



# Biofuel synthesis from campus dining operations waste oil and grease using DES: characterization and combustion analysis

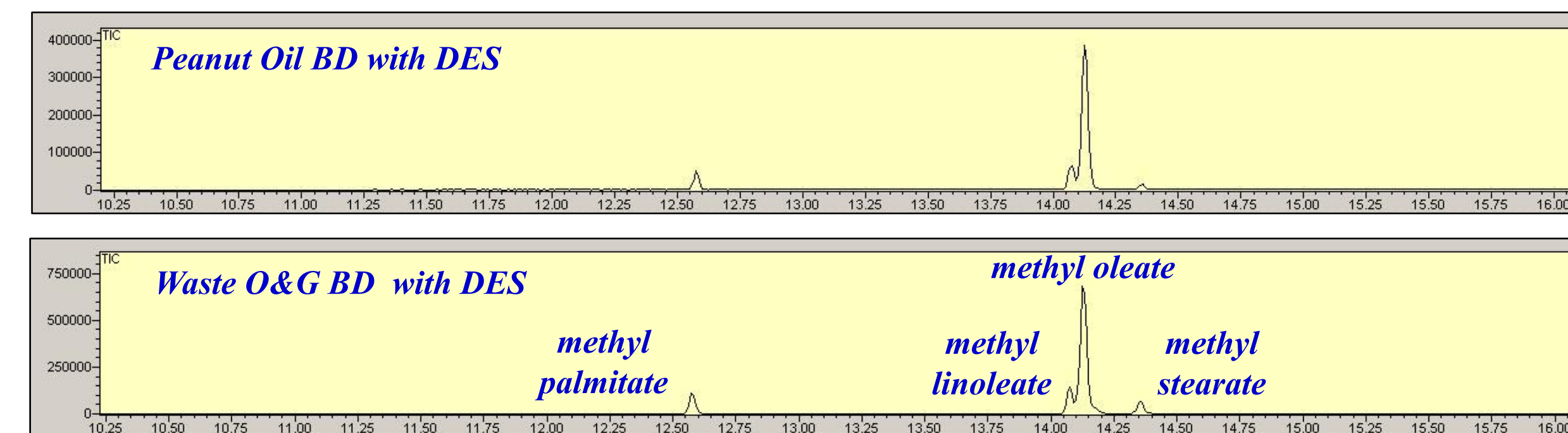
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## Motivation



## Biofuel Production & Characterization

### GC-MS



### Results with DES

FAME		Peanut Oil w/DES	Waste O&G w/DES
Methyl palmitate	C16:0	11.4%	13.7%
Methyl linoleate	C18:2 (9Z, 12Z)	26.5%	24.4%
Methyl oleate	C18:1 (cis-9)	58.2%	53.7%
Methyl stearate	C18:0	3.9%	8.3%

