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Separation of some Water-soluble Vitamins by Thin Layer Chromatography using Heulandite as an Adsorbent

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Separation of some water-soluble vitamins is done by thin layer chromatography on heulandite, a natural zeolite (45 μ), as an absorbent. The separation was affected within the distance of 5 cm by ascending tlc technique at optimised conditions using dimethyl formamide. The heulandite does not require a binder and was found to be a good adsorbent, comparable and sometimes better than silica gel G.

Heulandite is a hydrated aluminosilicate of calcium ($Ca_2Al_4Si_{1\,8}O_{3\,2}.11H_2O$, completely hydrated). It is a framework of aluminosilicate based on infinitely extending three-dimensional network of Al_4, SiO_4 tetrahydra linked to each other by sharing of all the oxygens. The framework contains channels and interconnected voids which are occupied by the cations and water molecules. The cations are mobile and may usually be exchanged and the intercrystalline zeolite water is removed continuously and regularly.

Heulandite has high resolution capacity and generally needs lesser distance of migration for resolution of compounds. These zeolites do not need binder for preparation of chromatoplates. The spots are generally sharp. Quick separation in shorter time was also observed in many cases using this heulandite as an adsorbent It was used earlier as an adsorbent for separation of many textile dyes[1], direct dyes[2], carbohydrates and catechol amines[3].

Results and Discussion

R_f values for different water-soluble vitamins on heulandite, silica gel G and H and for their quaternary mixtures are given in Tables 1 and 2 respectively. It is possible to separate many binary and ternary combinations.

TABLE 1—R_f VALUES FOR VITAMINS IN DIFFERENT ADSORBENTS

Compd.	Heulandite	Silica gel G	Silica gel H
Folic acid	0.00	0.00	0.00
Biotin	0 00	0 00	0.00
Pantothenic acid	0.65	0 57t	T
Pyridoxine	0.81	0 80	0.86
Thiamine	0.81	T	0.70
Nicotinamide	0.83	0.72	T
Ascorbic acid	0.88	0.98	0.90
Riboflavin	0.98	0.96	0.98

t=small tailing. T=big tailing from the spotting point.

The migratory behaviour of biotin is due to small molecule, which might have retained in channels present in the framework of heulandite, i.e. molecular sieving, and folic acid is due to the presence of COOH group which can interact with calcium present in the heulandite and form complex, hence the zero R_f value. Whereas migration and different R_f values of riboflavin, ascorbic acid, nicotinamide, thiamine, pyridoxine and pantothenic acid may be due to partition of a solute-sorbent interaction.

TABLE 2—R_f VALUES FOR VITAMIN MIXTURES IN DIFFERENT ADSORBENTS

Sl. no.	Mixture of vitamins	Heulandite	Silica gel G	Silica gel H
1.	Riboflavin+	0.98	NS	NS
	nicotinamide+	0.83		
	pantothenic acid+	0.65		
	biotin	0.00		
2.	Riboflavin+	0.98	NS	NS
	nicotinamide+	0.83		
	pantothenic acid+	0.65		
	folic acid	0.00		
3.	Riboflavin+	0.98	NS	NS
	thiamine+	0.80		
	pantothenic acid+	0.65		
	biotin	0.00		
4.	Riboflavin+	0.98	NS	NS
	thiamine+	0.80		
	pantothenic acid+	0.65		
	folic acid	0.00		

NS=No separation.

It is a known fact that no substance can act as a universal adsorbent. Heulandite shows many good points and suggests for its consideration as a good tlc sorbent for the following reasons. (1) The solute mixtures are successfully resolved on heulandite layers. It suggests that heulandite is an ideal adsorbent and has less capacity than silica gel or other sorbents to hold the resolvable quantities of solute mixtures resolved. This capacity is even much more due to presence of

large internal surface area in heulandite which is not available with silica gel and many adsorbents. (ii) Heulandite is neither acidic nor basic in nature. It holds the property of a good adsorbent also in the way that it is not found soluble in any of the solvents used except strong acid, which gelatinise it. (iii) Heulandite has high resolution capacity and generally needs lesser distance of migration in comparison to that on silica gel. (iv) It gives quick separations in lesser distance of migration (about 4—5 cm), thus consuming lesser quantity of adsorbent material and solvents.

Experimental

Heulandite sample was characterised as explained elsewhere[4]. Heulandite powder (45 μ size) was mixed with water in 1 : 2 ratio (w/v) without any binder. The layers were prepared by pouring method. Each plate (7.5×2.5 cm) was coated with aqueous slurry (~1 ml) having the layer thickness of about 0.01 cm.

The spot solution (3.0—3.5 μg sample) of vitamins and their different combinations were spotted on the chromatoplates. The chromatoplates were developed by ascending technique upto a distance of 4—5 cm within 3 min using solvent dimethyl formamide, then dried and cooled. The plates were kept in iodine chamber to develop colour. Thiamine appeared as dark brown and rest as yellow spots.

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