

## 14.7: Physical Properties of Esters

### Learning Objectives

- Compare the boiling points of esters with alcohols of similar molar mass.
- Compare the solubilities of esters in water with the solubilities of comparable alkanes and alcohols in water.

Ester molecules are polar but have no hydrogen atom attached directly to an oxygen atom. They are therefore incapable of engaging in intermolecular hydrogen bonding with one another and thus have considerably lower boiling points than their isomeric carboxylic acids counterparts. Because ester molecules can engage in hydrogen bonding with water molecules, however, esters of low molar mass are somewhat soluble in water. Borderline solubility occurs in those molecules that have three to five carbon atoms. Table 14.7.1 lists the physical properties of some common esters.

Esters are common solvents. Ethyl acetate is used to extract organic solutes from aqueous solutions—for example, to remove caffeine from coffee. It also is used to remove nail polish and paint. Cellulose nitrate is dissolved in ethyl acetate and butyl acetate to form lacquers. The solvent evaporates as the lacquer “dries,” leaving a thin film on the surface. High boiling esters are used as softeners (plasticizers) for brittle plastics.

Table 14.7.1: Physical Properties of Some Esters

Condensed Structural Formula	Name	Molar Mass	Melting Point (°C)	Boiling Point (°C)	Aroma
$\text{HCOOCH}_3$	methyl formate	60	−99	32	
$\text{HCOOCH}_2\text{CH}_3$	ethyl formate	74	−80	54	rum
$\text{CH}_3\text{COOCH}_3$	methyl acetate	74	−98	57	
$\text{CH}_3\text{COOCH}_2\text{CH}_3$	ethyl acetate	88	−84	77	
$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_3$	methyl butyrate	102	−85	102	apple
$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_2\text{CH}_3$	ethyl butyrate	116	−101	121	pineapple
$\text{CH}_3\text{COO}(\text{CH}_2)_4\text{CH}_3$	pentyl acetate	130	−71	148	pear
$\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$	isopentyl acetate	130	−79	142	banana
$\text{CH}_3\text{COOCH}_2\text{C}_6\text{H}_5$	benzyl acetate	150	−51	215	jasmine
$\text{CH}_3\text{CH}_2\text{CH}_2\text{COO}(\text{CH}_2)_4\text{CH}_3$	pentyl butyrate	158	−73	185	apricot
$\text{CH}_3\text{COO}(\text{CH}_2)_7\text{CH}_3$	octyl acetate	172	−39	210	orange

### Summary

Esters have polar bonds but do not engage in hydrogen bonding and are therefore intermediate in boiling points between the nonpolar alkanes and the alcohols, which engage in hydrogen bonding. Ester molecules can engage in hydrogen bonding with water, so esters of low molar mass are therefore somewhat soluble in water.

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