Supplementary Information

Waste snail shell derived heterogeneous catalyst for biodiesel production by transesterification of soybean oil

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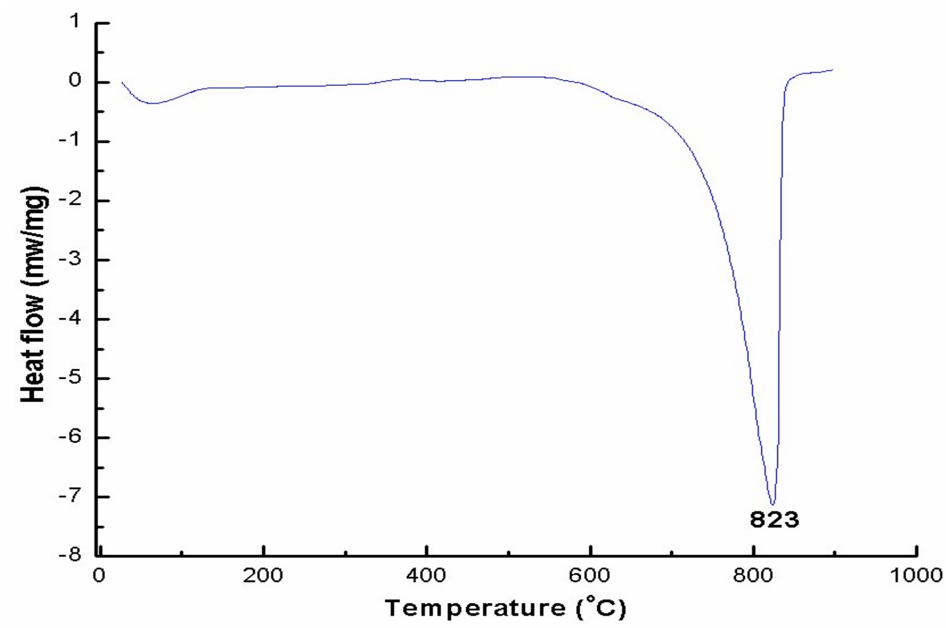

Fig. 1: DSC analysis of snail shells

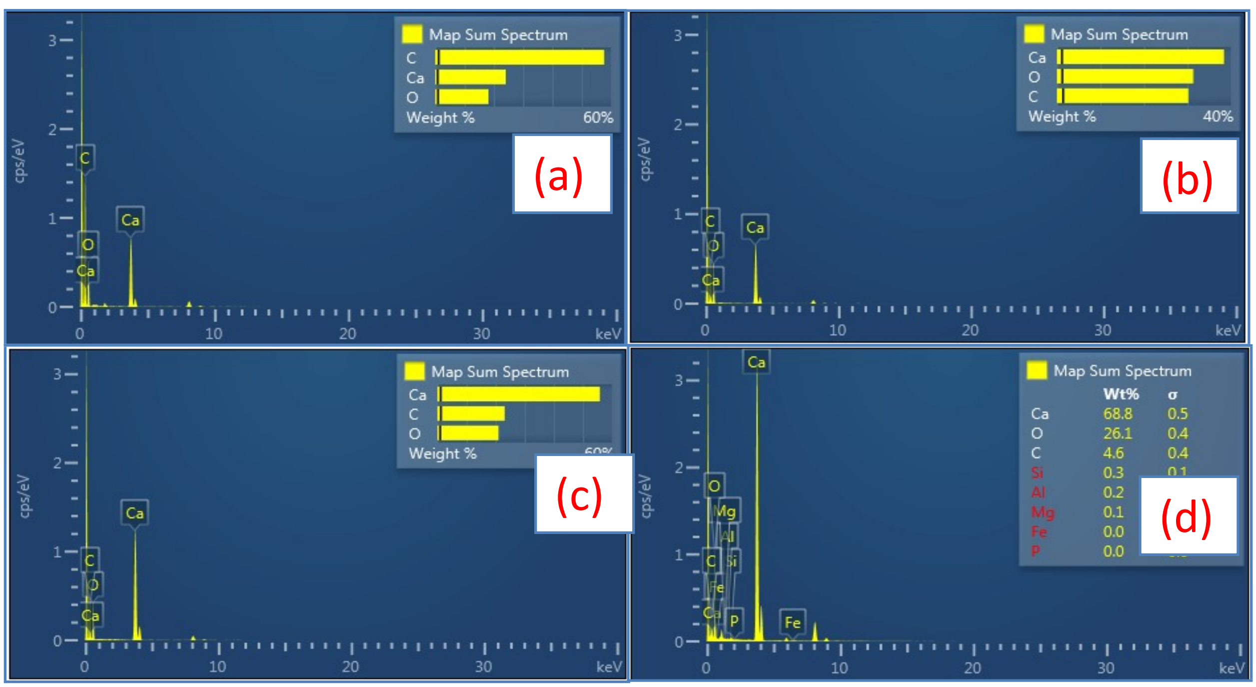

Fig. 2: EDS spectra (a) calcination at 600 °C (b) calcination at 700 °C (c) calcination at 800 °C (d) calcination at 900 °C.

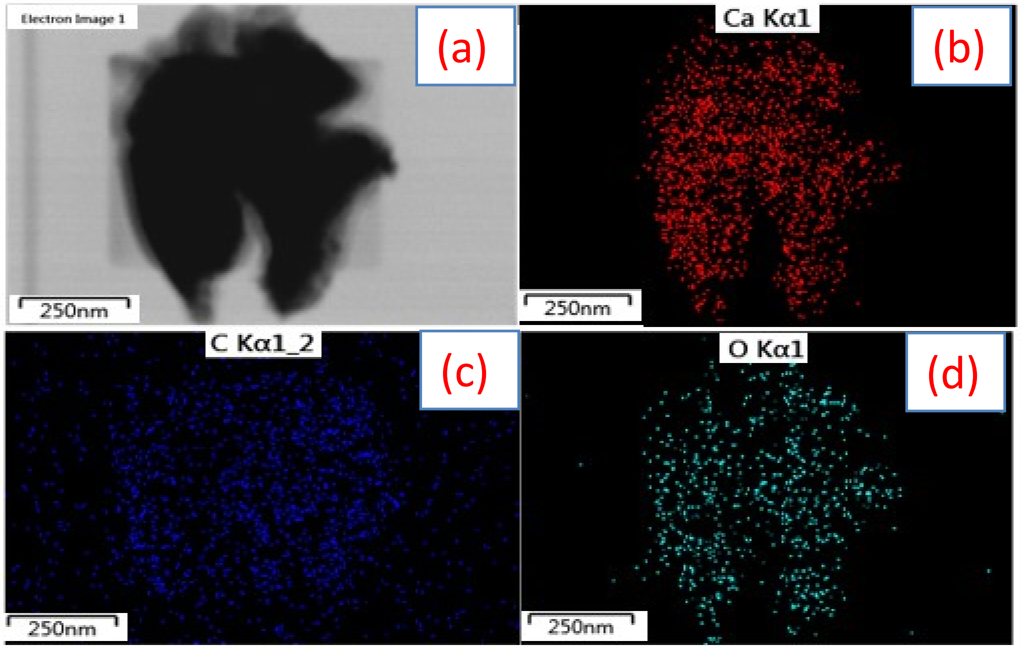

Fig. 3: EDS mapping of snail shell calcined at 600 ^{o}C (a) electron image (b) Ca (c) C (d) O

