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DESIGN, SYNTHESIS AND ANTICANCER ACTIVITIES OF NOVEL UNSATURATED FATTY ACID-BASED β-HYDROXY 1,2,3-TRIAZOLES

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ABSTRACT: A series of novel unsaturated fatty acid based β-hydroxy 1,2,3-triazole hybrids were designed and synthesised in excellent yields by esterification, epoxidation of oleic, ricinoleic and 10-undecenoic acids followed by azidolysis and "click" reaction with different alkynes. All the β-hydroxy 1,2,3-triazole hybrids were characterised by ESI-MS, IR and NMR spectra as well as HRMS analysis and were screened *in vitro* for their anticancer activity against selected four human cancer cell lines (DU-145, HeLa, MCF-7 and A549) in comparison with doxorubicin, a standard anticancer drug. Among all the triazoles, methyl oleate with-CH_2OH as 1,2,3-triazole side chain (1dii) exhibited good anti cancer activity against DU-145, HeLa, MCF-7 and A549 human cancer cell lines with IC_{50} values 10.73, 13.61, 11.93, and 16.54 μM respectively.

INTRODUCTION: Amongst the pharmacologically active nitrogenous compounds, 1,2,3-triazoles and their derivatives attracted considerable attention for the past few decades due to their chemotherapeutical value. 1,2,3-Triazole moiety is stable to metabolic degradation and capable of hydrogen bonding, which could be favourable in binding of bio-molecular targets and increasing solubility [1]. Moreover, 1,2,3-triazoles are attractive linker units which could connect two pharmacophores to give an innovative bi-functional drugs, have become increasingly useful and important in constructing bioactive molecules and functional molecules.

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Copper (I) has recently been found to be an efficient and regio specific catalyst for the preparation of 1,4-disubstituted 1,2,3-triazole derivatives [2]. This reaction has found application in various facets of drug discovery as it enables a modular approach to generate novel pharmacophores utilizing a collection of reliable chemical reactions. 1,2,3-Triazoles have found widespread applications in chemical synthesis, drug discovery [3], organometallic chemistry [4], surface science [5] and nanochemistry [6]. In addition, a number of compounds containing 1,2,3-triazoles have shown a broad spectrum of biological activities such as antimicrobial [7], antitubercular [8], anti-HIV [9], analgesic [10], anticancer activity [11] etc.

Cancer is one of the life-threatening diseases worldwide from decades and its chemotherapy has entered a new era of molecularly targeted therapeutics, which is highly selective and not associated with the serious toxicities of conventional cytotoxic drugs. There is a pressing need for new anticancer agents with high potency, less toxicity in non-cancerous cells, and unique targets of action. Currently, cancer therapy interfering with a single biological molecule or pathway has been successfully utilized for the treatment in clinics [12].

There is general belief that agents modulating more than one target could have superior efficacy compared to single target drugs [13]. Therefore, modulating multiple targets simultaneously can be achieved by the combination of multiple drugs with different mechanisms or by single chemical entity that could modulate several targets of a multi factorial disease. As a result, there is increasing interest in the discovery of agents that concomitantly address more than one biological target for cancer treatment.

Fatty acids are ubiquitous in nature and as such they belong to a physiologically important class of molecule involved in cell energy storage (e.g. adipose tissues), membrane structure (phospholipid bilayer) and in various signalling pathways. A number of azido, diazido and iodo-azido long chain fatty esters have been synthesized and the physical and biological properties of such unusual lipid molecules have been studied [14]. Azides are good starting blocks for organic molecules to be converted into nitrogen heterocycles by decomposition or addition reactions [15]. In the present study, we report the synthesis of oleic, ricinoleic and 10-undecnoic acid based β-hydroxy1,2,3-triazole derivatives for the first time by epoxidation and azidolysis of fatty acids followed by "click" reaction with aliphatic and aromatic alkynes. All the β-hydroxy 1,2,3-triazole derivatives were characterised by ESI-MS, IR and NMR spectra as well as HRMS analysis and further screened for anticancer activity against four human cancer cell lines namely, DU-145, HeLa, MCF-7 and A549 in comparison with a standard anticancer drug doxorubicin.

MATERIALS AND METHODS:

All chemicals (reagents and solvents) were procured from S. D. Fine or Sigma Aldrich Chemical companies unless otherwise indicated. Progress of the reactions was monitored by using TLC plates (coated with TLC grade silica gel, obtained from Merck, India). The spots were located by exposure to iodine vapours or under UV- light. Column chromatography was performed over silica gel (100-200 mesh) procured from Qualigens (India) using freshly distilled solvents. Melting points were determined in open capillaries on Barnstead Electro thermal's melting point apparatus (India) and are uncorrected. IR spectra were recorded on a Perkin Elmer (model: spectrum BX) FT-IR Spectrometer using $CHCl_3$ and KBr.

Nuclear magnetic resonance (^{1}H NMR and ^{13}C NMR) spectra were recorded at 300 K Brucker UXNMR (operating at 300 MHz and 500 for ^{1}H and 75 MHz for ^{13}C NMR) in $CDCl_3$ as solvents with TMS as an internal standard. Chemical shifts (δ) are given in ppm and coupling constants (J) in Hz. The splitting pattern abbreviations are as follows: s, singlet; bs, broad singlet; d, doublet; dd, double doublet; t, triplet; m, multiplet. Mass spectra were recorded using Waters, Micromass-Quatromicro electron spray ionization (ESI-MS). All of the compounds were drawn using the program CS Chem Draw Ultra version 10.0.

General Procedure:

Synthesis of fatty acid methyl ester [15] (1a/2a/3a): A stirred solution of fatty acid (5 g) in 2% H_2SO_4/CH_3OH (50 mL) was refluxed for 4 h. The reaction mixture was cooled to room temperature and extracted with ethyl acetate (2 × 50 mL). The combined organic phase was washed with water till the water washings become neutral to pH and dried over anhydrous Na_2SO_4. The residue obtained after removing the solvent in rotary evaporator under reduced pressure was purified by column chromatography (100% hexane) to afford pure fatty acid methyl ester.

Synthesis of fatty acid methyl ester epoxides [16] (1b/2b/3b):

A mixture of fatty acid methyl ester and *m*-CPBA (1:1.5) in DCM (20 mL) was stirred at room temperature for 4 h. The reaction mixture was washed with saturated solutions of $NaHSO_3$ followed by $NaHCO_3$ and NaCl. The organic layer was dried over anhydrous Na_2SO_4 and the solvent was evaporated under reduced pressure. The residue obtained was further purified by silica gel column chromatography (EtOAc/Hexane) to afford pure product.

Synthesis of β-hydroxy azide derivatives of fatty acid methyl ester [17] (1c/2c/3c):
A mixture of epoxide (1 eq), NaN_3 (5 eq) and NH_4Cl (2.3 eq) in $MeOH:H_2O$ (8:1) was heated to reflux for 12 h. Methanol from the reaction mixture was removed under reduced pressure, the residue obtained was washed with brine solution and dried over anhydrous Na_2SO_4. The product was further purified by silica gel column chromatography (EtOAc / Hexane).

Synthesis of β-hydroxy-(4-aryl/alkyl-1H-1,2,3-triazol-1-yl) derivatives of fatty acid methyl esters [2] ($1d_{(i-v)}/2d_{(i-v)}/3d_{(i-v)}$): $CuSO_4.5H_2O$ (0.01eq), sodium ascorbate (0.1eq) were added to a stirred suspension of fatty acid azidohydrin (1eq) and alkyne (1eq) in $t\text{-}BuOH:H_2O$ (1:1) and heated to reflux for 6 h. Progress of the reaction was monitored by TLC. After the reaction was completed solvent was removed under reduced pressure and the product was extracted in to EtOAc. The organic layer was washed with brine solution, dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to get crude 1,2,3-triazole. The product was further purified by silica gel column chromatography (EtOAc /Hexane/$CHCl_3$).

Synthesis of β-hydroxy-(4-alkyl/aryl-1H-1,2,3-triazol-1-yl) derivatives of fatty acids [18,19] ($1e_{(i-v)}/2e_{(i-v)}/3e_{(i-v)}$):
10% aq. KOH was added to 1,2,3-triazole derivatives of fatty acid methyl esters and stirred at 90 °C for 4 h. After the reaction was completed the reaction mixture was neutralized with dil. HCl and the pure product was extracted into ethyl acetate. Organic layer was washed with brine solution, dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to get pure compound.

TABLE 1: PHYSICO CHEMICAL PROPERTIES OF COMPOUNDS (1a/2a/3a)

Compound code	Compound	Molecular formula	Molecular weight*	Yield (%)	Physical state
1a	Methyl octadec-9-enoate	$C_{19}H_{36}O_2$	296	90	Colourless oil
2a	Methyl-12-hydroxyoctadec-9-enoate	$C_{19}H_{36}O_3$	312	95	Light yellow coloured oil
3a	Methyl undec-10-enoate	$C_{12}H_{22}O_2$	198	98	Colourless oil

***** $[M]^+$ from ESI-MS data.

TABLE 2: SPECTRAL DATA OF SYNTHESIZED COMPOUNDS (1a/2a/3a)

Compound code	IR (cm^{-1}) OH	C=<u>CH</u>	CH_{aliph}	C=O	^1H NMR ($CDCl_3$) δ ppm
1a	-	3004	2926	1744	0.89 (t, 3H, *J* = 6.5 Hz, H-18), 1.20-1.30 (m, 20H, H-4, H-5, H-6, H-7, H-12, H-13, H-14, H-15, H-16, H-17), 1.56-1.59 (m, 2H, H-3), 1.95-1.98 (m, 4H, H-8, H-11), 2.25 (t, 2H, *J* =7.5 Hz, H-2), 3.61 (s, 3H, $-OCH_3$), 5.28-5.30 (m, 1H, H-10), 5.68-5.82 (m, 1H, H-9)
2a	3450	3006	2929	1741	0.89 (t, 3H, *J* = 6.5 Hz, H-18), 1.21-1.50 (m, 16H,H-4, H-5, H-6, H-7, H-14, H-15, H-16, H-17), 1.54-1.67 (m, 2H, H-13), 1.99-2.08 (m, 2H, H-3), 2.10-2.15 (m, 2 H, H-8), 2.27 (t, 2H, *J* =7.5 Hz, H-2), 2.30 (t, 2 H, J = 7.6 Hz, H-11), 3.46 (s, 1H), 3.56 (m, 1H, H-12), 3.64 (s, 3H, $-OCH_3$), 5.31-5.42 (m, 1H, H-9), 5.45-5.58 (m, 1H, H-10)
3a	-	3077	2927	1742	1.41-1.25 (m, 10H, H-4, H-5, H-6, H-7, H-8), 1.65-1.55 (m, 2H, H-9), 2.07-1.98 (q, 2H, H-3), 2.26 (t, 2H, *J* =7.5 Hz, H-2), 3.64 (s, 3H, $-OCH_3$), 4.87-4.99 (m, 2H, H-11), 5.68-5.82 (m, 1H, H-10)

