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Notes

Influence of container on vitamin A stability in TPN admixtures

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Summary

Losses of vitamin A from a paediatric TPN lipid emulsion stored at 30°C under ward lighting and from an aqueous glucose/amino acid solution stored at 2–8°C in the dark were determined when different containers were used. Vitamin A assay was performed by reverse-phase HPLC. In the first instance, a PVC bag and a Buretrol showed little difference in $t_{90\%}$ (20 days and > 21 days, respectively). In the second case, $t_{90\%}$ in both a PVC bag and a glass container was ≃ 12 days. Hence, the material of the container has little effect on vitamin A stability in these two admixtures.

Substantial losses of vitamin A from parenteral nutrition (TPN) admixtures because of adherence to PVC bags (Moorhatch and Chiou, 1974), I.V. chambers and tubing, and glass (Hartline and Zachman, 1976) have been reported. Studies performed by Howard et al. (1980) showed that 30% of vitamin A lost from TPN solutions was due to sorption onto a PVC bag. Contrary to these findings, Allwood (1982) and Dahl et al. (1986) reported no adherence of vitamin A palmitate to PVC.

Vitamin A for TPN use is commonly added to PVC bags, Buretrol® units or glass containers. All of the above containers may ad- or absorb vitamin A which would decrease availability to the patient.

The purpose of this study was to determine the extent of vitamin A losses in these different containers. In an infant regimen vitamin A lost from admixtures stored in a PVC bag was compared with admixtures stored in a Buretrol® I.V. chamber. In an adult regimen a comparison was made between vitamin A lost from admixtures stored in a PVC bag and in a glass bottle.

Vitamin A is the most labile fat-soluble vitamin (Allwood, 1982; Gillis et al., 1983). Hence, it can be used as a marker to indicate stability for all fat-soluble vitamins.

Vitamin A stability was determined in two admixture systems (see Table 1).

The experimental conditions are listed in Table 2.

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TABLE 1

Composition of Admixtures 1 and 2

Preparation	Quantity (ml)	
	1 Paediatric lipid	2 Adult aqueous
Intralipid® 10%	300	–
Vamin® glucose	–	1000
Glucose 50%	–	1000
Soluvit® [a]	7.5	–
Vitalipid® Infant	15	–
Pancebrin®	–	10
Addamel®	–	10
Total volume	315	2020
Vitamin A (μg/ml)	4.762	7.426

[a] Soluvit® was reconstituted with Intralipid® 10%.

High-performance liquid chromatography (HPLC) analysis was performed on samples taken after 0, 24, 48 and 72 h and at weekly intervals for 3 weeks. Sampling was carried out with a hypodermic needle attached to a 10 ml plastic syringe. Samples were protected from exposure to daylight at all times.

Vitamin A palmitate content was analysed by reverse-phase HPLC, based on a method described by Herslöf and Dahl (1982). Each experiment was performed three times and all determinations were performed in triplicate, so that nine values were obtained at each time interval. Results were averaged and expressed as a percentage of the quantity at time zero. The log concentration of vitamin A was plotted against time.

TABLE 2

Time period for loss of vitamin A from Admixtures 1 and 2

Admixture	Storage conditions	Container	$t_{90\%}$ (days)
1 (Expt A)	30 °C, ward lighting	PVC bag	20
		Buretrol® I.V. chamber	> 21
2 (Expt B)	2–8 °C, protected from light	PVC bag	12.2
		Glass bottle	12.8

The raw data (nine observations at each time interval) were analysed using a Statgraphics software package.

The Student's *t*-test statistic was applied to the data to determine the significance of the difference between the means of vitamin A losses in the different containers.

Pharmaceutical significance of the vitamin A loss was calculated as previously described (Bluhm et al., 1991), with a 10% loss being the cut-off point for acceptability.

The results of Expt A showed that in the Buretrol® there was no detectable loss of vitamin A after 3 weeks ($100.9 \pm 3.63\%$). Loss of vitamin A from a PVC bag was also low (less than 10% after 3 weeks), but it was statistically significantly greater than in the Buretrol® after only 24 h.

It could not be established whether or not the losses followed a first-order process and $t_{90\%}$ was read from the graph. The results are presented in Table 2.

Although the difference between losses in the two containers is statistically significant it is apparent that neither PVC bags nor Buretrol® units ad- or absorbed pharmaceutically significant quantities of vitamin A palmitate from the paediatric lipid emulsion. These results support the findings of Allwood (1982) and Dahl et al. (1986) who reported no adherence of vitamin A palmitate to PVC.

The results of experiment B showed that over a storage period of 21 days vitamin A stability in Admixture 2 was generally better in glass than in a PVC bag, with statistically significant differences at 24 h, 72 h and 3 weeks.

Vitamin A losses did not comply with requirements for a first-order process and $t_{90\%}$ was read from the graph. Vitamin A losses in both admixtures were pharmaceutically significant after 12 days (see Table 2).

When Admixture 1 (paediatric lipid emulsion) was stored in a Buretrol® at ward light and a temperature of 30°C no loss of vitamin A was detected after 3 weeks. In a PVC bag $t_{90\%}$ was 20 days. Therefore, it is pharmaceutically acceptable to add fat-soluble vitamins to a lipid TPN emulsion stored in PVC bags or Buretrol® units for 20 days.

Vitamin A in Admixture 2 (aqueous glucose/amino acid) stored at 2–8°C and protected from light was more stable in a glass container than in a PVC bag over a storage period of 21 days. Both containers offered pharmaceutical acceptability over 12 days. Hence, fat-soluble vitamins can be added to aqueous TPN admixtures stored in these containers for this period.

Although there are differences in the amount of vitamin A lost from the above TPN admixtures in glass, PVC and Buretrol® containers, they have little practical importance under the proper conditions of storage and use.

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