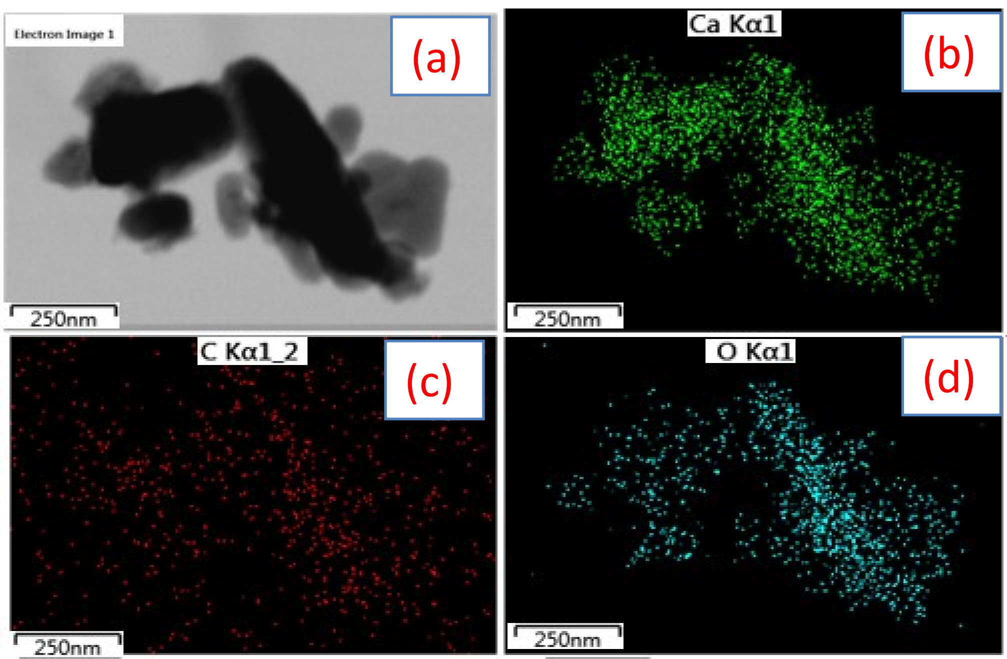

Fig. 4: EDS mapping of snail shell calcined at 700 ^{o}C (a) electron image (b) Ca (c) C (d) O

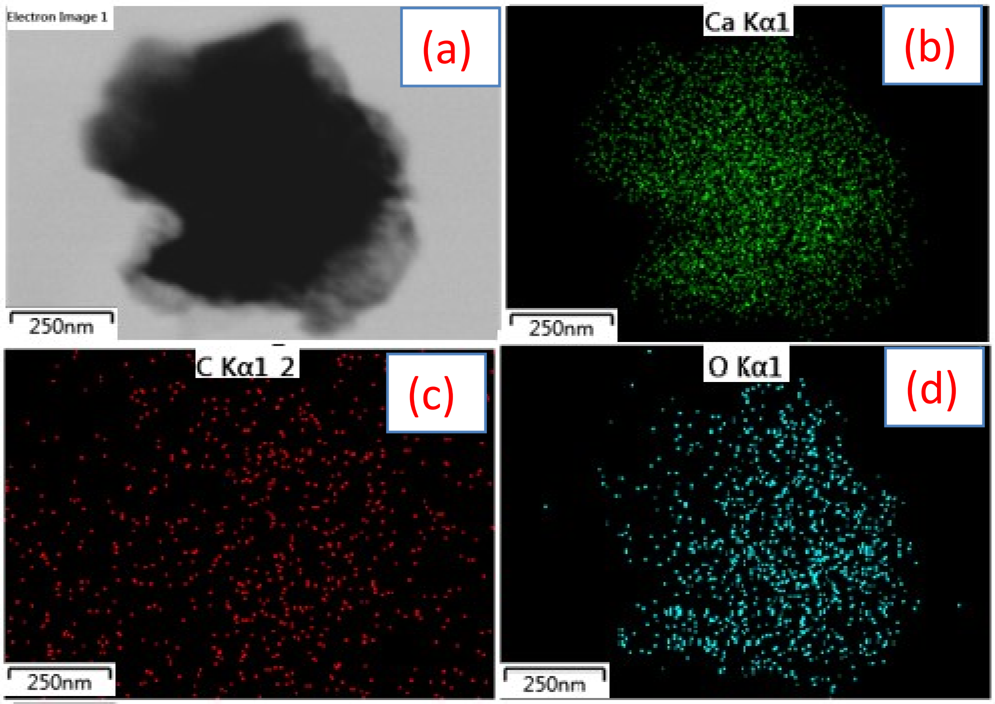

Fig. 5: EDS mapping of snail shell calcined at 800 °C (a) electron image (b) Ca (c) C (d) O

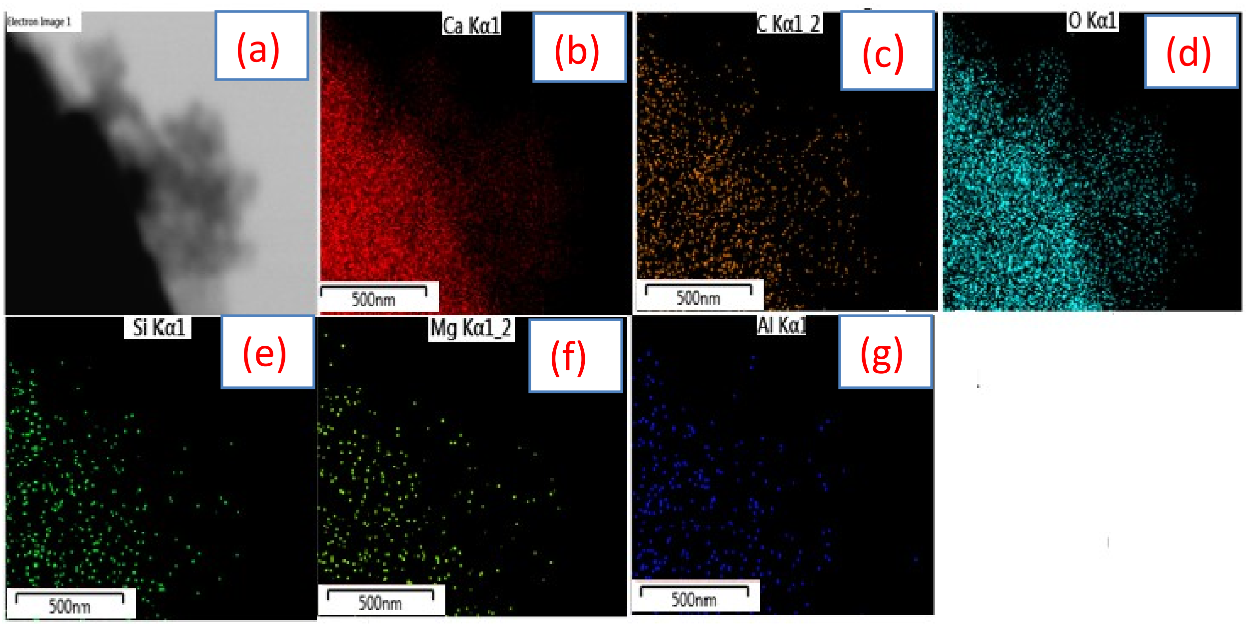

Fig. 6: EDS mapping of snail shell calcined at 900 °C (a) electron image (b) Ca (c) C (d) O (e) Si (f) Mg (g) Al

