_2), 52.8 (2×O–CH_3), 32.0 (C_3), 26.7 (2×CH_3), 17.5 (C_4); MS $[M+H]^+$: 540.

*1-[5-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl]-3–(3,4,5-trimethoxy-phenyl)-propenone (**13e**)*

Pale yellow solid; m.p.: 93–95 °C; IR (KBr) cm^{-1}: 3,137 (Ar–H), 1,659 (C=O), 1,592 (C=C), 1,503 (N=N), 1,235 (Ar–C), 1,162 (C–N) and 1,124 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.61–7.57 (d, $J = 16.06$ Hz, 1H, H_β), 7.54–7.53 (d, $J = 8.78$ Hz, 1H, Ar–H_7), 7.45–7.31 (m, 7H, H_α, Ar–H), 6.78 (s, 2H, Ar–H), 6.67–6.65 (d, $J = 8.78$ Hz, 1H, Ar–H_8), 5.34 (s, 2H, O–CH_2), 4.97 (s, 2H, N–CH_2), 3.91 (s, 9H, 3×CH3), 2.80 (t, $J = 7.27$ Hz, 2H, CH_2), 1.83 (t, $J = 7.02$ Hz, 2H, CH_2), 1.32 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 190.9 (C=O), 158.8 (C_{8a}), 156.9 (C_5), 153.5 (2C, Ar–C), 143.6 (1,2,3-triazole $C_{4'}$), 142.6 (HC=CH), 134.3–125.9 (8C, Ar–C), 124.7 (C_7), 123.6 (1,2,3-triazole $C_{5'}$), 115.9 (HC=CH), 113.9 (C_6), 109.9 (C_{4a}), 107.0 (C_8), 105.6 (2C, Ar–C), 75.1 (C_2), 67.7 (O–CH_2), 60.8 (1×O–CH_3), 56.2 (2×O–CH_3), 54.0 (N–CH_2), 32.0 (C_3), 26.7 (2×CH_3), 17.5 (C_4); MS $[M+H]^+$: 570.

*1-[5-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl]-3-(4-dimethylamino-phenyl)-propenone (**13f**)*

Yellow solid; m.p.: 95–97 °C; IR (KBr) cm^{-1}: 3,136 (Ar–H), 1,646 (C=O), 1,594 (C=C), 1,476 (N=N), 1,227 (Ar–C), 1,165 (C–N) and 1,118 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.69–7.65 (d, $J = 15.81$ Hz, 1H, H_β), 7.51–7.46 (m, 3H, Ar–H_7, Ar–H), 7.34–7.28 (m, 5H, Ar–H), 7.08–7.06 (m, 2H, Ar–H), 6.68–6.63 (m, 3H, Ar–H_8, Ar–H), 5.31 (s, 2H, O–CH_2), 4.98 (s, 2H, N–CH_2), 3.10 (s, 6H, 2×CH_3), 2.81 (t, $J = 7.27$ Hz, 2H, CH_2), 1.76 (t, $J = 7.02$ Hz, 2H, CH_2), 1.33 (s, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 191.4 (C=O), 158.2 (C_{8a}), 156.5 (C_5), 151.9 (1C, Ar–C), 144.0 (1,2,3-triazole $C_{4'}$), 143.8 (HC=CH), 134.5–125.4 (9C, Ar–C), 124.7 (C_7), 123.6 (1,2,3-triazole $C_{5'}$), 115.7 (HC=CH), 113.9 (C_6), 111.3 (2C, Ar–C), 109.9 (C_{4a}), 107.0 (C_8), 74.9 (C_2), 67.5 (O–CH_2), 53.9 (N–CH_2), 40.1 (2×N–CH_3), 32.0 (C_3), 26.7 (2×CH_3), 17.5 (C_4); MS $[M+H]^+$: 523.