TABLE 3: PHYSICO CHEMICAL PROPERTIES OF COMPOUNDS (1b/2b/3b)

Compound code	Compound	Molecular formula	Molecular weight*	Yield (%)	Physical state
1b	Methyl 8-(3-octyloxiran-2-yl) octanoate	$C_{19}H_{36}O_3$	313	85	Colourless oil
2b	Methyl 8-(3-(2-hydroxyoctyl)	$C_{19}H_{36}O_4$	329	86	Colourless oil

	oxiran-2-yl) octanoate				
3b	Methyl 9-(oxiran-2-yl) nonanoate	$C_{12}H_{22}O_3$	215	85	Colourless oil

***** $[M+H]^+$ from ESI-MS data.

TABLE 4: SPECTRAL DATA OF SYNTHESIZED COMPOUNDS (1b/2b/3b)

Compound code	IR (cm^{-1}) OH	CH$_{aliph}$	C=O	^{1}H NMR ($CDCl_3$) δ ppm
1b	-	2927	1742	0.88 (t, 3H, *J* = 6.5 Hz, H-18), 1.24-1.40 (m, 18H, H-4, H-5, H-6, H-7, H-12, H-13, H-14, H-15, H-16), 1.42-1.53 (m, 6H, H-8, H-11, H-17), 1.56-1.66 (m, 2H, H-3), 2.27 (t, 2H, *J* =7.5 Hz, H-2), 2.81(m, 2H, H-9, H10), 3.64 (s, 3H, -OCH_3)
2b	3480	2929	1741	0.89 (t, 3H, *J* = 6.5 Hz, H-18), 1.23-1.53 (m, 22H, H-4, H-5, H-6, H-7, H-8, H-11, H-13, H-14, H-15, H-16, H-17), 1.56-1.68 (m, 2H, H-3), 2.27 (t, 2H, *J* =7.5 Hz, H-2), 2.55-2.79 (bs, 1H, H-12), 2.81-2.93 (m, 1H, H-9), 3.02-3.13 (m, 1H, H-10), 3.64 (s, 3H, -OCH_3), 3.71-3.86 (m, 1H, H-12)
3b	-	2930	1740	1.27-1.38 (m, 10H, H-4, H-5, H-6, H-7, H-8), 1.41-1.52 (m, 2H, H-9), 1.55-1.66 (m, 2H, H-3), 2.26 (t, 2H, *J* =7.5 Hz, H-2), 2.37-2.41 (dd, 1H, *J* =2.6 Hz, 5.2 Hz, H-11), 2.67 (dd, 1H, *J* =4.1 Hz,4.6 Hz, H-11), 2.80-2.86 (m, 1H, H-10), 3.64 (s, 3H, -OCH_3)

TABLE 5: PHYSICO CHEMICAL PROPERTIES OF COMPOUNDS (1c/2c/3c)

Code	Compound*	Molecular formula	Molecular weight**	Yield (%)	Physical state
1c	Methyl 9(10)-azido-10(9)-hydroxy octadecanoate	$C_{19}H_{37}N_3O_3$	378	85	Light yellow coloured liquid
2c	Methyl 9(10)-azido-10(9),12-dihydroxyoctadecanoate	$C_{19}H_{37}N_3O_4$	394	90	Colourless waxy solid
3c	Methyl 11-Azido-10-hydroxyundecanoate	$C_{12}H_{23}N_3O_3$	280	95	Light yellow coloured liquid

* Nomenclature as reported in reference [17]

** $[M+Na]^+$ from ESI-MS data.

TABLE 6: SPECTRAL DATA OF SYNTHESIZED COMPOUNDS (1c/2c/3c)

Compound code	IR (cm^{-1}) OH	CH$_{aliph}$	$N^+{\equiv}N$	C=O	^{1}H NMR ($CDCl_3$) δ ppm
1c	3480	2928	2103	1740	0.88 (t, 3H, *J* = 6.5 Hz, H-18), 1.20-1.53 (m, 22H, H-4, H-5, H-6, H-7, H-11, H-12, H-13, H-14, H-15, H-16, H-17), 1.54-1.69 (m, 4H, H-3, H-8), 1.93-2.04 (bs, 1H, -OH), 2.27 (t, 2H, *J* =7.5 Hz, H-2), 3.10-3.19 (m, 1H, -CHN_3), 3.43-3.52 (m, 1H, -C*H*OH), 3.64 (s, 3H, -OCH_3)
2c	3359	2930	2106	1739	0.89 (t, 3H, *J* = 6.5 Hz, H-18), 1.20-1.55 (m, 18 H, H-4, H-5, H-6, H-7, H-8, H-14, H-15, H-16, H-17), 1.56-1.68 (m, 4H, H-3, H-13), 1.82-1.96 (m, 1H, H-11), 1.99-2.06 (m, 1H, H-11), 2.28 (t, 2H, *J* =7.5 Hz, H-2), 3.09-3.22 (m, 1H, CHN_3), 3.46-3.62 (m, 1H, C*H*OH), 3.65 (s, 3H, -OCH_3), 3.74-3.95 (m, 1H, C*H*OH)
3c	3458	2930	2101	1736	1.26-1.37 (m, 10H, H-4, H-5, H-6, H-7, H-8), 1.41-1.48 (m, 2H, H-9), 1.58-1.63 (m, 2H, H-3), 2.27 (t, 2H, *J* = 7.5 Hz, H-2), 2.57 (bs, 1H, OH), 3.19-3.23 (dd, 1H, J= 6.7 Hz, 12.0 Hz, H-11), 3.31-3.34 (dd, 1H, 3.7 Hz, 12.0 Hz, H-11), 3.64 (s, 3H, -OCH_3), 3.68-3.73 (m, 1H, C*H*OH)

TABLE 7: PHYSICO CHEMICAL PROPERTIES OF OLEIC ACID BASED β-HYDROXY 1,2,3-TRIAZOLES 1(d-e)$_{(i-v)}$

Compound code	Compound	X	Molecular formula	Yield (%)	M.P (°C)	Physical state
1d$_i$	Methyl-10(9)-(4-hexyl-1H-1,2,3-triazol-1-yl)-9(10)-hydroxy octadecanoate	C_6H_{13}	$C_{27}H_{51}N_3O_3$	89	-	Colourless oil

$1e_i$	10(9)-(4-Hexyl-1H-1,2,3-triazol-1-yl)-9(10)-hydroxyoctadecanoic acid	C_6H_{13}	$C_{26}H_{49}N_3O_3$	80	-	Colourless oil
$1d_{ii}$	Methyl-9(10)-hydroxy-10(9)-(4-(hydroxymethyl)-1H-1,2,3-triazol-1-yl)octadecanoate	CH_2OH	$C_{22}H_{41}N_3O_4$	90	97	Colour less solid
$1e_{ii}$	9(10)-Hydroxy-10(9)-(4-(hydroxy methyl)-1H-1,2,3-triazol-1-yl)octadecanoic acid	CH_2OH	$C_{21}H_{39}N_3O_4$	100	97.6	Colour less solid
$1d_{iii}$	Methyl 9(10)-hydroxy-10(9)-(4-phenyl-1H-1,2,3-triazol-1-yl) nonadecanoate	Ph	$C_{27}H_{43}N_3O_3$	90	-	Colour less viscous liquid
$1e_{iii}$	9(10)-Hydroxy-10(9)-(4-phenyl-1H-1,2,3-triazol-1-yl)octadecanoic acid	Ph	$C_{26}H_{41}N_3O_3$	80	-	Colour less viscous liquid
$1d_{iv}$	Methyl-9(10)-hydroxy-10(9)-(4-(3-hydroxyphenyl)-1H-1,2,3-triazol-1-yl)octadecanoate	*m*-OH-Ph	$C_{27}H_{43}N_3O_4$	85	-	Reddish brown coloured liquid
$1e_{iv}$	9(10)-Hydroxy-10(9)-(4-(3-hydroxyphenyl)-1H-1,2,3-triazol-1-yl)octadecanoic acid	*m*-OH-Ph	$C_{26}H_{41}N_3O_4$	100	-	Reddish brown coloured sticky solid
$1d_v$	Methyl-9(10)-hydroxy-10(9)-(4-(6-methoxynaphthalen-2-yl)-1H-1,2,3-triazol-1-yl)octadec- anoate	6-OMe-naphthyl	$C_{32}H_{47}N_3O_4$	89	50.2	Reddish brown coloured solid
$1e_v$	9(10)-hydroxy-10(9)-(4-(6-methoxynaphthalen-2-yl)-1H-1,2,3-triazol-1-yl)octadecanoic acid	6-OMe-naphthyl	$C_{31}H_{45}N_3O_4$	94	69.6	Reddish brown coloured solid