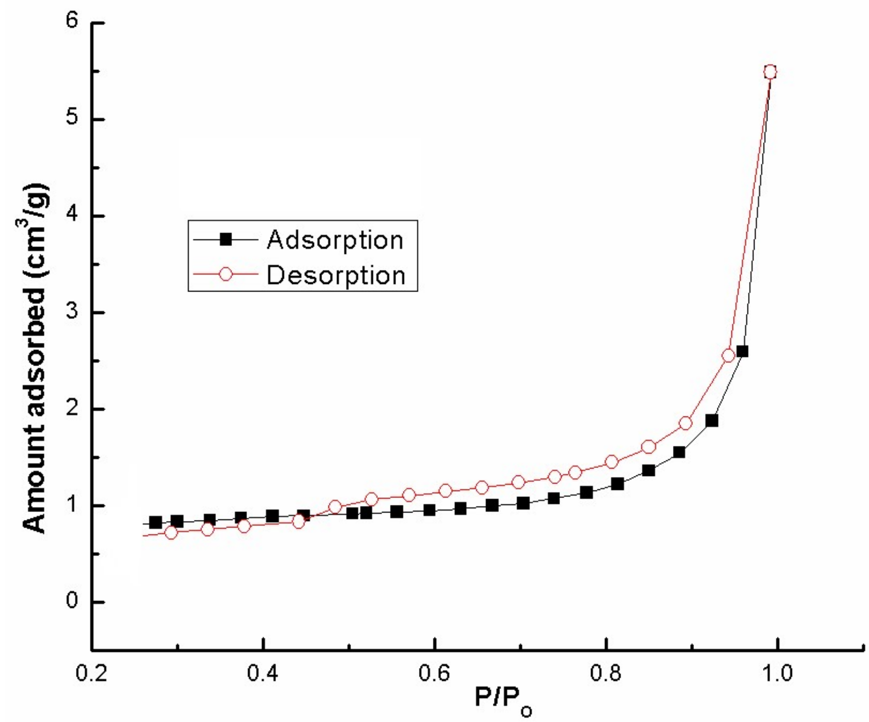

Fig. 7: N_2 adsorption-desorption analysis of snail shells (uncalcined)

