

NICKEL-SORBITOL-DEXTRIN-CITRIC ACID COMPLEX

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Chelate complexes of nickel with sorbitol; dextrin; sorbitol-dextrin; and -sorbitol-dextrin-citric acid are described. Complex formation with sorbitol alone is not satisfactory and dextrin is an essential component for its stability. With the exception of sorbitol complex others are stable between pH 10 to 4.2.

Key words: Nickel-chelate, Nickel complex, Nickel-sorbitol.

INTRODUCTION

Preparation and characterization of Ni-complex with sorbitol; dextrin; sorbitol-dextrin and -sorbitol-dextrin-citric acid has been reported in this communication. Iron-sorbitol [1a,b] dextrin-citric acid complex, which is used for the treatment of iron-deficiency anaemia, as an intramuscular preparation was described earlier. It was found that the iron-sorbitol complex is not sufficiently stable. On keeping for a few days at room temperature there appears sedimentation of fine dispersed ferric oxide particles and the percentage of iron in the preparation drops considerably. Later on after a few days more, the preparation turned into a gel. The isoelectric point, which is a better measure of stability of these chelates, is also at a higher pH of 6.5 to 7.5. Normally the stable carbohydrate [2,3] iron and nickel complex have isoelectric point of pH 4.5-5.5. However in conjunction with dextrin, and dextrin-citric acid, the complex stabilizes.

Iron cobalt and nickel belong to the first triad of the Periodic Group VIII and the resemblance among them are more pronounced. We attempted to prepare cobalt and nickel complexes following the method used for the preparation of iron-complex. With cobalt, we did not succeed. However, nickel produced a complex with sorbitol, but again it was found to be unstable and the adjunction of dextrin was essential for its stability.

MATERIAL AND METHODS

$\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$ (2.35 g) equivalent to 0.5 g elemental Ni was dissolved in boiled water (20 ml) and sodium hydroxide, 5 % (20 ml) was added to it dropwise with vigorous stirring. The green $\text{Ni}(\text{OH})_2$ obtained was washed with tap and distilled water to free it from electrolytes.

The wet hydroxide was taken into a porcelain dish and a calculated amount of hexitol, dextrin, citric acid and sodium hydroxide were admixed thoroughly with it. The contents were heated at 200° for different periods of time as indicated in the Tables. A dark brown cake was obtained which gave a clear solution when dissolved in water. At low temperature or when the time of heating is shorter, the solution of the final product looks brownish and turbid against reflected light. The solution was centrifuged and nickel in the complex was estimated.

Estimation. The complex (1 ml) was digested with a mixture of H_2SO_4 and nitric acid (1:1) in a Kjeldahl flask till the organic matter was carbonized completely. Nickel sulphate thus obtained was estimated colorimetrically using dimethyl glyoxime [4] at 455 nm.

Stability on boiling. The aqueous solution of the complex containing 0.5 % nickel was boiled for 1 hr at 100° or for 30 min. at 115° . The solution remained clear.

Stability at different pH. The pH of the preparation in aqueous solution was regulated within the range of 1-8 with 0.1 to 1.0 N HCl, in accordance with the method of Nissim [5] and Robson. The Ni concentration in all solution was 1 mg/ml. After keeping the solution for 24 hrs. at room temperature, the precipitate was removed by centrifugation and the Ni content and pH in supernatant was determined. The results from these studies showed that the stable complexes precipitated within a pH range of 4.1-3.9 and there was no precipitation above pH 4.2.

Stability on admixture with saline. To a solution of 0.9 % sodium chloride (100 ml) was added 0.5 % nickel complex (10 ml) and admixed thoroughly and kept for 24 hrs at room temperature. The solution remained clear, showing no sedimentation, coagulation or gel formation.

Stability on admixture with iron sorbitol-dextrin-Citric acid. Iron and nickel-sorbitol-dextrin-citric acid

complexes containing elemental iron and nickel in the ratio of 10:1 were admixed thoroughly and kept for 24 hr at room temperature. The solution remained stable and clear.