TABLE 8: PHYSICO CHEMICAL PROPERTIES OF RICINOLEIC ACID BASED β-HYDROXY 1,2,3-TRIAZOLES $2(d\text{-}e)_{(i\text{-}v)}$

Compound code	Compound	X	Molecular formula	Yield (%)	M.P (°C)	Physical state
$2d_i$	Methyl 10(9), 12-dihydroxy-9(10)-(4-hexyl-1H-1,2,3-triazol-1-yl)octadecanoate	C_6H_{13}	$C_{27}H_{51}N_3O4$	80	-	Colour less viscous liquid
$2e_i$	10(9),12-Dihydroxy-9(10)-(4-hexyl-1H-1,2,3-triazol-1-yl)octadecanoic acid	C_6H_{13}	$C_{26}H_{49}O_4N_3$	97		Colour less sticky solid
$2d_{ii}$	Methyl 10(9),12-dihydroxy-9(10)-(4-(hydroxymethyl)-1H-1,2,3-triazol-1-yl)octadecanoate	CH_2OH	$C_{22}H_{41}N_3O_5$	95	-	Colour less viscous liquid
$2e_{ii}$	10(9),12-Dihydroxy-9(10)-(4-(hydroxymethyl)-1H-1,2,3-triazol-1-yl)octadecanoic acid	CH_2OH	$C_{21}H_{39}N_3O_5$	70		Colour less sticky solid
$2d_{iii}$	Methyl 10(9),12-dihydroxy-9(10)-(4-phenyl-1H-1,2,3-triazol-1-yl)octadecanoate	Ph		88	-	Colour less viscous liquid
$2e_{iii}$	10(9),12-Dihydroxy-9(10)-(4-phenyl-1H-1,2,3-triazol-1-yl)octadecanoic acid	Ph	$C_{26}H_{41}N_3O_4$	85		Colour less sticky solid
$2d_{iv}$	Methyl 10(9),12-dihydroxy-9(10)-(4-(3-hydroxyphenyl)-1H-1,2,3-triazol-1-yl)octadecanoate	*m*-OH-Ph	$C_{27}H_{43}N_3O_4$	82	-	Colour less viscous liquid
$2e_{iv}$	10(9),12-Dihydroxy-9(10)-(4-(3-hydroxyphenyl)-1H-1,2,3-triazol-1-yl)octadecanoic acid	*m*-OH-Ph	$C_{26}H_{41}O_5N_3$	73	-	Colour less sticky solid
$2d_v$	Methyl 10(9),12-dihydroxy-9(10)-(4-(6-methoxynaphthalen-2-yl)-1H-1,2,3-triazol-1-yl)-octadecanoate	6-OMe-naphthyl	$C_{32}H_{47}N_3O_5$	92	-	Reddish brown viscous liquid

$2e_v$	10(9),12-Dihydroxy-9(10)-(4-(6-methoxynaphthalen-2-yl)-1H-1,2,3-triazol-1-yl)octadeca- noic acid	6-OMe-naphthyl	$C_{31}H_{45}O_5N_3$	96	-	Reddish brown sticky solid

TABLE 9: PHYSICO CHEMICAL PROPERTIES OF 10-UNDECENOLEIC ACID BASED β-HYDROXY 1,2,3-TRIAZOLES 3(d-e)$_{(i-v)}$

Compound code	Compound	X	Molecular formula	Yield (%)	M.P (°C)	Physical state
$3d_i$	Methyl 10-hydroxy-11-(4-hexyl-1H-1,2,3-triazol-1-yl)undecanoate	C_6H_{13}	$C_{20}H_{37}O_3N_3$	91	41.5	Colour less powdered solid
$3e_i$	10-hydroxy-11-(4-hexyl-1H-1,2,3-triazol-1-yl)undecanoic acid	C_6H_{13}	$C_{19}H_{35}O_3N_3$	95	82	Colour less powdered solid
$3d_{ii}$	Methyl 10-hydroxy-11-(4-(hydroxymethyl)-1H-1,2,3-triazol-1-yl)undecanoate	CH_2OH	$C_{15}H_{27}O_4N_3$	82	78.7	Colour less powdered solid
$3e_{ii}$	10-hydroxy-11-(4-(hydroxymethyl)-1H-1,2,3-triazol-1-yl)undecanoic acid	CH_2OH	$C_{14}H_{25}O_4N_3$	88	113	Colour less powdered solid
$3d_{iii}$	Methyl 10-hydroxy-11-(4-phenyl-1H-1,2,3-triazol-1-yl)undecanoate	Ph	$C_{20}H_{29}O_3N_3$	90	90.8	Colour less powdered solid
$3e_{iii}$	10-hydroxy-11-(4-phenyl-1H-1,2,3-triazol-1-yl)undecanoic acid	Ph	$C_{19}H_{27}O_3N_3$	83	132	Colour less powdered solid
$3d_{iv}$	Methyl 10-hydroxy-11-(4-(3-hydroxyphenyl)-1H-1,2,3-triazol-1-yl)undecanoate	m-OH-Ph	$C_{20}H_{29}O_4N_3$	85	100	Colour less powdered solid
$3e_{iv}$	10-hydroxy-11-(4-(3-hydroxyphenyl)-1H-1,2,3-triazol-1-yl)undecanoic acid	m-OH-Ph	$C_{19}H_{27}O_4N_3$	95	131	Colour less powdered solid
$3d_v$	Methyl 10-hydroxy-11-(4-(6-methoxynaphthalen-2-yl)-1H-1,2,3-triazol-1-yl)und-ecanoate	6-OMe-naphthyl	$C_{25}H_{33}O_4N_3$	83	148	Colour less powdered solid
$3e_v$	10-hydroxy-11-(4-(6-methoxynaphthalen-2-yl)-1H-1,2,3-triazol-1yl)undecanoic acid	6-OMe-naphthyl	$C_{24}H_{31}O_4N_3$	90	174	Colour less powdered solid

TABLE 10: IR, MASS AND HRMS SPECTRAL DATA OF OLEIC ACID BASED β-HYDROXY 1,2,3-TRIAZOLES 1(d-e)$_{(i-v)}$

Compound code	IR (cm^{-1})				Molecular weight*	HRMS
	OH	CH_{arom}	CH_{aliph}	C=O		
$1d_i$	3279	-	2928	1740	466	Calculated: 466.4003 Found: 466.4000
$1e_i$	3259	-	2928	1711	451†	Calculated: 452.3846 Found: 452.3834
$1d_{ii}$	3301	-	2925	1736	412	Calculated: 412.3169 Found: 412.3180
$1e_{ii}$	3257	-	2923	1710	397†	Calculated: 398.3013 Found: 398.3010
$1d_{iii}$	3316	3150	2928	1738	458	Calculated: 458.3382 Found: 458.3397
$1e_{iii}$	3333	3134	2928	1710	443†	Calculated: 444.3220 Found: 444.3205
$1d_{iv}$	3275	3124	2928	1738	474	Calculated: 474.3302 Found: 474.3315

1e$_{iv}$	3257	3014	2930	1708	459†	Calculated: 460.3169 Found: 460.3154
1d$_{v}$	3405	3164	2929	1740	538	Calculated: 538.3639 Found: 538.3635
1e$_{v}$	3416	3104	2922	1710	523†	Calculated: 524.3438 Found: 524.3428

† $[M]^{+}$, * $[M+H]^{+}$

TABLE 11: IR, MASS AND HRMS SPECTRAL DATA OF RICINOLEIC ACID BASED β-HYDROXY 1,2,3-TRIAZOLES 2(d-e)$_{(i-v)}$

Compound code	IR (cm^{-1})				Molecular weight*	HRMS
	OH	CH$_{arom}$	CH$_{aliph}$	C=O		
2d$_{i}$	3309	-	2933	1736	482	Calculated: 482.3947 Found: 482.3952
2e$_{i}$	3349	-	2980	1710	468	Calculated: 468.3796 Found: 468.3782
2d$_{ii}$	3356	-	2933	1731	428	Calculated: 428.1111 Found: 428.1119
2e$_{ii}$	3433	-	2930	1699	412$^{\$}$	Calculated: 412.2806 Found: 412.2808
2d$_{iii}$	3380	3153	2929	1736	474	Calculated: 474.3331 Found: 474.3343
2e$_{iii}$	3369	3154	2929	1709	459†	Calculated: 460.3169 Found: 460.3156
2d$_{iv}$	3431	3137	2935	1735	490	Calculated: 490.3274 Found: 490.3275
2e$_{iv}$	3458	3097	2985	1711	474$^{\$}$	Calculated: 474.2962 Found: 474.2963
2d$_{v}$	3390	3155	2925	1731	554	Calculated: 554.35885 Found: 554.35764
2e$_{v}$	3412	3024	2927	1709	538$^{\$}$	Calculated: 538.3275 Found: 538.3277

† $[M]^{+}$, * $[M+H]^{+}$, $^{\$}$ $[M-H]^{+}$

TABLE 12: IR, MASS AND HRMS SPECTRAL DATA OF RICINOLEIC ACID BASED β-HYDROXY 1,2,3-TRIAZOLES 3(d-e)$_{(i-v)}$

Compound code	IR (cm^{-1})				Molecular weight*	HRMS
	OH	CH$_{arom}$	CH$_{aliph}$	C=O		
3d$_{i}$	3457	3069	2925	1737	390$^{\#}$	Calculated: 390.2727 Found: 390.2718
3e$_{i}$	3642	-	2920	1703	352$^{\$}$	Calculated: 352.2594 Found: 352.2597
3d$_{ii}$	3424	-	2929	1733	336$^{\#}$	Calculated: 336.1893 Found: 336.1886
3e$_{ii}$	3414	-	2925	1713	298$^{\$}$	Calculated: 298.1761 Found: 298.1764
3d$_{iii}$	3404	3136	2933	1736	360	Calculated: 360.2287 Found: 360.2276
3e$_{iii}$	3457	3084	2920	1701	345†	Calculated: 346.2125* Found: 346.2122
3d$_{iv}$	3471	3282	2920	1730	376	Calculated: 376.2230 Found: 376.2237
3e$_{iv}$	3450	3208	2926	1714	360$^{\$}$	Calculated: 360.1917 Found: 360.1919
3d$_{v}$	3493	3123	2931	1735	462$^{\#}$	Calculated: 462.2363 Found: 462.2344
3e$_{v}$	3448	3124	2920	1710	424$^{\$}$	Calculated: 424.2230 Found: 424.2234