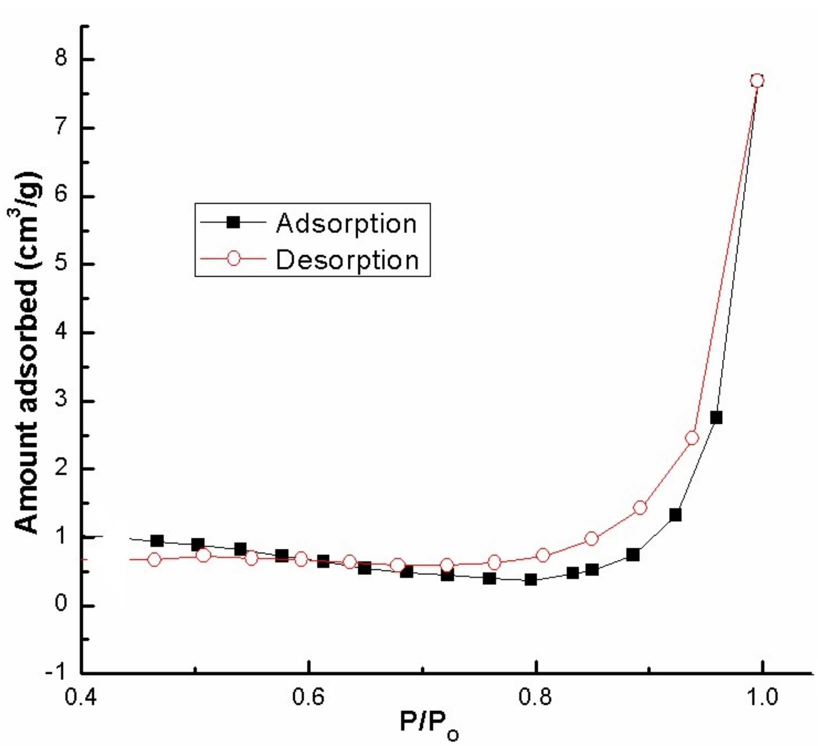

Fig. 8: N_2 adsorption-desorption analysis of snail shells calcined at 700 ^oC

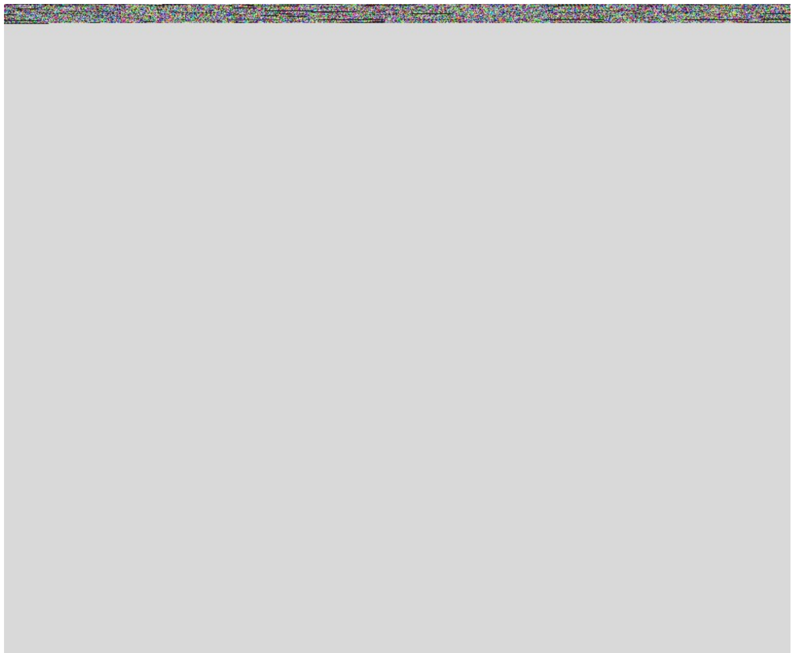

Fig. 9: N_2 adsorption-desorption analysis of snail shells calcined at 800 ^{o}C

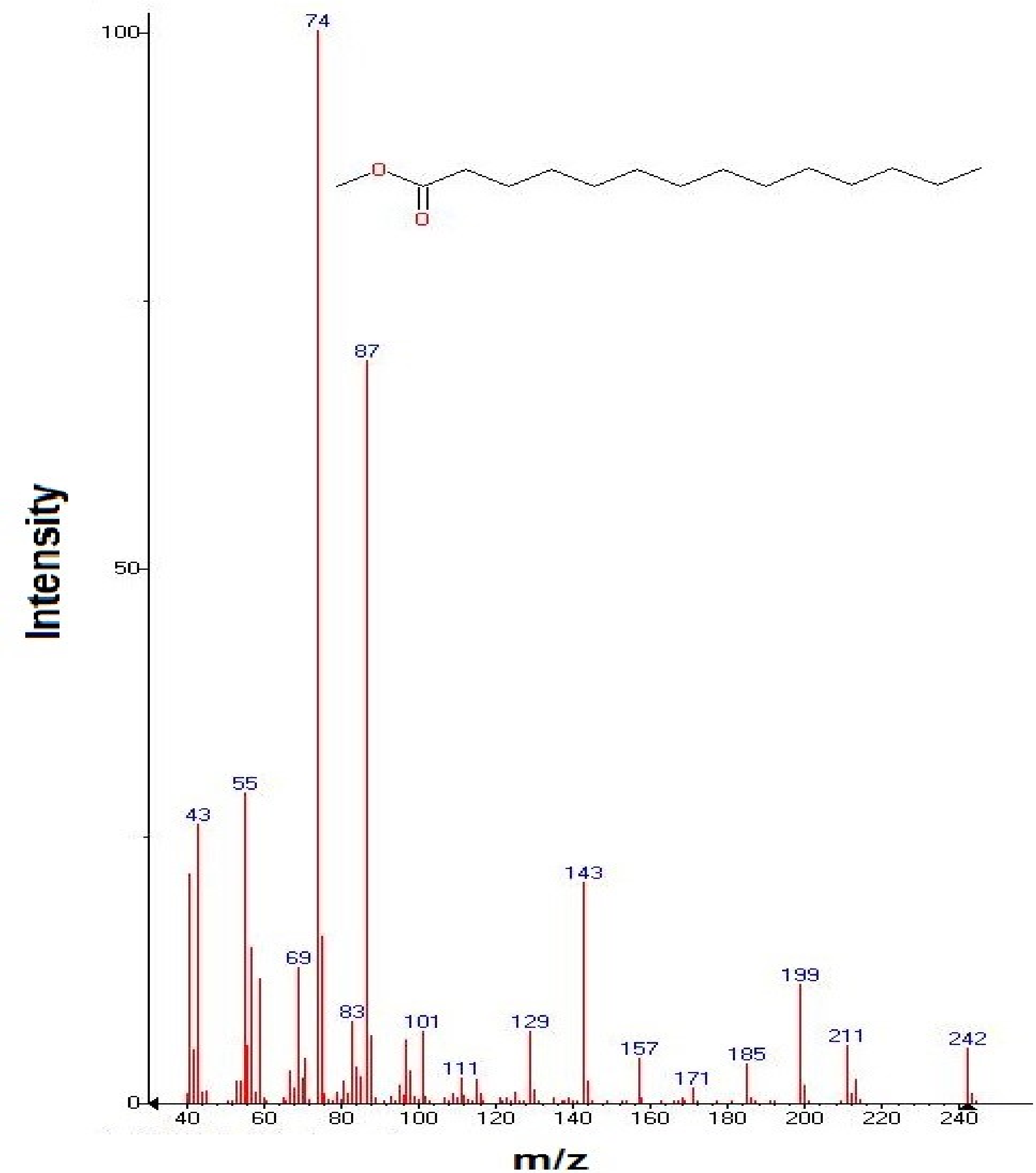

Fig. 10: Mass spectrum of methyl tetradecanoate (C14:0)

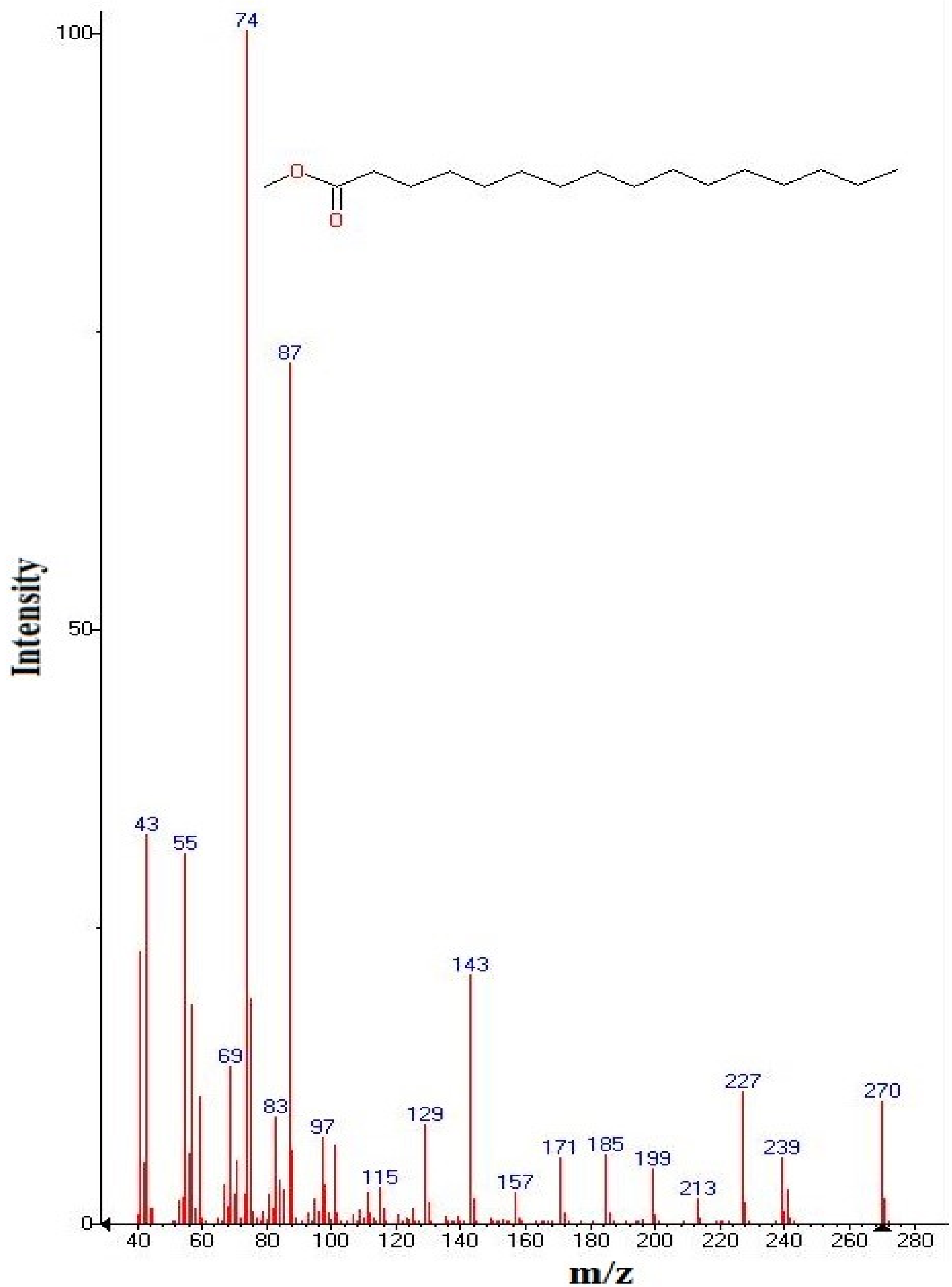

Fig. 11: Mass spectrum of methyl-hexadecanoate(C16:0)