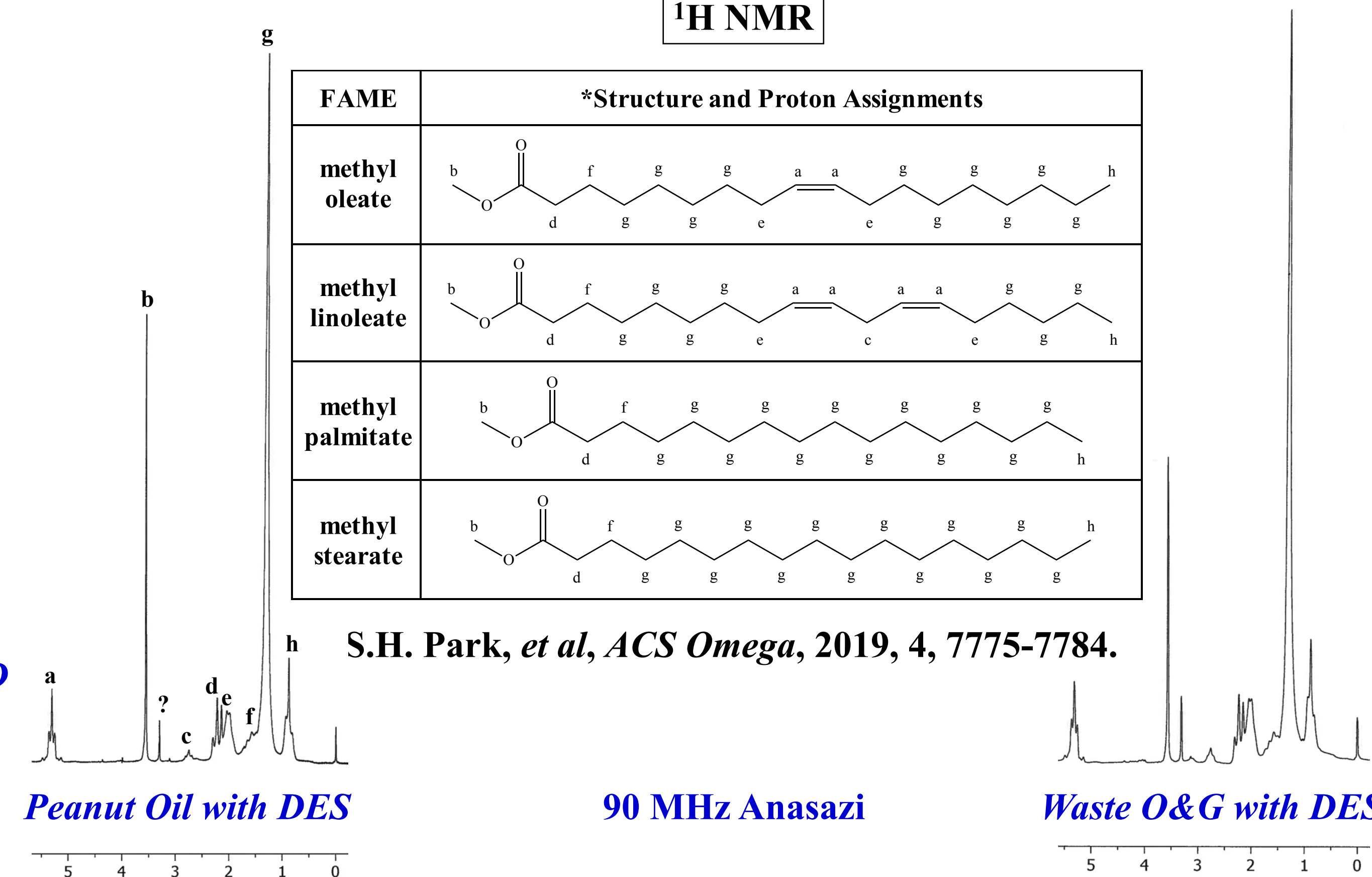
### Previous Results without DES

Material	C16:0	C18:0	C18:1	C18:2	C18:3	C20:0
Canola oil biodiesel	4.8%	2.1%	76.7%	14.3%	2.1%	
Peanut oil biodiesel	8.5%	2.2%	58.5%	27.2%	1.3%	2.3%
GGC Chick Fil-A waste oil biodiesel (peanut)	7.6%	1.9%	64.0%	24.3%	2.1%	
Off-campus Chick Fil-A waste-oil biodiesel (peanut)	7.7%	2.2%	63.7%	22.9%	1.5%	2.0%
Off-campus Chick Fil-A waste-oil biodiesel (canola)	6.9%	1.7%	64.4%	24.6%	2.4%	

### <sup>1</sup>H NMR

FAME	*Structure and Proton Assignments
methyl oleate	
methyl linoleate	
methyl palmitate	
methyl stearate	

S.H. Park, et al, ACS Omega, 2019, 4, 7775-7784.