† $[M]^{+}$, * $[M+H]^{+}$, $^{\$}$ $[M-H]^{+}$, $^{\#}$ $[M+Na]^{+}$

TABLE 13: ^{1}H AND ^{13}C NMR DATA OF OLEIC ACID BASED β-HYDROXY 1,2,3-TRIAZOLES 1(d-e)$_{(i-v)}$

Compound code	^{1}H NMR ($CDCl_3$) δ ppm	^{13}C NMR ($CDCl_3$) δ ppm
1d$_i$	0.87 (t, 6H, *J* = 6.0 Hz, H-18, H-8'), 1.13-1.49 (m, 28H, H-4, H-5, H-6, H-7, H-8, H-12, H-13, H-14, H-15, H-16, H-17, H-5', H-6', H-7'), 1.50-1.73 (m, 4H, H-3, H-4'), 1.80-2.17 (m, 2H, H-11), 2.27 (t, 2H, *J* =7.5 Hz, H-2), 2.35-2.45 (bs, 1H, OH), 2.71 (t, 2H, *J* =7.5 Hz, H-3'), 3.66 (s, 3H, -OCH_3), 3.83-3.94 (m,1H, C*H*OH), 4.30-4.40 (m, 1H, H-10), 7.34 (s, 1H, triazole-H)	174.2, 147.8, 121.1, 72.7, 65.3, 51.4, 34.2, 33.9, 32.1, 31.7, 31.5, 29.4, 29.3, 29.2, 29.1, 29.0, 28.9, 28.9, 25.9, 25.9, 25.7, 25.5, 24.7, 22.5, 22.5, 13.9, 13.9
1e$_i$	0.87 (t, 6H, *J* = 6.5 Hz , H-18, H-8'), 1.13-1.49 (m, 28H, H-4, H-5, H-6, H-7, H-8, H-12, H-13, H-14, H-15, H-16, H-17, H-5', H-6', H-7'), 1.50-1.73 (m, 4H, H-3, H-4'), 1.82-2.13 (m, 2H, H-11), 2.27 (t, 2H, *J* =7.5 Hz, H-2), 2.71 (t, 2H, *J* =7.5 Hz, H-3'), 3.83-3.94 (m,1H, C*H*OH), 4.30-4.40 (m, 1H, C*H*-triazole), 7.34 (s, 1H, triazole-H)	175.2, 146.9, 120.1, 71.3, 64.8, 33.5, 33.5, 33.4, 31.5, 31.1, 31.1, 30.9, 28.8, 28.7, 28.6, 28.5, 28.3, 28.2, 25.2, 25.0, 24.9, 24.2, 21.9, 21.9, 13.4, 13.4
1d$_{ii}$	0.87 (t, 3H, *J* = 6.5 Hz, H-18), 1.13-1.46 (m, 22H, H-4, H-5, H-6, H-7, H-8, H-12, H-13, H-14, H-15, H-16, H-17), 1.52-1.60 (m, 2H, H-3), 1.80-1.96 (m, 2H, H-11), 1.97-2.10 (bs, 2H, 2-OH), 2.27 (t, 2H, *J* =7.5 Hz, H-2), 2.83-3.04 (m, 1H, C*H*OH), 3.12-3.39 (m, 1H, C*H*OH), 3.66 (s, 3H, -OCH_3), 3.86-3.96 (m, 1H, C*H*-triazole), 4.35-4.4 (m, 1H, C*H*-triazole), 4.75 (s, 2H, CH_2OH), 7.64 (s, 1H, triazole-H)	174.2, 147.0, 121.0, 72.7, 65.7, 55.2, 51.4, 34.2, 33.9, 32.2, 31.7, 29.4, 29.2, 29.1, 29.1, 29.0, 28.9, 25.9, 25.5, 24.7, 22.5, 14.0
1e$_{ii}$	0.87 (t, 3H, *J* = 6.5 Hz, H-18), 1.13-1.46 (m, 22H, H-4, H-5, H-6, H-7, H-8, H-12, H-13, H-14, H-15, H-16, H-17), 1.52-1.60 (m, 2H, H-3), 1.80-1.96 (m, 2H, H-11), 1.97-2.10 (bs, 1H, OH), 2.27 (t, 2H, *J* =7.5 Hz, H-2), 3.86-3.96 (m, 1H, C*H*OH), 4.35-4.4 (m, 1H, C*H*-triazole), 4.75 (s, 2H, CH_2OH), 7.64 (s, 1H, triazole-H)	175.0, 147.0, 121.0, 71.2, 64.8, 55.4, 33.3, 31.2, 30.9, 28.7, 28.5, 28.4, 28.3, 28.1, 25.1, 25.0, 24.9, 24.7, 24.0, 21.8, 13.3
1d$_{iii}$	0.85 (t, 3H, *J* = 6.5Hz, H-18), 1.13-1.47 (m, 22H, H-4, H-5, H-6, H-7, H-8, H-12, H-13, H-14, H-15, H-16, H-17), 1.47-1.60 (m, 2H, H-3), 1.81-1.97 (m, 1H, H-11), 2.0 (s, 1H), 2.02-2.15 (m, 1H, H-11), 2.21 (t, 2H, *J* =7.5 Hz, H-2), 3.60 (s, 3H, -OCH_3), 3.88-3.97 (bs, 1H, C*H*OH), 4.02-4.13 (m, 1H, C*H*OH), 4.13-4.27 (bs, 1H, C*H*-triazole), 4.41-4.50 (m, 1H, C*H*-triazole), 7.20-7.28 (m, 1H, ArH), 7.29-7.39 (m, 2H, ArH), 7.22-7.32 (d, 2H, ArH), 7.98 (s, 1H, triazole-H)	173.4, 146.8, 130.7, 128.5, 128.5, 127.6, 125.5, 125.5, 119.8, 72.0, 65.7, 60.0, 51.1, 34.0, 33.7, 32.1, 31.7, 29.4, 29.3, 29.2, 28.8, 25.9, 25.8, 25.6, 25.5, 24.7, 22.6, 20.7, 14.0
1e$_{iii}$	0.85 (t, 3H, *J* = 6.5 Hz, H-18), 1.13-1.47 (m, 22H, H-4, H-5, H-6, H-7, H-8, H-12, H-13, H-14, H-15, H-16, H-17), 1.47-1.60 (m, 2H, H-3), 1.81-1.97 (bs, 1H, H-11), 2.0 (s, 1H, OH), 2.02-2.15 (m, 1H, H-11), 2.21 (t, 2H, *J* =7.5 Hz, H-2), 3.88-3.97 (bs, 1H, C*H*OH), 4.02-4.13 (m, 1H, C*H*OH), 4.13-4.27 (bs, 1H, C*H*-triazole), 4.41-4.50 (m, 1H, C*H*-triazole), 7.20-7.28 (m, 1H, ArH), 7.29-7.39 (m, 2H, ArH), 7.22-7.32 (d, 2H, ArH), 7.98 (s, 1H, triazole-H)	175.3, 146.8, 130.7, 128.5, 128.5, 127.6, 125.5, 125.5, 119.8, 72.7, 65.7, 55.2, 51.4, 34.2, 33.9, 32.2, 31.7, 29.4, 29.2, 29.1, 29.1, 29.0, 28.9, 25.9, 25.5, 24.7, 22.5, 14.0
1d$_{iv}$	0.87 (t, 3H, *J* = 6.5 Hz, H-18), 1.13-1.49 (m, 22H, H-4, H-5, H-6, H-7, H-8, H-12, H-13, H-14, H-15, H-16, H-17), 1.50-1.66 (m, 2H, H-3), 1.89-1.97 (m, 1H, H-11), 2.07-2.22 (m, 1H, H-11), 2.27 (t, 2H, *J* =7.5 Hz, H-2), 3.65 (s, 3H, -OCH_3), 3.92-4.02 (m, 1H, C*H*OH), 4.41-4.52 (m, 1H, C*H*-triazole), 6.79-6.89 (m, 1H, ArH), 7.21-7.29 (m, 2H, ArH), 7.41-7.49 (m, 1H, ArH), 7.85 (s, 1H, triazole-H)	174.4, 156.8, 147.0, 131.4, 130.0, 120.4, 117.4, 115.5, 112.6, 72.8, 66.1, 51.4, 33.6, 34.0, 32.0, 31.7, 31.7, 29.4, 29.3, 29.2, 29.1, 29.0, 28.9, 28.8, 28.8, 25.9, 25.7, 25.6, 25.3, 24.7, 24.7, 22.6, 22.5, 14.0
1e$_{iv}$	0.87 (t, 3H, *J* = 6.5 Hz, H-18), 1.13-1.49 (m, 22H, H-4, H-5, H-6, H-7, H-8, H-12, H-13, H-14, H-15, H-16, H-17), 1.50-1.66 (m, 2H, H-3), 1.89-1.97 (m, 2H, H-11), 2.07-2.22 (bs, 1H, OH), 2.27 (t, 2H, *J* =7.5 Hz, H-2), 3.92-4.02 (m, 1H, C*H*OH), 4.41-4.52 (m, 1H, CH-triazole), 6.79-6.89 (m, 1H, ArH), 7.21-7.29 (m, 2H, ArH), 7.41-7.49 (m, 1H, ArH), 7.85 (s, 1H,	174.2, 156.4, 145.4, 130.8, 128.6, 119.6, 115.3, 113.7, 111.0, 71.2, 69.1, 67.3, 65.5, 61.9,38.1, 37.9, 37.6, 37.3, 36.7, 35.9, 32.6, 30.4, 27.9, 27.6, 24.0, 23.5, 21.1, 12.6

	triazole-H)	
1d$_v$	0.87 (t, 3H, *J* = 6.5 Hz, H-18), 1.13-1.49 (m, 22H, H-4, H-5, H-6, H-7, H-8, H-12, H-13, H-14, H-15, H-16, H-17), 1.50-1.60 (m, 2H, H-3), 1.80-1.97 (m, 2H, H-11), 2.03-2.21 (bs, 1H, OH), 2.27 (t, 2H, *J* =7.5 Hz, H-2), 3.65 (s, 3H, -OCH$_3$), 3.93 (s, 3H, ArOCH$_3$), 3.94-4.02 (m, 1H, C*H*OH), 4.41-4.52 (m, 1H, C*H*-triazole), 7.14-7.20 (m, 2H,ArH), 7.75-7.82 (m, 2H, ArH), 7.91-7.95 (m, 1H, ArH), 7.96 (s, 1H, triazole-H), 8.27 (s, 1H, ArH)	174.2, 157.8, 147.3, 134.2, 129.6, 128.9, 127.2, 125.8, 124.3, 124.1, 119.8, 119.2, 105.7, 72.7, 65.7, 55.2, 51.4, 34.2, 33.9, 32.2, 31.7, 29.4, 29.3, 29.2, 29.1, 29.1, 29.0, 28.9, 25.9, 25.9, 25.5, 25.6, 25.3, 24.7, 22.5, 14.0
1e$_v$	0.87 (t, 3H, *J* = 6.5 Hz, H-18), 1.13-1.49 (m, 22H, H-4, H-5, H-6, H-7, H-8, H-12, H-13, H-14, H-15, H-16, H-17), 1.50-1.60 (m, 2H, H-3), 1.80-1.97 (m, 2H, H-11), 2.03-2.21 (bs, 1H, OH), 2.27 (t, 2H, *J* =7.5 Hz, H-2), 3.92 (s, 3H, ArOCH$_3$), 3.94-4.02 (m, 1H, C*H*OH), 4.41-4.52 (m, 1H, C*H*-triazole), 7.14-7.20 (m, 2H, ArH), 7.75-7.82 (m, 2H, ArH), 7.91-7.95 (m, 1H, ArH), 7.96 (s, 1H, triazole-H), 8.27 (s, 1H, ArH)	174.3, 156.6, 145.8, 132.9, 128.3, 127.7, 126.1, 125.3, 123.3, 122.7, 118.6, 118.0, 104.7, 70.5, 64.5, 54.1, 32.9, 30.9, 30.6, 28.2, 28.1, 27.9, 27.9, 27.8, 24.7, 24.5, 24.4, 23.7, 23.6, 21.4, 12.9