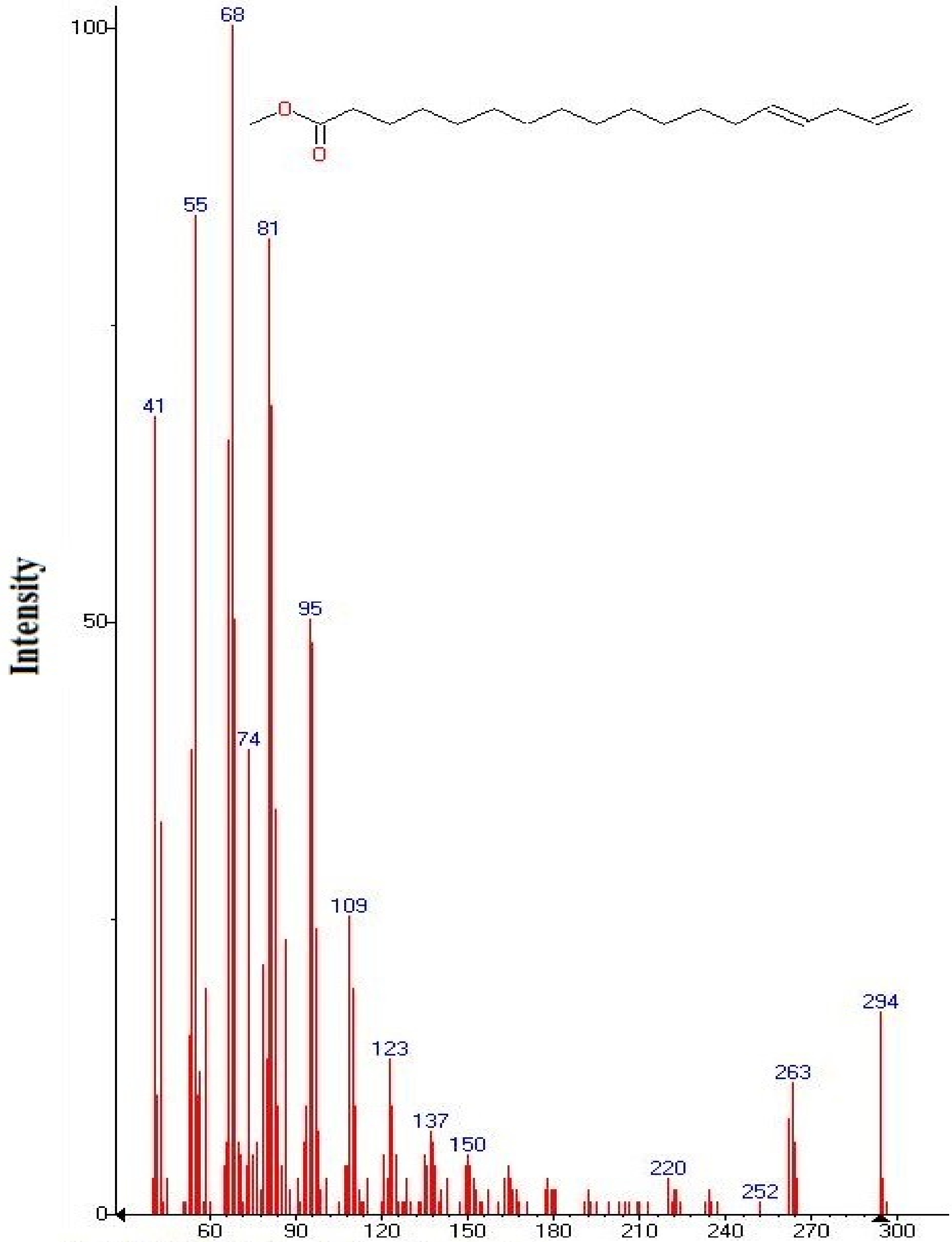

Fig. 12: Mass spectrum of methyl-octadeca-14,17-dieonate (C18:2)

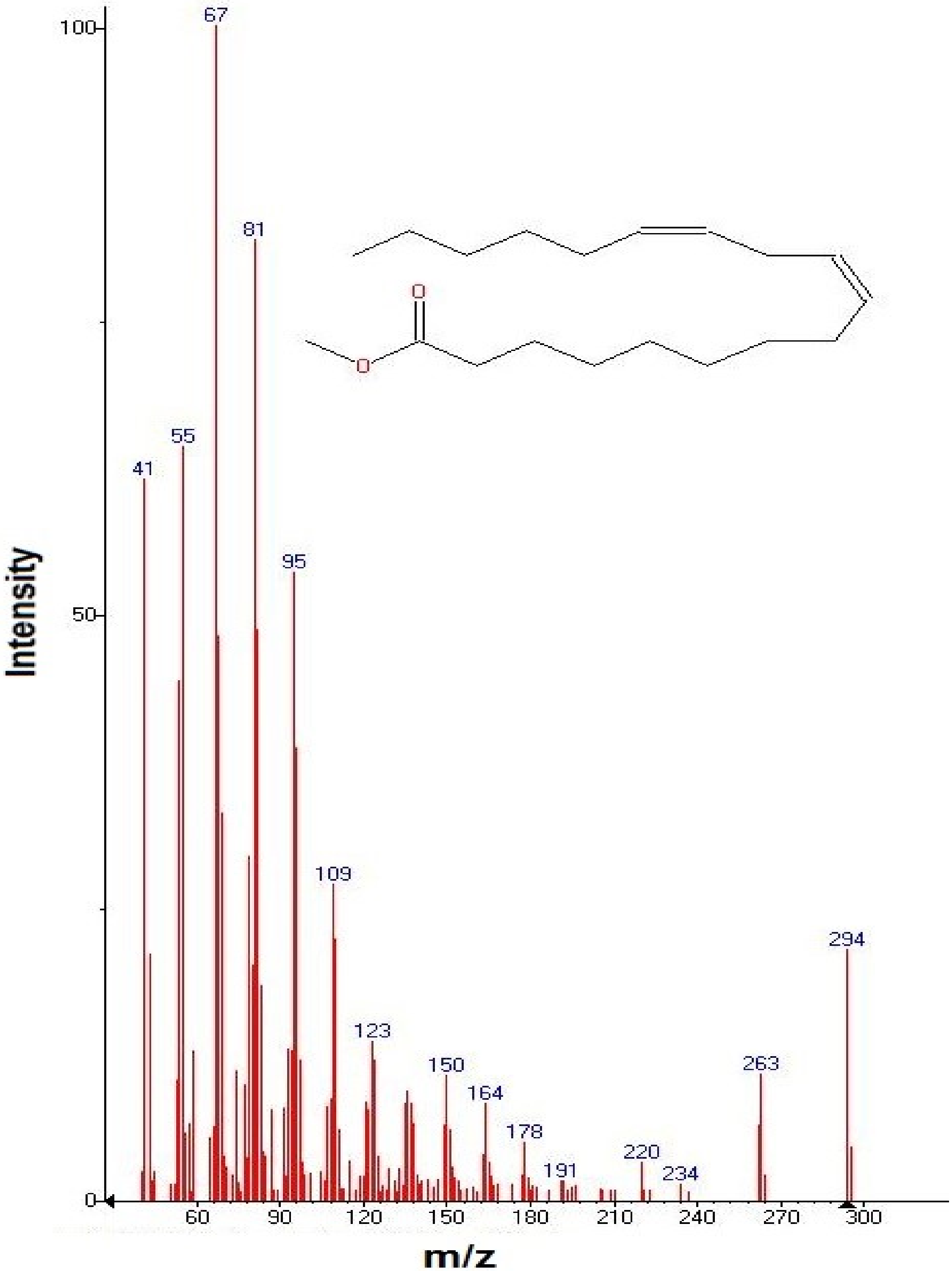

Fig. 13: Mass spectrum of methyl-octadeca-9,12-dieonate (C18:2)

