

# Coacervate Formation by Sodium Salicylate with Benzalkonium Chloride

**Keyphrases** □ Coacervate formation—sodium salicylate with benzalkonium chloride, density variations □ Sodium salicylate—coacervate formation with benzalkonium chloride □ Benzalkonium chloride—coacervate formation with sodium salicylate

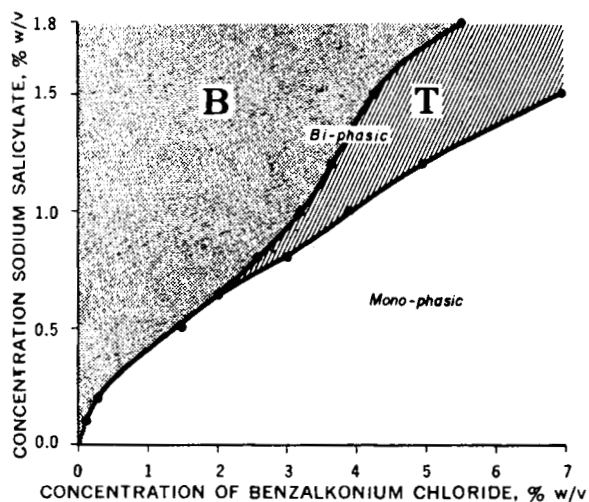
Sir:

Colloidal solutions undergo phase transformations when subjected to changes in temperature, pH, concentration, and other factors. These phase transformations include crystallization, flocculation, and gel formation. One of the least studied of these changes is coacervation. From the definition by Bungenberg de Jong (1) and as used in this report, coacervation is the phenomenon of separation of colloidal aqueous solutions into two or more immiscible aqueous layers. One of the aqueous layers contains most of the colloid and is termed the coacervate, while the second aqueous layer is colloid poor and is termed the equilibrium liquid (2, 3).

These coacervate systems are of growing general scientific (4, 5) and biological (6) interest.

This communication reports the preparation of a new coacervate system. Also reported is a unique phenomenon of this system which occurs with changes in either temperature or composition of the system.

The coacervate system is obtained by mixing various concentrations of sodium salicylate and benzalkonium chloride in water. Figure 1 shows a diagram of this system obtained by plotting mixing concentrations at the points of coacervate formation. This diagram illustrates two main regions: (a) biphasic coacervate system, and (b) monophasic solution. The biphasic coacervate system shows two distinct regions; in one region (B), the coacervate phase has a higher density than the equilibrium liquid and settles to the bottom of the container.



**Figure 1**—Mixing concentrations of sodium salicylate and benzalkonium chloride to give coacervate systems at 24°. Dark area represents the region of coacervate formation and light area represents region of no coacervate formation. Key: B, system with coacervate at the bottom; and T, system with coacervate at the top.

**Table I**—Mixing Concentrations and Relative Coacervate Density versus Temperature

Concentration of Sodium Salicylate, % w/v	Concentration of Benzalkonium Chloride, % w/v	Temperature	Location of Coacervate Phase in System
0.64	2.0	<26°	Bottom
		26–29°	Top
0.80	3.0	<16°	Bottom
		16–19°	Top
1.00	3.9	–2–0°	Bottom
		>0°	Top
1.12	4.0	<19°	Bottom
		19–23°	Top

rium liquid and settles to the bottom of the container. In the second region (T) the coacervate phase is lighter than the equilibrium liquid and floats on the top of the liquid. The transition from the biphasic to the monophasic system by increasing concentrations of benzalkonium chloride was observed to be a sharp one.

Some biphasic systems at the transition line of the diagram were studied for the effect of temperature (Table I). It was observed that it is possible to change the density of a coacervate enough to make it lighter or denser than the equilibrium liquid by changing the temperature of the whole system; *i.e.*, both the equilibrium liquid and the coacervate phase change their relative densities to different degrees when undergoing the same change in temperature.

In Table I, the range in temperature for this change in relative density is reported. A more precise temperature could not be obtained, because the coacervate phase is viscous and also tends to stick to the wall of the container so an excess change in energy (temperature) is required to break it loose and make it begin to move.

The coacervate phase was observed to be isotropic when observed under a polarizing microscope.

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