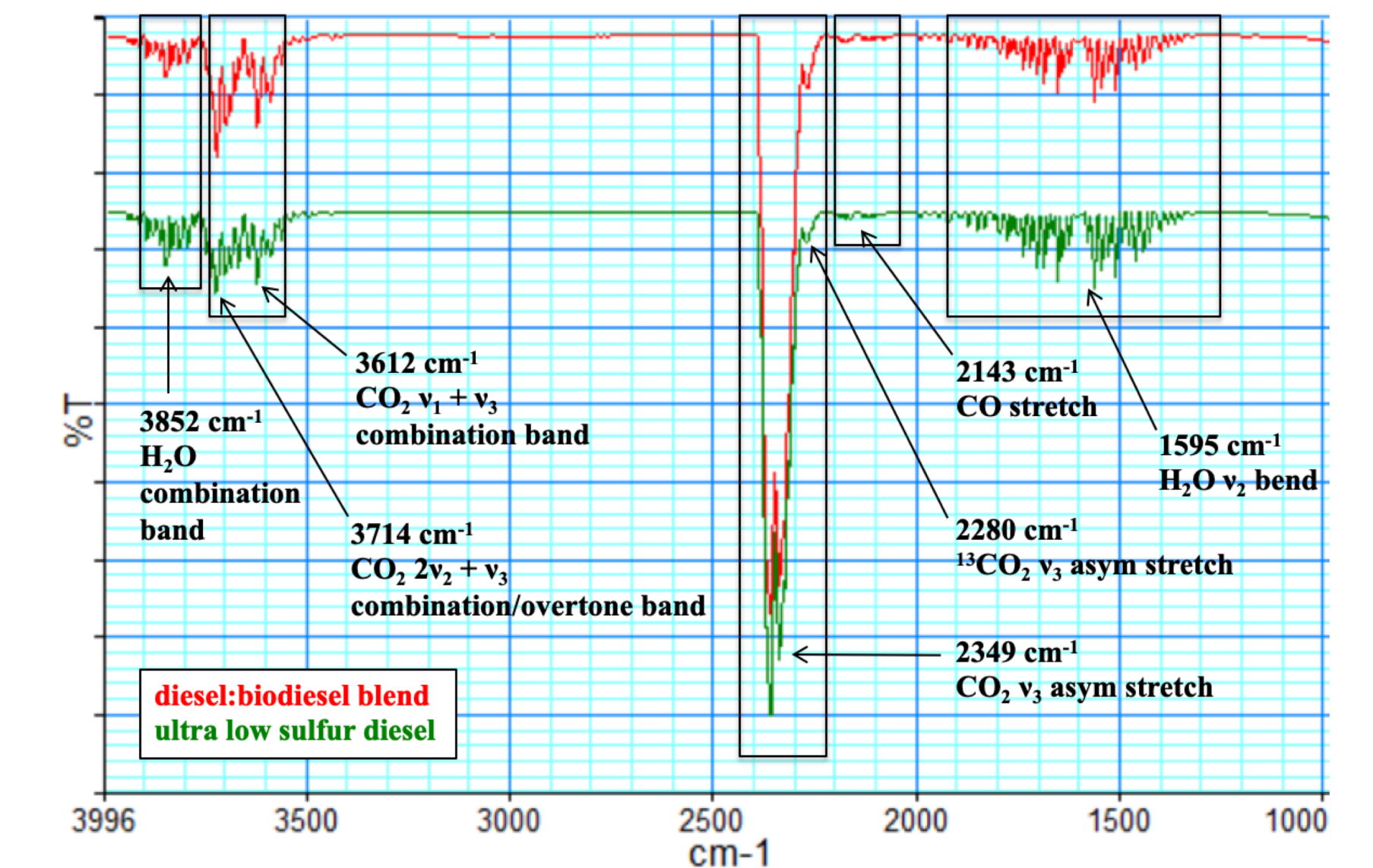
### Kinematic Viscosity (cSt)

Temp (°C)	Without DES			With DES	
	Waste O&G	70:30 Blend	80:20 Blend	Peanut Oil	Waste O&G
23	-	-	-	7.51	7.90
30	6.13	3.83	3.58	3.14	-
40	4.86	3.1	2.91	2.59	5.03
60	3.28	2.15	2.06	1.95	3.39
80	2.37	1.64	1.54	1.38	2.47
100	1.83	1.3	1.22	1.15	1.90