TABLE 14: ^{1}H AND ^{13}C NMR DATA OF RICINOLEIC ACID BASED β-HYDROXY 1,2,3-TRIAZOLES 2(d-e)$_{(i-v)}$

Compound code	^{1}H NMR (CDCl$_3$+DMSO) δ ppm	^{13}C NMR (CDCl$_3$+DMSO) δ ppm
2d$_i$	0.87 (t, 6H, *J* = 6.0 Hz, H-18, H-8'), 1.0-1.71 (m, 30H, H-3, H-4, H-5, H-6, H-7, H-8, H-13, H-14, H-15, H-16, H-17, H-4', H-5', H-6', H-7'), 1.80-1.93 (m, 1H, H-11), 1.93-2.03 (m, 1H, H-11), 2.28 (t, 2H, *J* =7.5 Hz, H-2), 2.69 (t, 2H, *J* =7.5 Hz, H-3'), 3.13 (m, 1H, C*H*OH), 3.66 (s, 3H, -OCH$_3$), 3.71-4.02 (m, 2H, C*H*OH), 4.14-4.48 (m, 1H, C*H*-triazole), 4.69-4.81(m, 1H, C*H*-triazole), 7.48 (s, 1H, triazole-H)	174.2, 147.8, 121.7, 73.0, 71.6, 68.7, 67.9, 66.1, 62.3, 51.3, 40.1, 39.8, 39.4, 38.3, 38.0, 37.5, 37.2, 33.9, 31.9, 31.6, 29.2, 29.1, 28.8, 25.6, 25.3, 25.1, 24.7, 22.5, 13.9
2e$_i$	0.88 (t, 6H, *J* = 6.5 Hz, H-18), 1.00-1.75 (m, 30H, H-3, H-4, H-5, H-6, H-7, H-8, H-13, H-14, H-15, H-16, H-17, H-4', H-5', H-6', H-7'), 1.77-2.09 (m, 2H, H-11), 2.24 (t, 2H, *J* =7.5 Hz, H-2), 2.68 (t, 2H, *J* =7.5 Hz, H-3'), 2.91-3.04 (m, 1H, C*H*OH), 3.35-3.41 (m, 1H, C*H*OH), 3.42-3.96 (m, 1H, C*H*OH), 4.05-4.32 (m, 1H, C*H*-triazole), 4.80-4.99 (m, 1H, C*H*-triazole), 7.68 (s, 1H, triazole-H)	174.9, 146.4, 120.5,73.1, 71.5, 69.6, 66.1, 64.4. 61.6, 40.0, 38.6, 38.3, 38.0, 37.7, 36.9, 36.0, 33.0, 30.7, 30.4, 28.2, 27.9, 27.7, 24.4, 23.8, 21.4, 12.8, 12.8
2d$_{ii}$	0.88 (t, 3H, *J* = 6.5 Hz, H-18), 1.12-1.50 (m, 22H, H-3, H-4, H-5, H-6, H-7, H-8, H-13, H-14, H-15, H-16, H-17), 1.79-1.92 (m, 2H, H-3), 1.94-2.08 (bs, 1H, H-11), 2.09-2.22 (s, 1H, H-11), 2.21 (t, 2H, *J* =7.5 Hz, H-2), 2.99-3.12 (bs,1H, C*H*OH), 3.65 (s, 3H, -OCH$_3$), 3.77-3.88 (bs, 1H, C*H*OH), 3.90-3.99 (bs, 1H, C*H*-triazole), 4.11-4.45 (m, 1H, C*H*-triazole), 4.62-4.78 (s, 2H, C*H*$_2$OH), 7.72 (s, 1H,triazole-H)	174.3, 146.9, 123.2, 73.0, 72.0, 67.3, 63.1, 55.8, 51.4, 39.0, 38.0, 37.0, 33.9, 33.7, 31.6, 31.4, 29.2, 29.0, 28.8, 25.7, 25.4, 24.7, 25.2, 14.0
2e$_{ii}$	0.88 (t, 3H, *J* = 6.5 Hz, H-18), 1.10-1.70 (m, 22H, H-3, H-4, H-5, H-6, H-7, H-8, H-13, H-14, H-15, H-16, H-17), 1.74-1.92 (m, 1H, H-11), 1.94-2.11 (m, 1H, H-11), 2.26 (t, 2H, *J* = 7.5 Hz, H-2), 2.97-3.61(m, 1H, C*H*OH), 3.69-4.01 (m, 1H, C*H*OH), 4.66-4.75 (s, 2H, C*H*$_2$OH), 4.75-4.86 (m, 1H, C*H*-triazole), 7.83 (s, 1H, triazole-H)	175.3, 146.4, 122.0, 71.9, 70.0, 68.0, 66.3, 65.0, 62.1, 54.9, 38.7, 37.2, 33.2, 30.9, 28.4, 28.1, 24.8, 24.6, 24.0,21.7, 13.1
2d$_{iii}$	0.88 (t, 3H, *J* = 6.5 Hz, H-18), 1.19-1.67 (m, 22H, H-3, H-4, H-5, H-6, H-7, H-8, H-13, H-14, H-15, H-16, H-17), 1.81-1.97 (m, 1H, H-11), 2.0 (m, 1H, H-11), 2.02-2.15 (bs, 1H, C*H*OH), 2.21 (t, 2H, *J* =7.5 Hz, H-2), 3.60 (s, 3H, -OCH$_3$), 3.88-3.97 (bs, 1H, C*H*OH), 4.02-4.13 (m, 1H, C*H*OH), 4.13-4.27 (bs, 1H,C*H*-triazole), 4.41-4.50 (m, 1H,C*H*-triazole), 7.20-7.28 (m, 1H, ArH), 7.29-7.39 (m, 2H, ArH), 7.22-7.32 (d, 2H, ArH), 7.98 (s, 1H, triazole-H)	174.4, 147.2, 130.4, 128.8, 128.1, 125.5, 120.7, 120.4, 120.0, 73.0, 71.5, 68.7, 67.9, 62.8, 62.5, 51.4, 38.1, 37.5, 37.1, 34.0, 31.7, 29.2, 29.0, 28.9, 25.8, 25.6, 25.5, 24.7, 22.5, 14.0
2e$_{iii}$	0.88 (t, 3H, *J* = 6.5 Hz, H-18), 1.19-1.67 (m, 22H, H-3, H-4, H-5, H-6, H-7, H-8, H-13, H-14, H-15, H-16, H-17), 1.81-1.97 (m, 1H, H-11), 2.0 (s, 1H), 2.02-2.15 (m, 1H, H-11), 2.21 (t, 2H, *J* =7.5 Hz, H-2), 3.88-3.97 (bs, 1H, C*H*OH), 4.02-4.13 (m, 1H, C*H*OH), 4.13-4.27 (bs, 1H, C*H*OH), 4.41-4.50 (m, 1H,	175.1, 146.0, 130.3, 128.0, 128.0, 127.1, 125.7, 124.8, 124.8, 71.9, 70.0, 68.0, 66.5, 65.8, 62.1, 61.7, 37.5, 36.8, 33.5, 31.0, 28.5, 28.3, 25.1,

	C*H*-triazole), 4.80-4.92 (m, 1H, C*H*-triazole), 7.20-7.28 (m, 1H, ArH), 7.29-7.39 (m, 2H, ArH), 7.22-7.32 (d, 2H, ArH), 7.98 (s, 1H, triazole-H)	24.9, 24.7,24.1, 21.8, 13.4
$2d_{iv}$	0.87 (t, 3H, *J* = 6.5 Hz, H-18), 1.05-1.59 (m, 22H, H-3, H-4, H-5, H-6, H-7, H-8, H-13, H-14, H-15, H-16, H-17), 1.78-1.95 (m, 1H, H-11), 1.95-2.17 (m, 2H, H-11, C*H*OH), 2.27 (t, 2H, *J* = 7.5 Hz, H-2), 3.65 (s, 3H, -OCH_3), 3.90-4.06 (m, 2H, 2C*H*OH), 4.35-4.45 (m, 1H,C*H*-triazole), 4.76-4.89 (m, 1H, C*H*-triazole), 6.79-6.88 (m, 1H, ArH), 7.15-7.24 (m, 2H, ArH), 7.29-7.44 (m, 1H, ArH), 7.93 (s, 1H, triazole-H), 8.14-8.30 (bs,1H, ArOH)	174.6, 156.8, 146.8, 130.1, 121.4, 117.2, 115.6, 112.3, 73.2, 71.9, 69.5, 67.9, 63.2, 51.5, 39.2, 37.9, 37.4, 37.2, 33.9, 33.7, 31.7, 31.6, 29.1, 28.8, 25.8, 25.4, 24.7, 22.5, 14.0
$2e_{iv}$	0.86 (t, 3H, *J* = 6.5 Hz, H-18), 1.02-1.68 (m, 22H, H-3, H-4, H-5, H-6, H-7, H-8, H-13, H-14, H-15, H-16, H-17), 1.80-2.00 (m, 1H, H-11), 2.00-2.17 (m, 1H, H-11), 2.27 (t, 2H, *J* =7.5 Hz, H-2), 3.08-3.80 (m, 1H, C*H*OH), 3.87-4.04 (m, 1H, C*H*OH), 4.05-4.29 (m, 1H, C*H*-triazole), 6.77-6.90 (m, 1H, ArH), 7.21-7.39 (m, 3H, ArH), 7.92 (s, 1H, triazole-H), 8.14 (s, 1H)	174.2, 156.4, 145.5, 130.8, 128.6, 119.6, 115.3, 113.7, 111.0, 71.2, 69.1, 67.3, 65.6, 61.6, 38.1, 37.9, 37.6, 37.3, 36.7, 35.9, 32.6, 30.4, 27.9, 27.6, 24.2, 24.0, 23.5, 21.1, 12.6
$2d_{v}$	0.88 (t, 3H, *J* = 6.5 Hz, H-18), 1.14-1.64 (m, 22H, H-3, H-4, H-5, H-6, H-7, H-8, H-13, H-14, H-15, H-16, H-17), 1.86-2.0 (m, 1H, H-11), 2.02-2.17 (bs, 1H, H-11), 2.26 (t, 2H, *J* =7.5 Hz, H-2), 2.31-2.42 (m, 1H, C*H*OH), 3.22 (bs,1H, C*H*OH), 3.64 (s, 3H, -OCH_3), 3.92 (s, 3H, ArOCH_3), 3.97-4.07 (m, 1H, C*H*OH), 4.21-4.53 (m, 1H, C*H*-triazole), 4.80-4.92 (m, 1H, C*H*-triazole), 7.07-7.20 (m, 2H, ArH), 7.69-7.80 (m, 2H, ArH), 7.85-7.94 (m, 1H, ArH), 7.99-8.07 (s, 1H, triazole-H), 8.17-8.26 (m,1H, ArH)	174.3, 157.8, 147.3, 134.2, 129.5, 128.8, 127.2, 125.5, 124.1, 120.6, 119.9, 119.2, 105.6, 73.0, 71.6, 68.9, 67.9, 62.8, 66.5, 55.2, 51.4, 39.7, 38.0, 37.5, 37.0, 33.9, 31.6, 29.1, 28.8, 25.7, 25.5, 24.7, 22.5, 14.0
$2e_{v}$	0.86 (t, 3H, *J* = 6.5 Hz, H-18), 1.06-1.67 (m, 22H, H-3, H-4, H-5, H-6, H-7, H-8, H-13, H-14, H-15, H-16, H-17), 1.82-1.98 (m, 1H, H-11), 2.00-2.16 (m, 1H, H-11), 2.24 (t, 2H, *J* =7.5 Hz, H-2), 3.09-3.38 (m, 1H, C*H*OH), 3.55-3.85 (m, 1H, C*H*OH), 3.91 (s, 3H, ArOCH_3), 4.05-4.32 (m, 1H, C*H*-triazole), 4.80-4.99 (m, 1H, C*H*-triazole), 7.12-7.20 (m, 2H, ArH), 7.72-7.83 (m, 2H, ArH), 7.88-7.96 (s, 1H, triazole-H), 8.14 (m, 2H, ArH)	175.4, 157.2, 146.5, 133.6, 128.8, 128.2, 126.6, 125.1, 123.6, 123.4, 120.0, 118.5, 105.1, 72.0, 70.2, 68.0, 66.5, 62.4, 54.2, 39.0, 38.7, 38.5, 37.3, 36.8, 36.5, 33.3, 31.0, 28.5, 28.2, 24.7, 24.1, 21.8, 13.2