*1-[5-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl]-3-(4-chloro-phenyl)-propenone (**13g**)*

Pale yellow solid; m.p.: 150–152 °C; IR (KBr) cm^{-1}: 3,150 (Ar–H), 1,648 (C=O), 1,591 (C=C), 1,486 (N=N), 1,216 (Ar–C), 1,165 (C–N) and 1,120 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.64–7.60 (d, $J = 16.06$ Hz, 1H, H_β), 7.56–7.46 (m, 4H, H_α, Ar–H_7, Ar–H),7.35–7.31(m, 5H, Ar–H), 7.24 (d, $J = 9.78$ Hz, 1H, Ar–H), 7.14–7.11 (m, 2H, Ar–H), 6.67–6.65 (d, $J = 8.53$ Hz, 1H, Ar–H_8), 5.37 (s, 2H, O–CH_2), 4.95 (s, 2H, N–CH_2), 2.79 (t, $J = 7.02$ Hz, 2H, CH_2), 1.77 (t, $J = 7.02$ Hz, 2H, CH_2), 1.33 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 190.5 (C=O), 171.1 (C_{8a}), 159.0 (C_5), 143.6 (1,2,3-triazole $C_{4'}$), 141.1 (HC=CH), 134.3–126.6 (12C, Ar–C), 124.7 (C_7), 123.6 (1,2,3-triazole $C_{5'}$), 115.9 (HC=CH), 114.0 (C_6), 109.9 (C_{4a}), 107.0 (C_8), 75.2 (C_2), 67.8 (O–CH_2), 54.0 (N–CH_2), 31.9 (C_3), 26.7 (2×CH_3), 17.5 (C_4); MS $[M+H]^+$: 514.

*1-[5-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl]-3-(3,4-dichloro-phenyl)-propenone (**13h**)*

Pale yellow solid; m.p.: 97–99 °C; IR (KBr) cm^{-1}: 3,140 (Ar–H), 1,644 (C=O), 1,593 (C=C), 1,467 (N=N), 1,220 (Ar–C), 1,169 (C–N) and 1,118 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.84–7.82 (d, $J = 8.78$ Hz, 1H, Ar–H_7), 7.68–7.63 (d, $J = 15.05$ Hz, 1H, H_β), 7.61–7.50(m, 2H, Ar–H), 7.42–7.33 (m, 7H, H_α, Ar–H), 7.15–7.13 (m, 2H, Ar–H), 6.68–6.65 (d, $J = 8.78$ Hz, 1H, Ar–H_8), 5.41 (s, 2H, O–CH_2), 4.96 (s, 2H, N–CH_2), 2.80 (t, $J = 7.02$ Hz, 2H, CH_2), 1.77 (t, $J = 7.02$ Hz, 2H, CH_2), 1.33 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 197.1 (C=O), 171.1 (C_{8a}), 159.2 (C_5), 143.5 (1,2,3-triazole $C_{4'}$), 139.7 (HC=CH), 135.2–127.7 (12C, Ar–C), 124.7 (C_7), 123.6 (1,2,3-triazole $C_{5'}$), 115.9 (HC=CH), 113.9 (C_6), 109.9 (C_{4a}), 107.0 (C_8), 75.2 (C_2), 67.8 (O–CH_2), 54.1 (N–CH_2), 34.8 (C_3), 26.7 (2×CH_3), 17.5 (C_4); MS $[M+H]^+$: 549.

*1-[5-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl]-3-(4-isopropyl-phenyl)-propenone (**13i**)*

Pale yellow solid; m.p.: 95–97 °C; IR (KBr) cm^{-1}: 3,146 (Ar–H), 1,667 (C=O), 1,611 (C=C), 1,475 (N=N), 1,229 (Ar–C), 1,186 (C–N) and 1,098 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.70–7.66 (d, $J = 16.06$ Hz, 1H, H_β), 7.54–7.46 (m, 5H, Ar–H_7, Ar–H), 7.35–7.29 (m, 5H, H_α, Ar–H), 7.08–7.06 (m, 2H, Ar–H), 6.67–6.64 (d, $J = 8.78$ Hz, 1H, Ar–H_8), 5.30 (s, 2H, O–CH_2), 4.97 (s,