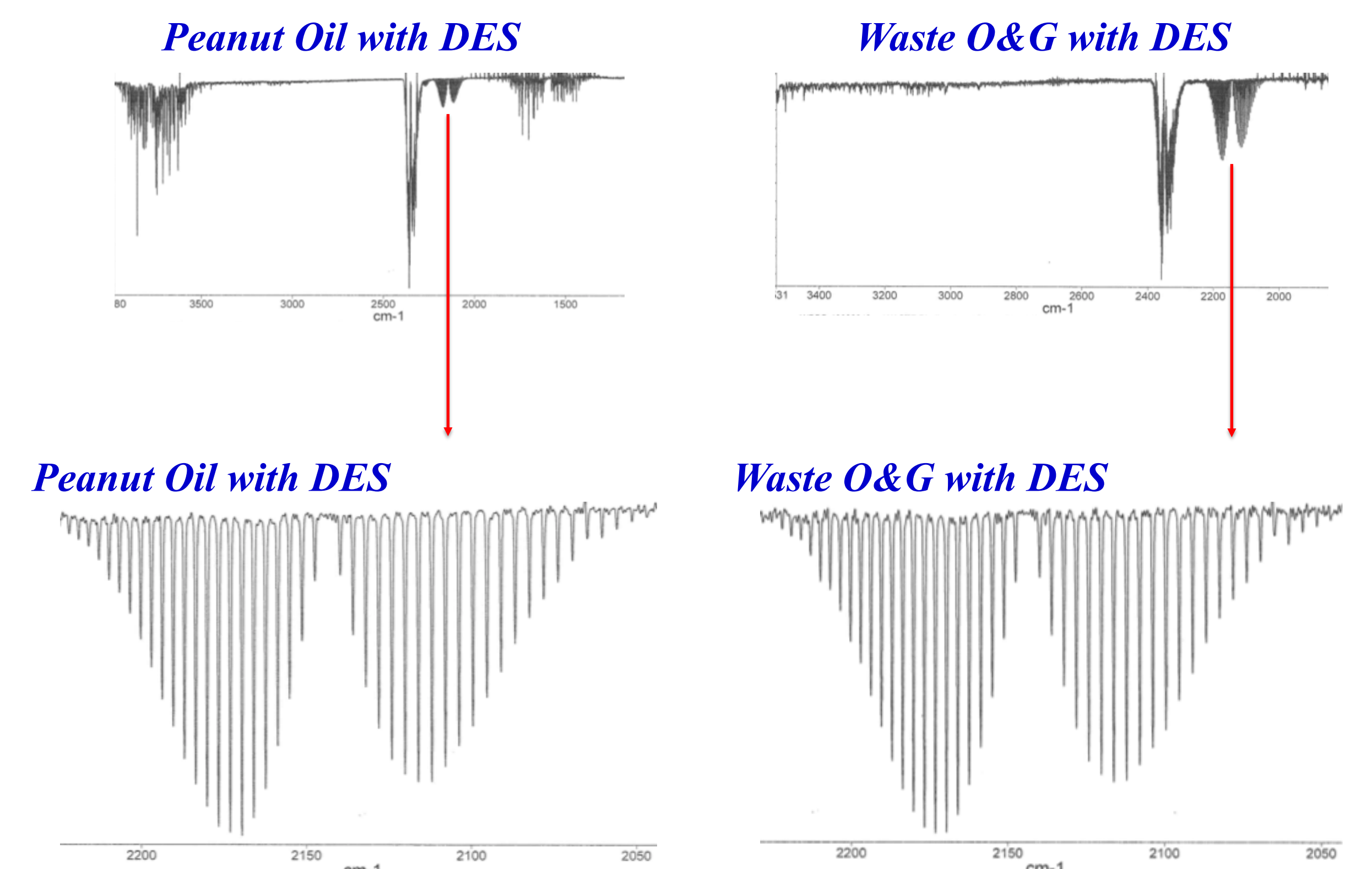
Standards	Viscosity (cSt)	Ref.
U.S BioDiesel	1.9-6.0	ASTM D6751
Peanut Oil Based BioDiesel	4.8	USDA
Ultra Low Sulfur Diesel (ULSD)	1.9-4.1	ASTM D975

