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ZINC-SORBITOL, DEXTRIN AND CITRIC ACID COMPLEX

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A preparation containing a complex of zinc, sorbitol, dextrin and citric acid is described. Complex formation with sorbitol alone is not satisfactory and dextrin is an essential component for its stability. The preparation is stable between pH 6 to 8.

Key words: Zinc-sorbitol, Zinc-hexitol chelate and chelate of zinc.

INTRODUCTION

Zinc is an essential trace element and is widely distributed in various tissues and organs of the human body. It acts as an activator of the enzymes, carbonic anhydrase, aminopeptidase, dipeptidases and alcohol dehydrogenases. Insulin contains 0.3 to 0.69 % of the metal.

Severe zinc deficiency [1] in male and female weanling rats resulted in extreme retardation of growth, abnormal growth hair and dermal lesions. Growth retardation was also observed in zinc deficient pigs [2]. In zinc deficiency [3] the rats had a decreased calcium balance.

Zinc along with cobalt, copper, and manganese helps the metabolization of iron. A number of multimineral iron preparations are available in the market where zinc is incorporated in the form of its salts such as the sulphate. The complexes of zinc having non-ionic nature, on the other hand, are comparatively superior, since these are least irritable. Keeping in view this consideration we report the preparation and characterization of zinc complexes with sorbitol, dextrin and citric acid in this paper.

Method and characterization of the preparation. To an aqueous M solution of zinc chloride (15.3 ml) an equivalent to I g elemental zinc and N sodium hydroxide (17.5 ml) was added dropwise with vigorous stirring to get a fine precipitate of zinc hydroxide. The precipitate was washed with distilled water by decantation to get rid of the electrolytes. The wet zinc hydroxide was taken in a porcelain dish, required quantity of sorbitol, dextrin sodium hydroxide and citric acid was mixed thoroughly. The contents were heated at different temperatures for the periods indicated in the Tables. A dark brown cake was obtained which gave clear solution when dissolved in water. The solution was centrifuged, analysed and made up to contain 0.5 % elemental zinc. Different ratios were tried to get the ideal complex, but only successful results have been reported in the Tables. At low temperatures or when the time of heating is shorter, the solution of the final product looks brownish and turbid against reflected light. About 10% zinc was transformed into oxide, and thus the complete utilization of zinc hydroxide in the formation of complex has never been observed.

Estimation. The complex (1 ml) was carbonized in a Kjeldahl flask with concentrated nitric and sulphuric acids, transforming it into zinc sulphate. Zinc was then estimated colorimetrically by means of 0.001% dithiazone in carbon tetrachloride at 525 nm.

Stability on boiling. An aqueous solution of the complex was boiled in a sealed ampoule at 100° for 1 hr. or at 115° for 30 min. The unstable preparation formed a gel, while the stable preparation remained clear.

Stability at different pH. The stability of the complex at different pH was tested in accordance with the method of Nissim and Robson [7]. The complex precipitated with in the pH range of 5.5-42 and there was no precipitation between pH 8-6.

Stability on admixture with saline and iron saccharate. The zinc complex remained stable on admixture with saline and with iron saccharate in a ratio of 1:10.

Reaction on admixture with egg albumin. Fresh egg albumin mixed with water in a ratio of 1:6 started precipitating on admixture with 0.1 mg of elemental zinc in the form of $ZnCl_2$ (6.42%) while no precipitation took place on the addition of up to 10 mg elemental zinc in the form of a Zn complex.

Density and viscosity. The density and viscosity of the aqueous solution containing 0.5% zinc of the best sample (No. 1, Table 3) were 1.1802, 12.6749 millipoise at 19°

DISCUSSION

Zinc chloride is dissolved in boiled water for the preparation of zinc hydroxide and washed quickly with distilled water to free it from electrolytes. Complex formation does not take place if freshly prepared zinc hydroxide is not used. Zinc also forms a complex with sorbitol alone in a ratio of zinc 1, sorbitol 18 and NaOH 1.8 (Table 1) but

Table 1. Zinc sorbitol complex

Expt. No.	Ratio of Zn: sorbitol	Ratio of Zn: NaOH	Temperature (^oC)	Time (hr)	Metal in the complex	Stability on long boiling	Final pH before boiling	Iso-electric point
				Sorbitol variable				
1.	1 : 10	1 : 1.8	200	0.45	–	Unstable	–	–
2.	1 : 17	1 : 1.8	200	0.45	85%	Stable	9.9	5.5-4.2
3.	1 : 18	1 : 1.8	200	0.45	85%	Stable	9.8	5.5-4.2
				Alkali variable				
4.	1 : 18	1 : 2.0	200	0.45	80%	Stable	9.8	5.35-4.1
5.	1 : 18	1 : 2.4	200	0.45	72%	Stable	9.9	5.35-4.1
				Temperature variable				
6.	1 : 18	1 : 1.8	160	0.45	No formation			
7.	1 : 18	1 : 1.8	165	0.45	No formation			
				Time variable				
8.	1 : 18	1 : 1.8	200	0.15	No formation			
9.	1 : 18	1 : 1.8	200	1.30	Overheated			