TABLE 15: ^{1}H AND ^{13}C NMR DATA OF 10-UNDECENOIC ACID BASED β-HYDROXY 1,2,3-TRIAZOLES $3(d\text{-}e)_{(i\text{-}v)}$

Compound code	^{1}H NMR ($CDCl_3$+DMSO) δ ppm	^{13}C NMR ($CDCl_3$+DMSO) δ ppm
$3d_{i}$	0.88 (t, 3H, *J* = 6.5 Hz, H-8’), 1.19-1.43 (m, 16H, H-4, H-5, H-6, H-7, H-8, H-5’, H-6’, H-7’), 1.42-1.55 (m, 2H, H-9), 1.54-1.76 (m, 4H, H-3, H-4’), 2.3 (t, 2H, *J* = 7.5 Hz, H-2), 2.7 (t, 2H, *J* = 7.5 Hz, H’-2), 3.66 (s, 3H, -OCH_3), 4.00-4.10 (m, 1H, C*H*OH), 4.15-4.25 (dd, 1H, *J* = 7.4 Hz, 13.7 Hz, H-11), 4.37-4.45 (dd, 1H, *J* = 2.6 Hz, 13.7 Hz, H-11), 7.37 (s, 1H, triazole-H)	174.2, 147.8, 121.7, 70.5, 55.8, 51.4, 34.2, 34.0, 31.5, 29.3, 29.2, 29.2, 29.0, 29.0, 28.9, 25.6, 25.2, 24.8, 22.5, 14.0
$3e_{i}$	0.88 (t, 3H, *J* = 6.5 Hz, H-8’), 1.22-1.40 (m, 14H, H-4, H-5, H-6, H-7, H-8, H-5’, H-6’), 1.41-1.53 (m, 4H, H-9, H-7’), 1.54-1.71 (m, 4H, H-3, H-4’), 2.34 (t, 2H, *J* = 7.5 Hz, H-2), 2.69 (t, 2H, *J* = 7.5 Hz, H-3’), 4.00-4.11 (m, 1H, H-10), 4.15-4.26 (dd, 1H, *J* = 7.4 Hz, 13.7 Hz, H-11), 4.36-4.46 (dd, 1H, *J* = 2.6 Hz, 13.7 Hz, H-11), 7.39 (s, 1H, triazole-H)	174.8, 148.1, 122.0, 70.4, 55.8, 34.2, 33.8, 31.5, 30.8, 39.3, 29.1, 29.0, 28.8, 28.8, 25.5, 25.1, 24.6, 22.5, 14.0
$3d_{ii}$	1.21-1.43 (m, 10H, H-4, H-5, H-6, H-7, H-8), 1.44-1.56 (m, 2H, H-9), 1.56-1.68 (m, 2H, H-3), 1.97 (bs, 1H, OH), 2.30 (t, 2H, *J* = 7.5 Hz, H-2), 3.41-3.64 (m, 2H, CH_2OH), 3.66 (s, 3H, -OCH_3), 3.72-3.86 (m, 1H, C*H*OH), 3.97-4.08 (m, 1H, C*H*-triazole), 4.09-4.23 (dd, 1H, *J* = 7.4 Hz, 13.7 Hz, CH_2-triazole), 4.37-4.47 (dd, 1H, *J* = 2.6 Hz, 13.7 Hz, CH_2-triazole), 4.61-4.73 (s, 2H, triazole-CH_2OH), 7.62 (s, 1H, triazole-H)	174.3, 147.1, 123.4, 70.3, 70.2, 59.8, 56.3, 55.9, 51.4, 34.3, 34.0, 29.3, 29.2, 29.0, 29.0, 25.3, 24.8
$3e_{ii}$	1.15-1.36 (m, 10H, H-4, H-5, H-6, H-7, H-8), 1.36-1.49 (m,	174.2, 146.8, 122.1, 68.5, 54.7,

	2H, H-9), 1.51-1.65 (m, 2H, H-3), 2.23 (t, 2H, *J* =7.5 Hz, H-2), 3.87 (bs, 1H, H-10), 4.16-4.28 (dd, 1H, *J* = 7.4 Hz, 13.7 Hz, H-11), 4.33-4.45 (dd, 1H, *J* = 2.6 Hz, 13.7 Hz, H-11), 4.67 (s, 2H, C*H*$_2$OH), 7.76 (s, 1H, triazole-H)	48.3, 33.9, 32.9, 28.1, 28.0, 27.9, 27.8, 24.1, 23.6
3d$_{iii}$	1.26-1.37 (m, 10H, H-4, H-5, H-6, H-7, H-8), 1.46-1.54 (m, 2H, H-9), 1.55-1.65 (m, 2H, H-3), 2.25 (t, 2H, *J* =7.5 Hz, H-2), 3.64 (s, 3H, -OCH$_3$), 4.07-4.14 (dd, 1H, *J* = 7.4 Hz, 13.7 Hz, H-11), 4.35-4.44 (dd, 1H, *J* = 2.6 Hz, 13.7 Hz, H-11), 4.47-4.57 (bs, 1H, C*H*OH), 7.19-7.32 (m, 3H, ArH), 7.48-7.56 (d, 2H, ArH), 7.69 (s, 1H, triazole-H)	174.3, 147.1, 130.2, 128.6, 128.6, 127.9, 125.4, 125.4, 121.1, 70.2, 56.3, 51.4, 34.3, 34.0, 29.3, 29.1, 29.0, 28.9, 25.3, 24.8
3e$_{iii}$	1.26-1.37 (m, 10H, H-4, H-5, H-6, H-7, H-8), 1.46-1.54 (m, 2H, H-9), 1.55-1.65 (m, 2H, H-3), 2.18 (t, 2H, *J* =7.5 Hz, H-2), 3.78-3.94 (bs, 1H, C*H*OH), 4.07-4.14 (dd, 1H, *J* = 7.4 Hz, 13.7 Hz, H-11), 4.35-4.44 (dd, 1H, *J* = 2.6 Hz, 13.7 Hz, H-11), 7.19-7.32 (m, 1H, ArH), 7.32-7.46 (d, 2H, ArH), 7.73- 7.89 (m, 2H, ArH), 8.14 (s, 1H, triazole-H)	174.3, 147.1, 130.2, 128.6, 128.6, 127.9, 125.4, 125.4, 121.1, 70.2, 56.3, 34.3, 34.0, 29.3, 29.1, 29.0, 28.9, 25.3, 24.8
3d$_{iv}$	1.8-1.42 (m, 10H, H-4, H-5, H-6, H-7, H-8), 1.43-1.69 (m, 4H, H-3, H-9), 1.82-2.07 (bs, 1H, OH), 2.29 (t, 2H, *J* =7.5 Hz, H-2), 3.66 (s, 3H, -OCH$_3$), 4.08-4.24 (dd, 1H, *J* = 7.4 Hz, 13.7 Hz, H-11), 4.26-4.37 (m, 1H, C*H*OH), 4.39-4.52 (dd, 1H, *J* = 2.6 Hz, 13.7 Hz, H-11), 6.79 (d, 1H, ArH), 7.05-7.27 (m, 3H, ArH), 7.74 (s, 1H, triazole-H), 7.80 (bs, 1H, ArOH)	174.5, 156.8, 146.9, 130.0, 130.0, 121.6, 117.3, 115.5, 112.3, 70.4, 56.4, 51.5, 34.3, 34.0, 29.2, 29.1, 29.0, 29.0, 25.3, 24.8
3e$_{iv}$	1.23-1.39 (m, 10H, H-4, H-5, H-6, H-7, H-8), 1.40-1.53 (m, 2H, H-9), 1.54-1.68 (m, 2H, H-3), 2.25 (t, 2H, *J* =7.5 Hz, H-2), 3.88-4.02 (m, 1H, C*H*OH), 4.30-4.35 (dd, 1H, *J* = 7.4 Hz, 13.7 Hz, H-11), 4.42-4.53 (dd, 1H, *J* = 2.6 Hz, 13.7 Hz, H-11), 4.79-4.98 (bs, 1H, C*H*OH), 6.73-6.86 (d, 1H, ArH), 7.15-7.39 (m, 3H, ArH), 8.02 (s, 1H, triazole-H), 9.10 (s, 1H, ArOH)	174.6, 156.8, 146.0, 131.1, 128.8, 120.5, 115.6, 114.2, 111.6, 68.3, 55.1, 33.6, 33.2, 28.4, 28.3, 28.1, 28.0, 24.4, 23.9
3d$_{v}$	1.16-1.46 (m, 10H, H-4, H-5, H-6, H-7, H-8), 1.47-1.70 (m, 4H, H-3, H-9), 2.30 (t, 2H, *J* =7.5 Hz, H-2), 3.66 (s, 3H, -OCH$_3$), 3.93 (s, 3H, ArOCH$_3$), 4.09-4.21 (m, 1H, C*H*OH), 4.20-4.34 (dd, 1H, *J* = 7.4 Hz, 13.7 Hz, H-11), 4.47-4.57 (dd, 1H, *J* = 2.6 Hz, 13.7 Hz, H-11), 7.10-7.17 (m, 2H, ArH), 7.66-7.77 (m, 2H, ArH), 7.79-7.85 (m, 1H, ArH), 7.91 (s, 1H, triazole-H), 8.12 (s, 1H, ArH)	174.3, 157.8, 147.5, 134.2, 129.6, 128.8, 127.2, 125.6, 124.1, 124.1, 120.9, 119.1, 105.7, 70.5, 56.2, 55.3, 51.4, 34.4, 34.0, 29.3, 29.2, 29.0, 29.0, 25.3, 24.8
3e$_{v}$	1.22-1.38 (m, 10H, H-4, H-5, H-6, H-7, H-8), 1.39-1.50 (m, 2H, H-9), 1.50-1.62 (m, 2H, H-3), 2.58 (t, 2H, *J* =7.5 Hz, H-2), 3.92 (s, 3H, ArOCH$_3$), 4.26-4.38 (dd, 1H, *J* = 7.4 Hz, 13.7 Hz, H-11), 4.42-4.54 (dd, 1H, *J* = 2.6 Hz, 13.7 Hz, H-11), 4.96-5.14 (bs, 1H, H-10), 7.10-7.23 (d, 2H, ArH), 7.75-7.95 (m, 4H, 3-ArH, 1-triazole-H), 8.22-8.31 (m, 2H, ArH)	173.7, 156.2, 146.2, 132.6, 128.0, 127.3, 125.8, 124.8, 122.8, 122.2, 120.1, 117.7, 104.3, 68.1, 54.6, 53.8, 33.0, 32.6, 27.8, 27.7, 27.6, 27.4, 23.8, 23.3