2H, N–CH_2), 2.9 (m, 1H, C–H), 2.80 (t, $J = 7.02$ Hz, 2H, CH_2),1.76 (t, $J = 7.02$ Hz, 2H, CH_2), 1.33 (s, 6H, 2×CH_3), 1.26 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 191.2 (C=O), 158.8 (C_{8a}), 156.9 (C_5), 151.7 (1C, Ar–C), 143.6 (1,2,3-triazole $C_{4'}$), 142.6 (HC=CH), 134.4–125.6 (11C, Ar–C), 124.8 (C_7), 123.8 (1,2,3-triazole $C_{5'}$), 115.9 (HC=CH), 113.9 (C_6), 109.9 (C_{4a}), 107.0 (C_8), 75.1 (C_2), 67.6 (O–CH_2), 53.9 (N–CH_2), 34.1 (CH–2×CH_3), 32.0 (C_3), 26.7 (2×CH_3), 23.8 (CH–2×CH_3), 17.5 (C_4); MS $[M+H]^+$: 522.

*1-[5-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy)-2,2-dimethyl-chroman-6-yl]-3-(3-nitro-phenyl-propenone (**13j**)*

Pale yellow solid; m.p.: 80–83 °C; IR (KBr) cm^{-1}: 3,140 (Ar–H), 1,655 (C=O), 1,617 (C=C), 1,493 (N=N), 1,283 (Ar–C), 1,142 (C–N) and 1,115 (Ar–O); ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 8.38–8.36 (t, 1H, Ar–H), 8.22–8.19 (m, 1H, Ar–H), 7.85–7.83 (dd, 1H, Ar–H), 7.66–7.65(d, $J = 16.30$ Hz, 1H, H_β), 7.58–7.56 (d, $J = 8.78$ Hz, 1H, Ar–H_7), 7.54–7.52 (d, $J = 16.30$ Hz, H_α),7.39 (s, 1H, Ar–H), 7.37–7.33 (m, 4H, Ar–H), 7.18–7.16 (m, 2H, Ar–H), 6.69–6.67 (d, $J = 8.78$ Hz, 1H, Ar–H_8), 5.44 (s, 2H, O–CH_2), 5.00 (s, 2H, N–CH_2), 2.78 (t, $J = 7.02$ Hz, 2H, CH_2), 1.18 (t, $J = 6.67$ Hz, 2H, CH_2), 1.34 (s, 6H, 2×CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 189.9 (C=O), 159.4 (C_{8a}), 157.3 (C_5), 148.6 (1C, Ar–C), 143.5 (1,2,3-triazole $C_{4'}$), 139.6 (HC=CH), 136.9–124.2 (11C, Ar–C), 123.2 (C_7), 122.3 (1,2,3-triazole $C_{5'}$), 115.9 (HC=CH), 114.1 (C_{4a}), 110.9 (C_6), 100.8 (C_8), 75.3 (C_2), 67.9 (O–CH_2), 54.1 (N–CH_2), 31.9 (C_3), 26.7 (2×CH_3), 17.5 (C_4); MS $[M+H]^+$: 525.

Conclusion

An efficient Microwave-assisted synthesis of 1, 2, 3-triazole derivatives has been carried out successfully under mild reaction conditions. All the final compounds were investigated for their in vitro antimicrobial activity. Compounds **8a**, **8b**, **8d**, **8e**, **13a**, **13d** and **13e** showed promising antimicrobial activity compared with the standard. We observed that compounds not having substituents on phenyl ring showed very good antimicrobial activity compared to those having substituents.

Acknowledgments The authors are thankful to The Head, Department of Chemistry, Osmania University, Hyderabad for providing Laboratory facilities and one of the authors D. Mohan Gandhi thankful to UGC, New Delhi, India for financial support in the form of UGC-SRF. We also thankful to The Director, CFRD, Osmania University, Hyderabad for providing spectral analysis facilities.

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