Table 2. Zinc dextrin complex

Expt. No.	Ratio of Zn: dextrin	Ratio of Zn: NaOH	Temperature (^oC)	Time (hr)	Metal in the complex	Stability on long boiling	Final pH before boiling	Iso-electric point
				Dextrin Variable				
1.	1 : 12	1 : 2.85	200	0.45	–	Unstable	–	–
2.	1 : 16	1 : 2.85	200	0.45	70%	Stable	9.5	5.8-5.0
3.	1 : 20	1 : 2.85	200	0.45	78%	Stable	9.4	4.85-4.2
4.	1 : 24	1 : 2.85	200	0.45	80%	Stable	8.6	4.6-3.9
				Alkali variable				
5.	1 : 20	1 : 3.6	200	0.45	78%	Stable	9.9	5.5-4.2
6.	1 : 20	1 : 3.0	200	0.45	80%	Stable	9.8	5.5-4.2
7.	1 : 20	1 : 2.4	200	0.45	80%	Stable	9.4	5.5-4.2

Table 3. Zinc sorbitol dextrin and citric acid complex

Expt. No.	Ratio of Zn: S:D:C*	Ratio of Zn:NaOH	Tempera-ture (°C)	Time (hr)	Metal in the complex	Stability on long boiling	Final pH before boiling	Iso-elec-tric point
1.	1:18:10:3.5	1:2.85	200	0.45	85%	Stable	9.2	5.1-2.6
2.	1:18:10:4.0	1:2.85	200	0.45	85%	Stable	8.0	5.1-2.6
3.	1:18:10:5.0	1:3.4	200	0.45	89%	Stable	7.0	3.5-2.6

*S = Sorbitol; D = Dextrin; C = Citric acid.

Table 4. Zinc sucrose complex

Expt. No.	Ratio of Zn: sucrose	Ratio of Zn:NaOH	Tempera-ture (°C)	Time (hr)	Metal in the complex	Stability on long boiling	Final pH before boiling	Iso-elec-tric point
				Sucrose variable				
1.	1 : 15	1 : 2.85	200	0.45	88.8%	Stable	8.2	4.0-3.6
2.	1 : 14	1 : 2.85	200	0.45	88.5%	Stable	9.0	4.0-3.8
				Temp. variable				
3.	1 : 15	1 : 2.85	170	0.45	–	No formation	–	
4.	1 : 15	1 : 2.85	165	0.45	–	No formation	–	
				Time variable				
5.	1 : 15	1 : 2.85	200	0.15	–	No formation	–	
6.	1 : 15	1 : 2.85	200	1.30	–	Over Heated		

on keeping for 2-3 weeks, its zinc content dropped to 62% due to sedimentation. In conjunction with dextrin and citric acid the complex remained stable and the zinc concentration did not change. This phenomenon was also observed in the case of iron [9]. The interaction of iron with sorbitol took place smoothly with sorbitol as has been observed with other carbohydrates. The complex did not show gel formation or any other indication of instability even on long boiling but deteriorated on storage. In other carbohydrate complexes [10] it was observed that their stability can be varied by changing the time of heating, temperature or the proportion of the ingredients. In the case of zinc sorbitol complex, however, this technique did not work. Various ratios, change in temperature and time were tried without success.

In conjunction with dextrin and citric acid in ratio of Zn 1, sorbitol 18, dextrin 10, citric acid 5 and NaOH 3.4 (Table 3), the pH of the final product is 7 and the isoelectric point 3.5-2.6, while in the ratio of Zn 1, sorbitol 18, dextrin 10, citric acid 3.5 and NaOH 2.85 the pH is 9.2 and isoelectric point 5.1-2.6. Both the ratios are giving excellent results. The isoelectric point or the pH at which precipitation takes place is a more reliable measure of stability and the lower is the pH of precipitation the more stable would be the complex. This is due to the fact that these complexes are alkaline and the binding of zinc with sorbitol is more firm if the pH of the precipitation is lower towards the acidic side. Zinc forms a complex with dextrin alone as well, in a ratio of Zn 1, dextrin, 24, NaOH 2.85.

An intramuscular preparation of iron-sorbitol, dextrin and citric acid is very popular. Iron forms a stable complex with dextrin alone, but this preparation is not used for intramuscular use, since it is painful [10]. Dextrin is essential for the stability of the sorbitol complex.

Tests with egg albumin substantiate the findings that metal ions interact with proteins while non-ionic complexes do not. Zinc chloride in concentrations of 0.1-0.2 mg precipitated the egg albumin while the zinc complex up to 2 mg did not have any effect.

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