Pharmacology:

Cytotoxicity Evaluation: Cellular viability was determined using an MTT-micro cultured tetrazolium assay as reported previously [20], with minor modifications. Briefly, all four selected cell lines were seeded in 96-well plates with flat bottom surface (10,000 cells/well in 100 µl of culture medium containing 10% serum) and cultured for 18–24 h with a constant supply of 5% CO_2 in a humid incubator. The series of compounds synthesized are dissolved in DMSO to prepare stock concentrations from 0.5 to 5000 µM with 10 fold increase in the range. From working stock two µl of test compounds and doxorubicin (as a standard control anticancer drug prepared in DMSO) were added to the culture media to achieve a final concentration of 0-100 µm final concentration to the cells.

Cells continued to grow further for 48 h with a constant supply of 5% CO_2 in the humid incubator. On termination of assay, filter-sterilized 3-(4, 5-dimethylthiazol-2-yl) - 2, 5 - diphenyltetrazolium bromide (MTT) in PBS (5 mg/ml, 10 ml per well) was added to the culture plate. After 2 h of further incubation subsequently the medium was removed and 100 ml of DMSO was added to the cells solubilising MTT bound to cells. The absorbance of purple colour directly proportional to cell growth was measured at 562nm in a multimode micro plate reader (Tecan GENios; Tecan AG, Mannedorf, Switzerland). The IC_{50} values were calculated from the observed cell growth with and without the test compounds. The results analyzed are from three independent experiments, each performed in triplicates.

RESULTS AND DISCUSSION:

Chemistry:

The β-hydroxy 1,2,3-triazole hybrids of unsaturated fatty acids namely, oleic (**1**), ricinoleic (**2**) and 10-undecnoic acid (**3**) were synthesised as shown in **Figures 1** and **2.** The employed synthetic protocol comprises of i) esterification, ii) epoxidation, iii) azidolysis, iv) "click" reaction followed by v) hydrolysis. According to **Figure 1**, the fatty acids **1/2/3** were converted to methyl esters **1a/2a/3a** by treating with 2% H_2SO_4/MeOH [15] then subjected to epoxidation with *m*-CPBA in DCM [16] to obtain corresponding epoxy fatty acid methyl esters **1b/2b/3b** in 85, 70 and 85% yield respectively.

Nucleophilic ring opening of **1b/2b/3b** with NaN_3 in presence of NH_4Cl in aq. MeOH resulting in the corresponding regio and stereo isomeric mixture [17] of β-hydroxy azides **1c/2c/3c** in 85, 90 and 95% yields.

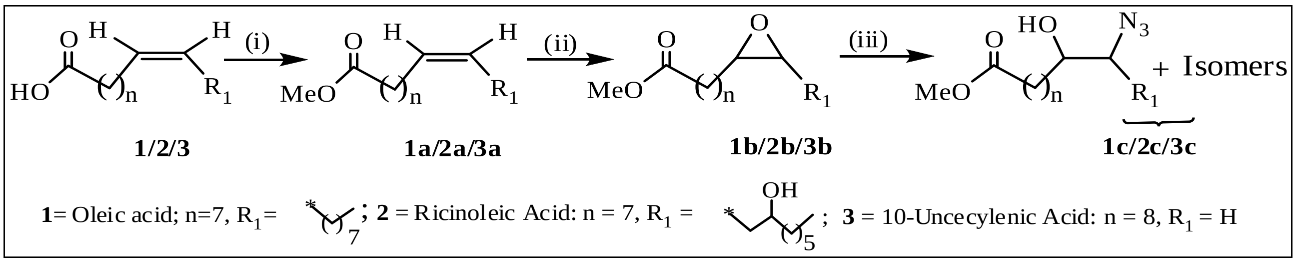

FIGURE 1: REAGENTS AND CONDITIONS: i) 2% H_2SO_4/CH_3OH, REFLUX. ii) *m*-CPBA, DCM, ROOM TEMPERATURE. iii) NaN_3, NH_4Cl, MeOH: H_2O (8:1), REFLUX.

The main focus of the present work is to impart value addition to the fatty acids, hence the mixture of β-hydroxy azides itself have been chosen as azide source for click reaction. All the above synthesized compounds were characterized by physico chemical, analytical and spectral data and are in comparison with the reported authentic samples as depicted in **Tables 1-9.** Presence of sharp peaks in FT-IR spectrum of **1c/2c/3c** at 2100-2010 cm^{-1} and broad peaks 3350-3480 cm^{-1} corresponding to the $-N_3$ and -OH functional groups respectively are characteristic of β-hydroxy azide. These azides **1c/2c/3c** were subjected to click reaction with different alkynes namely, oct-1-yne (**i**), prop-2-yn-1-ol (**ii**), phenyl acetylene (**iii**), 3-ethynylphenol (**iv**) and 2-ethynyl-6-methoxy naphthalene (**v**) in presence of $CuSO_4.5H_2O$ and sodium ascorbate [2] as reducing agent in 1:1 (v/v) mixture of t-butanol:water to obtain corresponding β-hydroxy1,2,3-triazole fatty acid methyl esters **$1d_{(i-v)}/2d_{(i-v)}/3d_{(i-v)}$** in good yields. The fatty acid methyl ester triazoles on further hydrolysis with aq. KOH [18,19] at 90 °C to obtain corresponding β-hydroxy1,2,3-triazole fatty acids **$1e_{(i-v)}/2e_{(i-v)}/3e_{(i-v)}$** in quantitative yields as depicted in **Figure 2.**

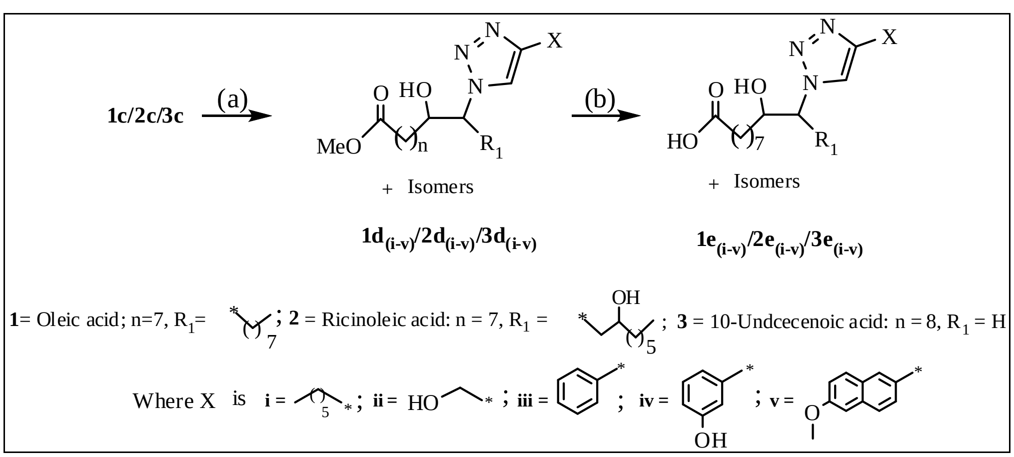

FIGURE 2: REAGENTS AND CONDITIONS: a) ALKYNES (i-v), t-BuOH:H_2O (1:1), $CuSO_4$. $5H_2O$, SOD ASCORBATE, REFLUX. b) 10% aq. KOH, 90 °C.