Reaction on admixture with egg albumin. Fresh egg albumin was prepared by mixing it with water in the ratio of 1:6 in accordance with the method of Hawk [6]. To this was added Ni SO₄ (0.47 %) and admixed thoroughly. The precipitation of egg albumin started on the addition of 0.3 mg elemental Ni.

The Ni complex was also added in the same manner, but no precipitation was observed even on the addition of upto 3 mg of elemental Ni.

The reaction with saline egg albumin was also the same.

Density and viscosity. The density and viscosity in poises refer to a solution containing 0.5 % elemental Ni, (sample No. 2, Table 2) 1.0629, 0.02558; (sample No. 1, Table 2) 1.0810, 0.02830, (sample No. 4, Table 2) 1.0619, 0.02817; (sample No. 1, Table 3) 1.0665, 0.02295 and (sample No. 1, Table 4) 1.0867, 0.02440.

DISCUSSION

The interaction of Ni with sorbitol alone took place smoothly as has been observed with other carbohydrates in a ratio of Ni 0.5 : sorbitol 15:NaOH 3 and 0.5 : 12 : 3 (Table 1, expt. 1 and 2). The complexes were stable even on boiling, but on keeping for few days turned into gel. Their isoelectric point was pH 10-9.5 and 9.5-9. The measure of stability on long boiling is only a rough indication. The isoelectric point or precipitation point with HCl is a more reliable measure and the lower the pH of precipitation the more stable would be the complex. This is due to the fact that these complexes are alkaline and binding of Ni with sorbitol is more firm if the pH of precipitation is lower towards the acidic side. This type of behaviour was also observed by us in iron - sorbitol [Ib] complex. We also found in the case of iron [2] saccharate that a preparation with precipitation pH of 6.5 - 7.5 showed gel formation on keeping for a few days while that with pH of 4.9 - 5.2 remained stable for years. In the case of iron-saccharate the stability, however, can be varied by changing time of heating, temperature or proportion of the ingredients, but in the case of sorbitol, the pH of precipitation could not be lowered. Various ratios, change of temperature and time were tried without success. In conjunction with dextrin and citric acid, however the pH of precipitation dropped to 4.1-3.9 (Table 4, expt. 1 and 2). The incorporation of dextrin is essential

Table 1. Ni-sorbitol complex.

Ext. No.	Ratios of Ni:Sorbitol: NaOH	pH of the complex	Stability on long boiling	Metal in complex	Isoelectric point
1.	0.5:15:3	12.6	Stable	90.0	10-9.5
2.	0.5:12:3	12.3	Stable	90.0	9.5-9
3.	0.5:10:3	12.2	Stable	63.0	8.5-8
4.	0.5: 8:3	10.8	Stable	25.38	8.5-8

Note. Best temp. : 200^o; Time : 3.45 hr.

Table 2. Ni-Dextrin complex.

Ext. No.	Ratios of Ni-Dextrin: NaOH	pH of the complex	Stability on long boiling	Metal in the complex	Isoelectric point
1.	0.5:15:3	9.65	Stable	89.0	3.8-3.2
2.	0.5:12:3	9.95	Stable	82.0	4.6-4

Note. Best temp. . 200^o Time 3.20 hr.

Table 3. Ni-Sorbitol-Dextrin-complex.

Expt. No.	Ratios of Ni:Sorbitol: Dextrin:NaOH	pH of the complex	Stability on long boiling	Metal in the complex	Isoelectric point
1.	0.5:10:10:3	10.4	Stable	94.0	4.2-4.6
2.	0.5:10:8:3	10.6	Stable	91.0	5.5-4.7

Note: Best temp. : 200^o Time: 3.75 hr.

Table 4. Ni-Sorbitol-Dextrin-Citric acid complex.

Expt. No.	Ratios of Ni:Sorbitol: Dextrin: Citric acid: NaOH	pH of the complex	Stability on long boiling	Metal in the complex	Isoelectric point
1.	0.5:10:8:3:3	9.7	Stable	98.0	4.1-3.9
2.	0.5:10:6:3:3	9.9	Stable	95.6	4.1-3.9

Note: Best temp. : 200^o Time. 2.45 hr.

for the stability of the complex, since sorbitol alone does not form a stable complex.

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