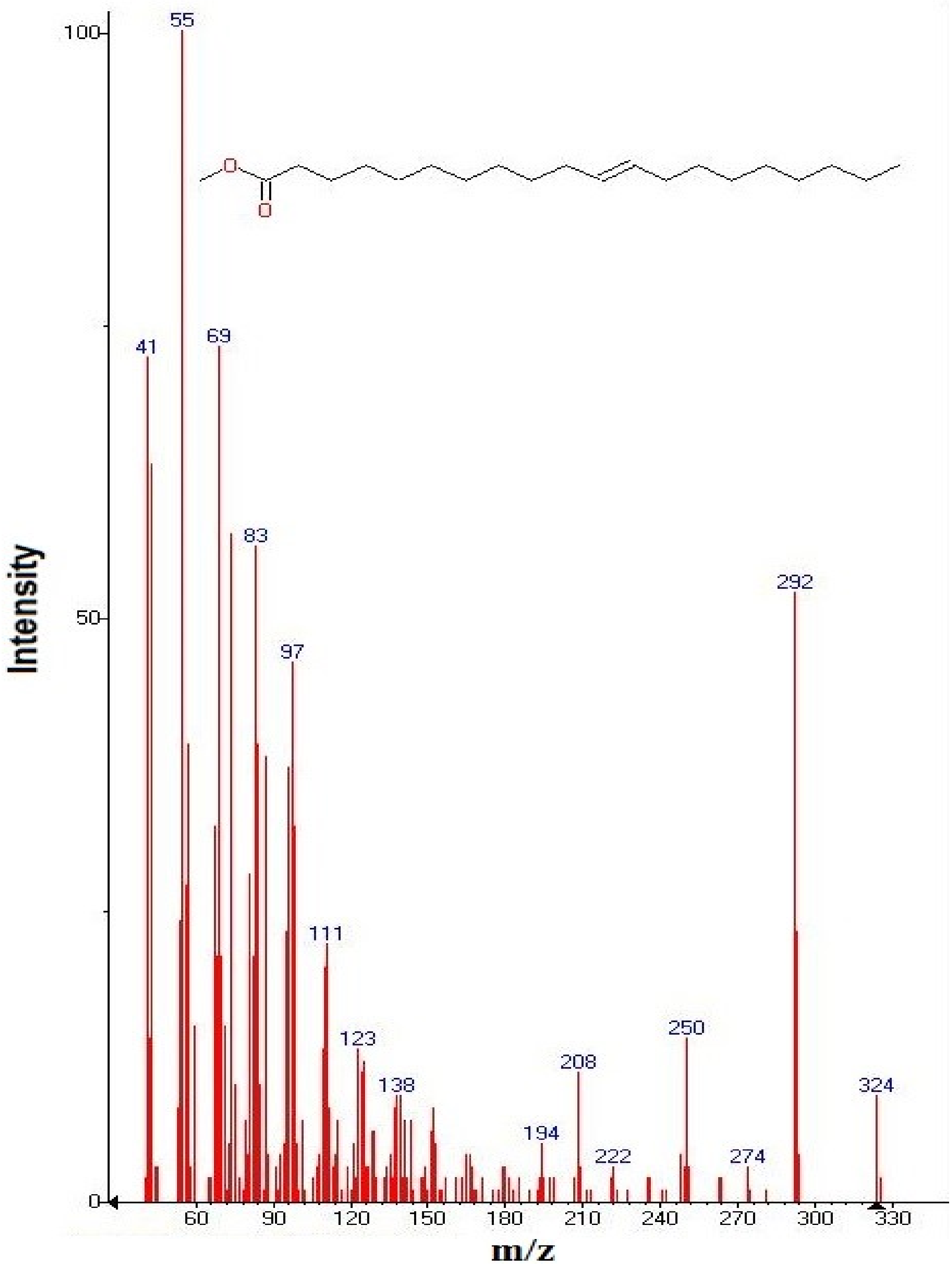

Fig. 14: Mass spectrum of methyl -11-eicosenoate (C20:1)