All the purified structure hybrids of 1, 2 and 3 were fully characterized by IR, Mass, HRMS (**Tables 10-12**) and ^{1}H and ^{13}C NMR (**Tables 13-15**) spectral studies. ^{1}H NMR spectrum of **1d$_{iii}$** shows peaks at δ 7.20-7.39 corresponding to aromatic protons of phenyl ring and singlet at δ 7.98 corresponding to the proton of 1,2,3-triazole ring and -OCH_3 peak as singlet at δ 3.60; the characteristic peaks for methyl ester. The prominent peaks in the ^{13}C NMR for the carbonyl and methoxy carbons of **1d$_{iii}$**, were found to be at δ 174.2, and 51.4 respectively, including requisite number of carbons. Absence of peaks at δ 51.4 and δ 3.60 of ^{13}C & ^{1}H NMRs of compound **1e$_{iii}$** clearly indicate the complete hydrolysis of methyl ester to acid. The molecular ion peaks in ESI-MS spectrum of **1d$_{iii}$** and **1e$_{iii}$** were found to be at 458 $[M+H]^+$ and 443 $[M]^+$ respectively, were in good coincidence with HRMS values as shown in **Tables 10-12**.

TABLE 16: INHIBITORY RESULTS OF FATTY ACID BASED Β-HYDROXY 1,2,3-TRIAZOLE HYBRIDS AGAINST FOUR HUMAN CANCER CELL LINES

Code	X (1,2,3-triazole side chain)	IC_{50}(μM)* DU-145	HeLa	MCF-7	A549
		Oleic acid-based triazoles			
1d$_i$	C_6H_{13}	123.54±10.72	121.16±11.58	154.82±6.68	-
1e$_i$	C_6H_{13}	-	-	-	-
1d$_{ii}$	CH_2OH	10.73 ± 0.32	13.61 ± 2.50	11.9 3± 0.52	16.54 ± 0.43
1e$_{ii}$	CH_2OH	-	-	-	-
1d$_{iii}$	Ph	126.51±6.03	99.91±0.64	104.41±11.91	156.99±0.00
1e$_{iii}$	Ph	17.96±0.11	107.47±4.93	19.19±3.10	132.81±4.92
1d$_{iv}$	*m*-OH-Ph	19.01 ± 2.01	16.45 ± 2.47	20.85 ± 3.93	20.05 ± 1.95
1e$_{iv}$	*m*-OH-Ph	66.55±0.21	19.49 ± 2.83	84.77±7.36	24.16 ± 3.16
1d$_v$	6-OMe-naphthyl	-	-	-	-
1e$_v$	6-OMe-naphthyl	84.93±5.12	116.76±15.56	-	106.35±3.39
		Ricinoleic acid-based triazoles			
2d$_i$	C_6H_{13}	79.71±2.29	97.68±3.70	24.08 ± 2.85	139.63±11.69
2e$_i$	C_6H_{13}	69.64±1.45	130.21±3.12	83.88±6.68	-
2d$_{ii}$	CH_2OH	89.83±3.24	121.48±10.27	-	164.89±9.98
2e$_{ii}$	CH_2OH	-	-	-	-
2d$_{iii}$	Ph	138.45±15.03	108.65±2.10	82.05±2.67	150.33±11.37
2e$_{iii}$	Ph	112.44±8.01	-	195.14±19.26	-
2d$_{iv}$	*m*-OH-Ph	70.71±1.62	132.14±15.91	75.82±4.44	105.05±12.93
2e$_{iv}$	*m*-OH-Ph	-	-	-	-
2d$_v$	6-OMe-naphthyl	-	-	-	-
2e$_v$	6-OMe-naphthyl	24.02 ± 3.95	108.27±8.29	85.34±4.75	108.46±12.35
		10-Undecenoic acid-based triazoles			
3d$_i$	C_6H_{13}	95.56±3.97	92.07±2.79	90.41±4.24	144.20±9.71
3e$_i$	C_6H_{13}	21.67 ± 2.02	152.80±10.99	-	-
3d$_{ii}$	CH_2OH	-	-	-	-
3e$_{ii}$	CH_2OH	116.34±7.90	140.47±21.58	-	-
3d$_{iii}$	Ph	-	114.87±14.26	115.71±6.84	148.47±19.80
3e$_{iii}$	Ph	-	-	-	-
3d$_{iv}$	*m*-OH-Ph	87.19±6.86	95.51±7.97	84.45±4.84	119.28±1.69
3e$_{iv}$	*m*-OH-Ph	-	-	-	-
3d$_v$	6-OMe-naphthyl	-	-	-	-
3e$_v$	6-OMe-naphthyl	-	-	-	-
	Doxorubicin	7.78±0.74	5.82±0.07	6.68±0.12	7.37±0.17

* Inhibitory activity was assayed by exposure to substance and expressed as concentration required to inhibit tumour cell proliferation by 50% (IC_{50}). Data are presented as the mean ± SDs of three independent experiments.

In the ^1H and ^{13}C NMR spectral data of oleic and 10-undecenoic acid based triazoles no additional peaks corresponding to the isomeric mixture was observed, while that of ricinoleic acid based triazoles two more additional peaks than the expected according to the molecular structure were noticed and were found to be characteristic peaks for C_9, C_{10} regio isomers formed by the nucleophilic ring opening of epoxide with azide nucleophile as reported in the literature [42]. In case of ricinoleic acid based triazoles, C_{12}-OH functionality of carbon chain directs major isomer by the attack of N_3^- through less hindered side of epoxide ring resulting in the formation of unequal proportions of regio isomers.

The reason for the non appearance of the additional peaks in oleic acid derivatives might be the formation of approximately equal ratios of the regio isomeric mixture and in 10-undecenoic acid, nucleophilic ring opening at the terminal carbon of the epoxide ring leads to the formation of major percentage of terminal azide containing β-hydroxy azide.

Anticancer Activity: The IC_{50} values (concentration required to inhibit tumour cell proliferation by 50%) for the synthesized β-hydroxy1,2,3-triazole compounds i.e., $\mathbf{1d_{(i-v)}}$/$\mathbf{2d_{(i-v)}}$/$\mathbf{3d_{(i-v)}}$ and $\mathbf{1e_{(i-v)}}$/$\mathbf{2e_{(i-v)}}$/$\mathbf{3e_{(i-v)}}$ against four human cancer cell lines namely, DU-145 (human prostate cancer cell line), HeLa (human cervical cancer cell line), MCF-7 (human breast cancer cell line) and A549 (human lung cancer cell line) were determined in MTT (3-[4,5-dimethylthiazol-2-yl]-2,5 diphenyl tetrazolium bromide) assay based on the conversion of MTT into formazan crystals by living cells. The IC_{50} values were listed in **Table 16** and the standard anticancer drug doxorubicin was used as positive control.

Among the oleic acid based triazole compounds ($\mathbf{1d_{(i-v)}}$ and $\mathbf{1e_{(i-v)}}$) only methyl oleate triazole $\mathbf{1d_{ii}}$ with -CH_2OH side chain exhibited good anti cancer activity against the above four human cancer cell lines with IC_{50} values 10.73, 13.61, 11.93, and 16.54 μM, respectively. Whereas, it's hydrolyzed compound i.e. $\mathbf{1e_{ii}}$ didn't show any activity. However, the methyl oleate triazole $\mathbf{1d_{iii}}$ with phenyl side chain showed poor activity, where as its acid $\mathbf{1e_{iii}}$ exhibited moderate activity against DU-145 and MCF-7 with IC_{50} values 17.96 and 19.19 μM respectively. In case of methyl oleate triazole $\mathbf{1d_{iv}}$ with hydroxyl phenyl side chain the IC_{50} values were found to be 19.01 and 16.45 μM against DU-145 and HeLa cell lines, and its acid derivative $\mathbf{1e_{iv}}$ exhibited moderate activity against HeLa (IC_{50} value 19.48 μM) cancer cell line only.

The cytotoxicity study of the ricinoleic acid based β-hydroxy 1,2,3-triazoles ($\mathbf{2d_{(i-v)}}$ and $\mathbf{2e_{(i-v)}}$) revealed that, only $\mathbf{2d_i}$ with hexyl side chain in methyl ester form and $\mathbf{2e_v}$ with 6-methoxynaphthyl side chain in acid form were found to be moderately active against MCF-7 (IC_{50} value 24.08 μM) and DU-145 (IC_{50} value 24.02 μM) respectively. The triazole compounds $\mathbf{2e_{ii}}$, $\mathbf{2e_{iv}}$ with -CH_2OH, *m*-OH-Ph as side chain in acid form and $\mathbf{2d_v}$ with 6-OMe-naphthyl side chain in ester form are inactive against all the cell lines and remaining triazoles showed poor activity.

In case of 10-undecenoic acid based triazoles ($\mathbf{3d_{(i-v)}}$ and $\mathbf{3e_{(i-v)}}$), only $\mathbf{3e_i}$ with hexyl side chain in acid form was found to be active against DU-145 cancer cell line (IC_{50} value 21.67 μM). The compounds $\mathbf{3d_{ii}}$, $\mathbf{3d_v}$ with -CH_2OH, 6-OMe-naphthyl side chain in ester form and $\mathbf{3e_{iii}}$, $\mathbf{3e_{iv}}$, $\mathbf{3e_v}$ with phenyl, *m*-OH-Ph, 6-OMe-naphthyl side chain in acid form are inactive against all the cell lines and the remaining triazoles were not considerably active.

CONCLUSIONS: In conclusion, a new class of fatty acid based β-hydroxy 1,2,3-triazole hybrids namely, oleic, ricinoleic and 10-undecenoic acid based were synthesized for the first time and screened for anticancer activity against four human cancer call lines. The key step in this protocol is the 1, 3-dipolar addition of β-hydroxy azide of fatty acids with different alkyl/aryl alkynes using click reaction.

Among all the synthesized 1,2,3-triazole derivatives ($\mathbf{1\text{-}3d_{(i-v)}}$ **&** $\mathbf{1\text{-}3e_{(i-v)}}$), only methyl oleate based triazoles exhibited promising to moderate anti cancer activity against four human cancer cell lines DU-145, HeLa, MCF-7 and A549. Methyl oleate triazole with -CH_2OH side chain $\mathbf{1d_{ii}}$ exhibited promising anti cancer activity against the above four human cancer cell lines with IC_{50} values

10.73, 13.61, 11.93 and 16.54 μM respectively. Moderate activity was observed for the methyl oleate triazole with *m*-OH-Ph side chain **$1d_{iv}$** showing IC_{50} values 19.01, 16.45, 20.85 and 20.05 μM against the above cell lines, where as its acid form is active against only HeLa (IC_{50} value 19.49 μM), A549 (IC_{50} value 24.16 μM) cell lines. Whereas, oleic acid triazole with phenyl side chain **$1e_{iii}$** is active against DU-145 and MCF-7 cell lines only with IC_{50} values 17.96 and 19.19 μM respectively.

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