Besides citrate buffers, other carboxylic acid buffers such as acetate, glycolate, and malate have shown to have negligible to minimal potential for crystallization and hence stable pH during freezing and thawing. Electrical resistance measurements have shown no crystallization for glycolate buffer at pH 5 during freeze/thaw cycles [26]. A DSC study showed that during freeze/thaw of sodium acetate, no crystallization was observed [10] and similar findings were obtained for sodium malate [44].

Like the other carboxylic acid buffers described above, succinate buffer at pH 5 shows minimal pH changes during freezing [35] and no crystallization during freezing for a 0.25 M solution at pH 4–6 [44]. However, crystallization was observed during heating of the frozen succinate buffer [44]. This is consistent with other studies using electrical resistance measurement [26]. The crystallization can be attributed to the propensity of monosodium succinate to crystallize. It has been shown that neither disodium succinate nor succinic acid crystallized during freeze-thaw experiments.

Recent studies using XRD have shown a "pH swing" in freeze-concentrate of a succinate buffer. This finding is attributed to sequential crystallization of succinic acid, monosodium succinate, and disodium succinate [47]. Specifically, the study showed that the pH of a 200 mM succinate solution increased from 4 to 8 during initial freezing from RT to −25 °C and then decreased to pH 2.2 due to sequential crystallization. A pH swing in the opposite direction was observed when succinate solution pH 6 was cooled. In this case, the basic buffer component crystallized first.

Co-solutes can influence the crystallization behavior and consequently pH shifts in frozen buffer solution [41]. Four commonly used co-solutes (glycine, mannitol, sucrose, and trehalose) in lyophilized formulations have been shown to inhibit crystallization of succinate buffer components [45]. Specifically, it was shown that only when the co-solute retained amorphous was it able to inhibit buffer crystallization. However, when the co-solute crystallized (e.g., trehalose) or degraded to yield a crystalline composition (e.g., sucrose), buffer crystallization was observed.

Moreover, even with buffers which do not usually crystallize such as sodium citrate buffer, a co-solute can also have an impact on the apparent acidity and the rate of acid-catalyzed degradation processes. This effect was demonstrated in studies which used sucrose as a model of acid-sensitive compound which was lyophilized using citrate buffer and several different lyoprotectors [12, 29]. Freeze-dried formulations, containing sucrose and co-solute (lactose, polyvinyl pyrrolidone (PVP), and dextran of different molecular weights) at 1:10 weight ratio, were prepared from solutions of the same pH with citrate buffer, and the rate of acid-catalyzed sucrose inversion was determined during storage of the lyophiles. The apparent acidity of the freeze-dried formulations was determined using sulfonephthalein indicators and expressed as the Hammett acidity function (H_{2-}). Significant difference in the H_{2-} was observed between formulations, with dextran-based formulations determined to be the most acidic while PVP formulations were least acidic. Accordingly, the rate of the acid-catalyzed sucrose inversion was fastest in the dextran formulations followed