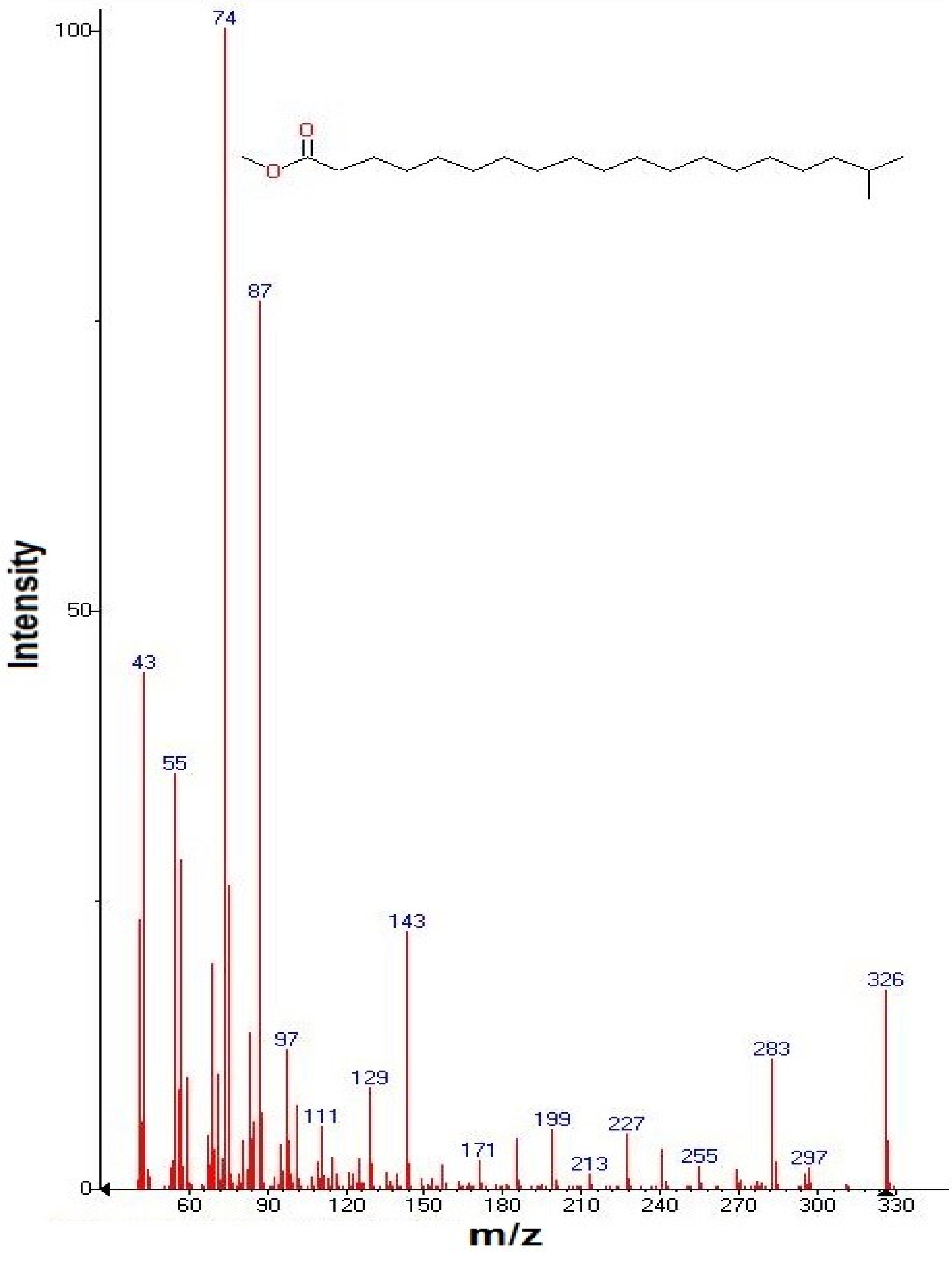

Fig. 15: Mass spectrum of methyl nonadecanoate (C20:0)

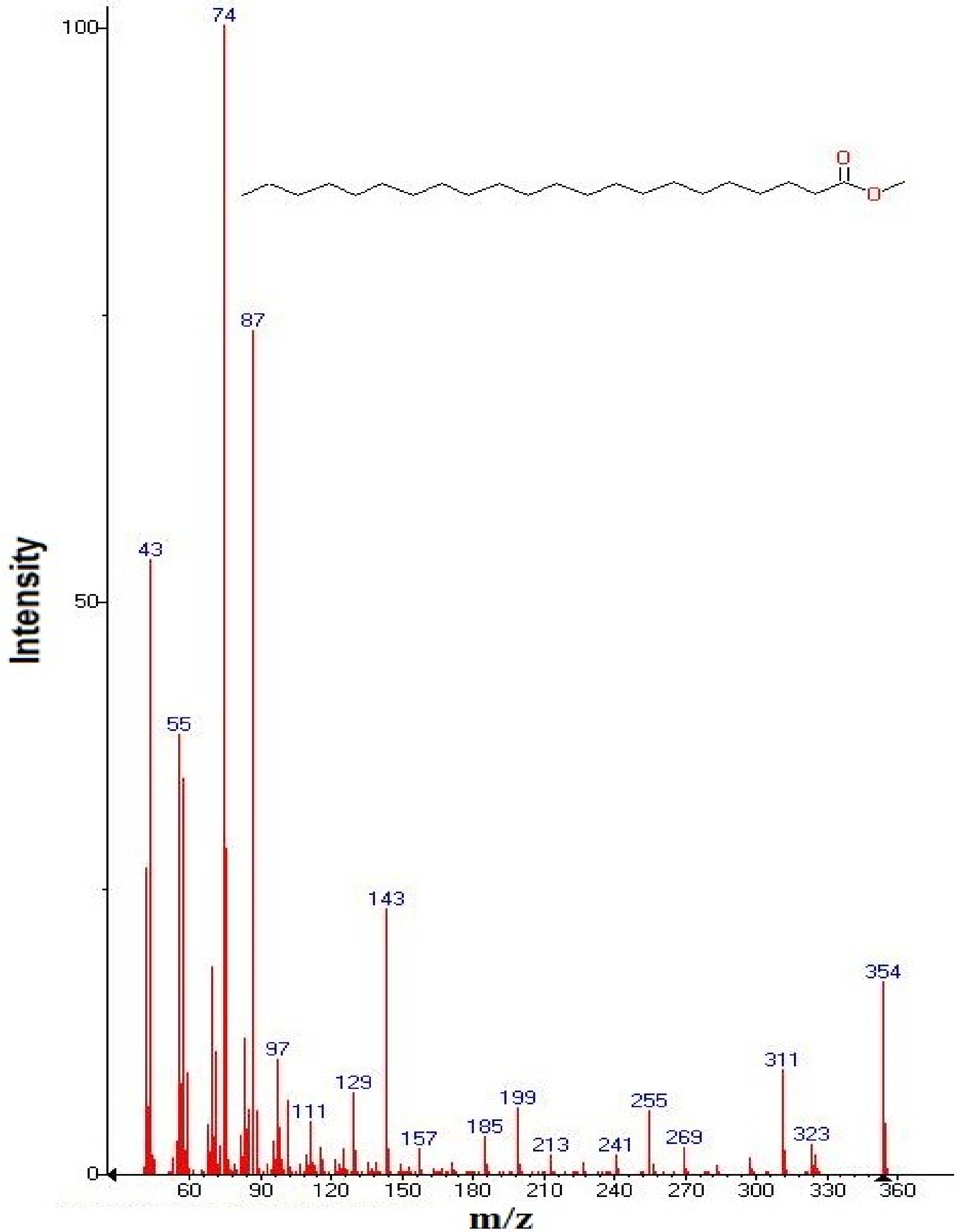

Fig. 16: Mass spectrum of methyl docosanoate (C22:0)