## Use as Fuel

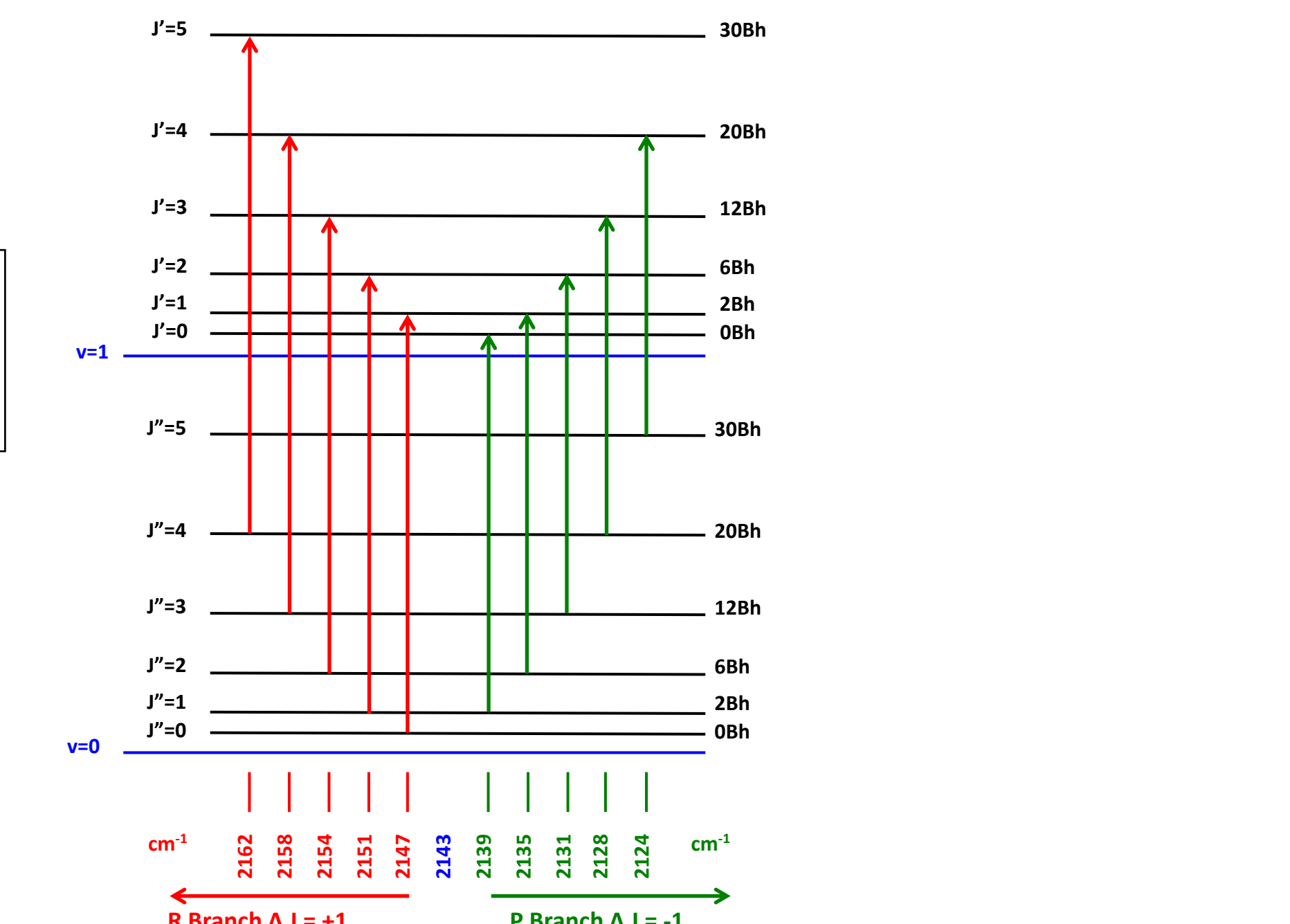
### Exhaust FT-IR without DES



### Exhaust FT-IR with DES



### CO ν₀ to ν₁ Rotational Assignments

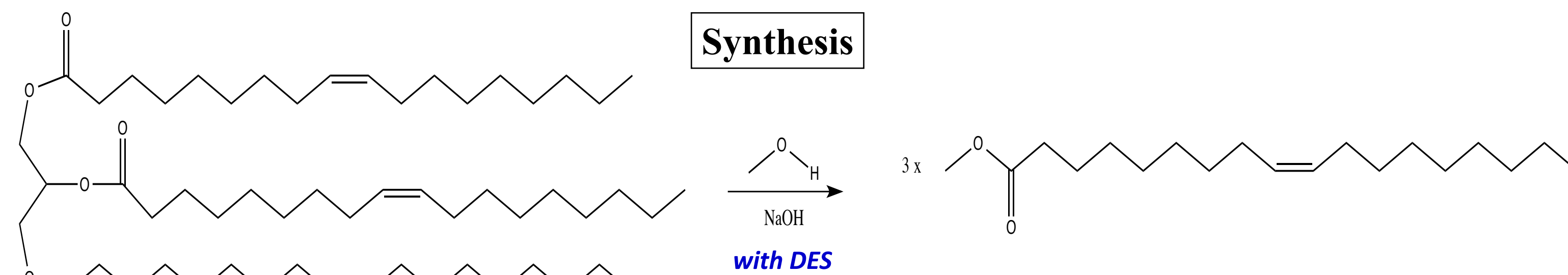


## Conclusions

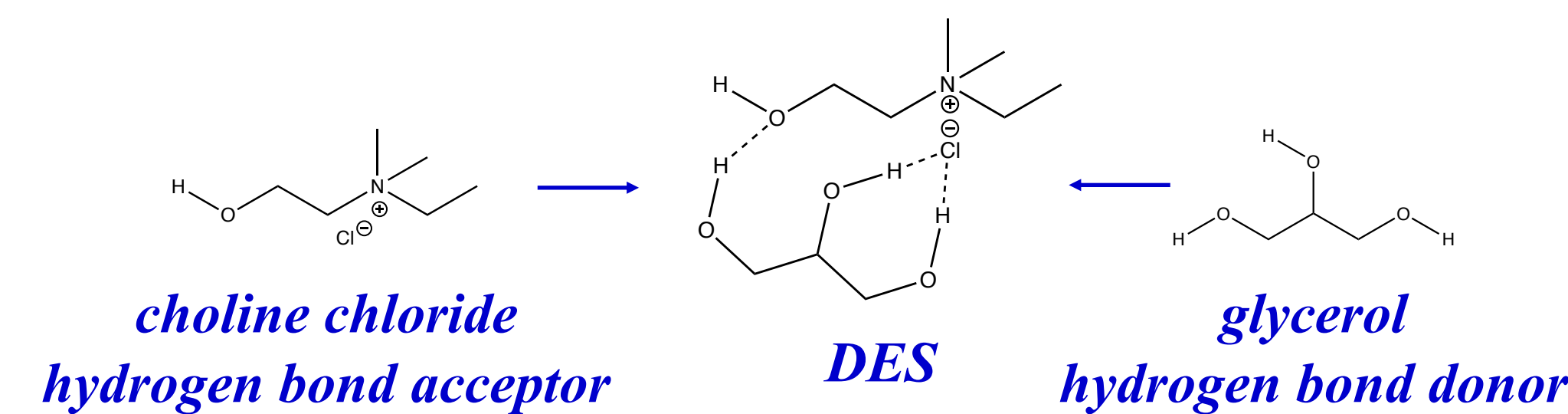
- >> Synthesized biodiesel from waste O&G using a DES
- >> Characterized biodiesel and diesel:biodiesel fuel blends
- >> Powered a diesel generator with the diesel:biodiesel fuel blend
- >> Completed preliminary generator exhaust gas characterization

## Biofuel Production & Characterization

### Synthesis



### Deep Eutectic Solvent (DES)



### FT-IR