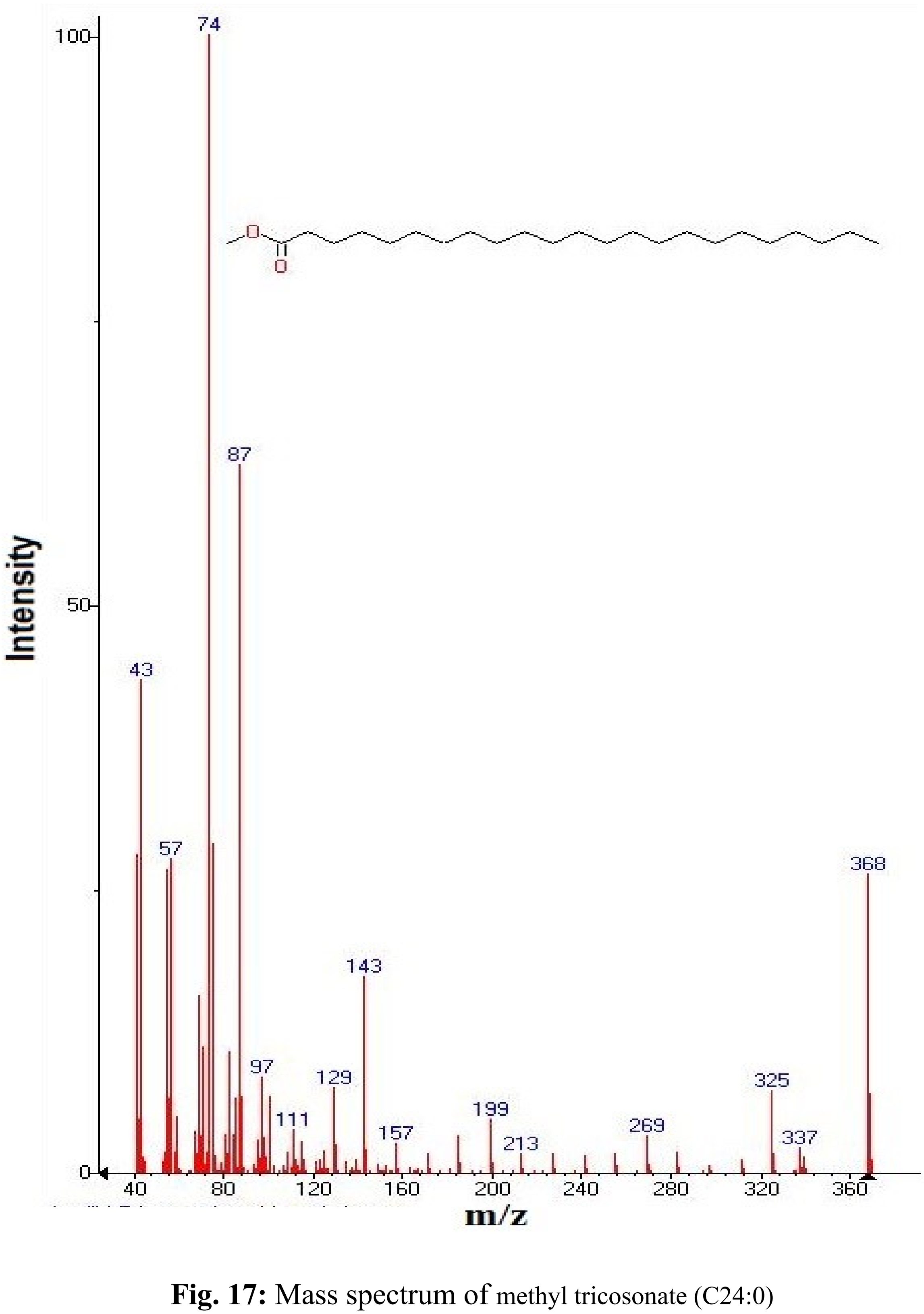

Fig. 17: Mass spectrum of methyl tricosonate (C24:0)

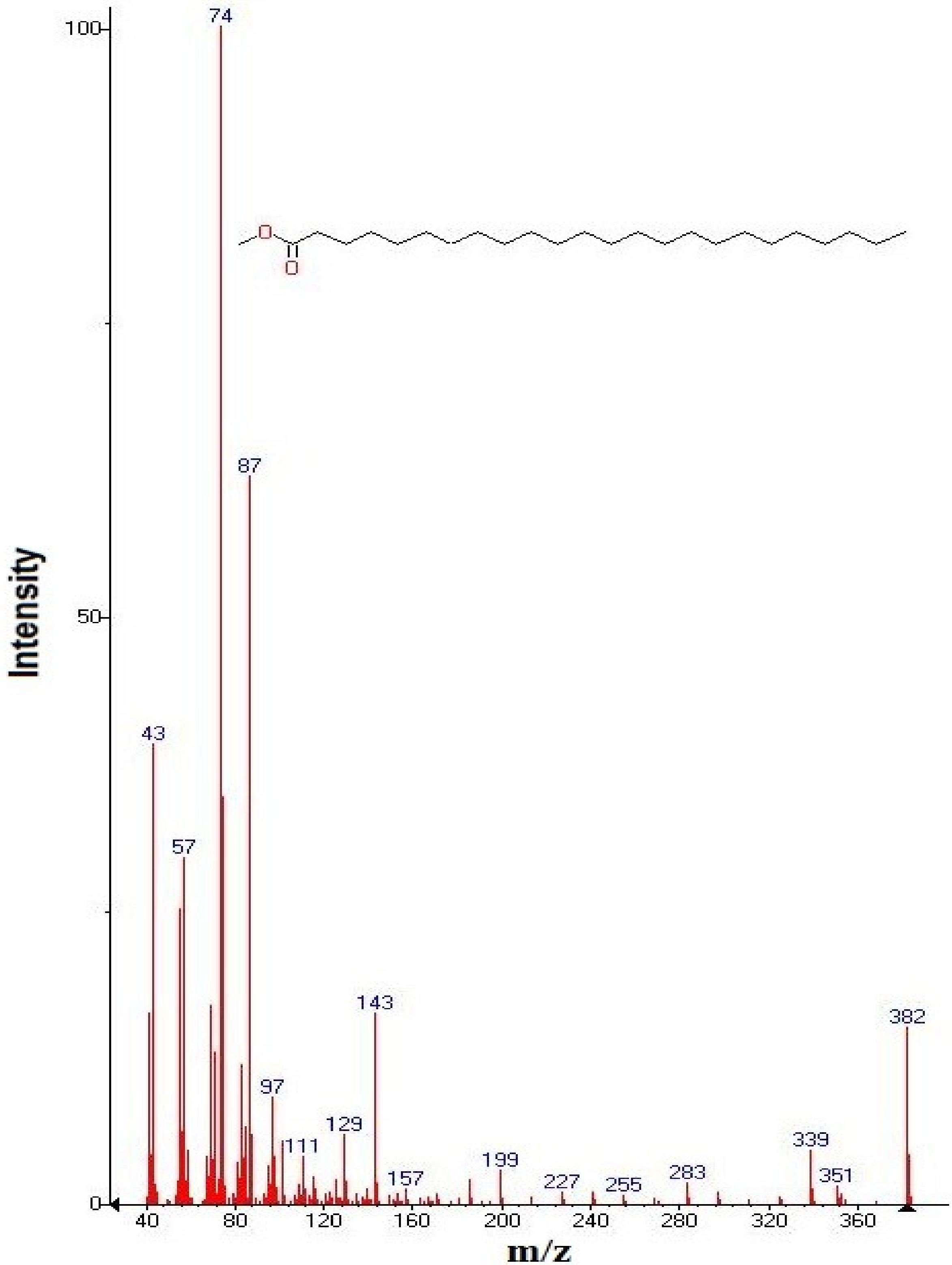

Fig. 18: Mass spectrum of methyl tetracosanoate (C24:0)

Table 1: Physico-chemical properties and fatty acids of soyabean oil

Physical properties	Soyabean oil	ASTM standards
Density (gm/cm^3)	0.91	ASTM D 1448-1972
Kinematic Viscosity(cst at 30 ^{o}C)	32	ASTM D445
Flash point (^{o}C)	315	ASTM D 7215
Acid value (mgKOH/g)	0.54	ASTM D446
Free fatty acid (%)	0.01	--
Saturated fatty acid (%)	15	
Monounsaturated fatty acid (%)	22	
Poluonsaturatted fatty acid (%)	60	
Trans Fatty acid (%)	2	

Table 2: GCMS conditions for fatty acid methyl esters

Instrument		**GC-MS conditions**	
GC			
Injection mode		Splitless	
Injector temperature		250 °C	
Split ratio		10	
Constant column flow mode		1 mL/min	
Carrier gas		Helium	
Column oven temperature progress			
Temperature (°C)	Rate (°C/min)	Hold (min)	Total (min)
80	-	1	1
200	30	1	5
275	5	0.5	20.5
280	1	0.5	26
Column: HP-5 ms			
Length		50 m	
Diameter		0.25 mm	
Film thickness		0.25 µm	
MS			
Ionization mode EI auto		EI auto	
Start m/z 50		m/z 50	
End m/z 350		m/z 350	