Serum Vitamin A Elevation in DDT Exposed Volunteers

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Introduction

Work by Phillips and others (1,2) spanning the period of 1963-1965 indicates that DDT ingestion may diminish liver stores of vitamin A in experimental animals. More recently Phillips, et al. (3) presented evidence that normal diatary levels of DDT and resulting burdens do not contribute to the incidence of low vitamin A stores in Canadians. This paper will report results of an investigation of DDT and vitamin A sera levels in forty-two volunteers in coastal South Carolina.

Methods

Twenty-one volunteers intensively and occupationally exposed to DDT and a spectrum of other pesticides, were matched by age, (±3 years), race and sex with an equal number of control subjects. The experimental group consisted of agricultural chemical formulators most of whom had been exposed daily to DDT for periods of five to 17 years. Controls were selected from non-pesticide chemical industries who reported no known pesticide exposure. Fasting blood samples obtained by venipuncture were drawn in heparinized and plain vacutainers. Plasma from the heparinized specimens was triple hexane extracted following the Dale-Cueto procedure and analyzed for pesticides by gas-liquid chromatography using a Nickel electron capture detector.

Blood obtained for vitamin A was immediately wrapped in aluminum foil to prevent photodegradation,

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kept at room temperature approximately 30 minutes to allow for clot retraction, and centrifuged. Sera thus obtained was also wrapped in aluminum foil, and frozen until assayed for vitamin A by a commercial laboratory using Natebon's Procedure (2nd Edition of Micro-Techniques of Clinical Chemistry. Charles C. Thomas, publisher, 1961).

Volunteers taking synthetic vitamins were excluded from the study.

Results and Discussion

As shown in Table 1, pesticide exposed participants had significantly higher serum vitamin A, and plasma DDT, DDD, and DDE levels than their matched controls. Both exposed and control groups' vitamin A levels remained within normal ranges.

TABLE 1

Vitamin A,DDT,DDD, and DDE Comparisons of 21 Matched[1] Pairs of Pesticide Exposed and Control Volunteers

	Mean Blood Levels Exposed	Control	Comparison
Vitamin A (I.U.)[2]-Serum	225	141	p<.02*
DDT ppb, Plasma	21	3	p<.001***
DDD ppb, Plasma	4	1	p<.02*
DDE ppb, Plasma	13	4	p<.01*

[1]Matched by age, race, sex
[2]Vitamin A normal range 50-300 I.U.

Table 2 presents a significant positive linear correlation of vitamin A with DDT, and its principal metabolites DDD and DDE. Coefficients of determination (r^2) were 13% for DDT, 17% for DDD, and 37% for DDE.

TABLE 2

Vitamin A Correlation[1] with DDT,DDD,and DDE

Correlate	Corr.Coeff.(r)	Coeff. of Determination (r^2)	Signi-ficance
pp'DDT	.3715	.1380	p<.02
pp'DDD	.4178	.1746	p<.01
pp'DDE	.6094	.3714	p<.001

[1]Forty-two observations sets from twenty-one pairs of exposed and control volunteers matched by age, race, and sex.

Associations between DDT and its metabolites and vitamin A may be spurious if DDT is considered only as an indicator chemical of general pesticide exposure. Indeed, most workers exposed to organophosphate, carbamate, and the organchochlorine spectrum of pesticides are also exposed to DDT. It must likewise be considered that both DDT as well as DDD and DDE and vitamin A are lipid soluble compounds. Other studies by Sandifer and Keil (4) have demonstrated a positive, significant correlation between DDT, cholesterol and total lipids in a human study. These associations may be a natural consequence of lipid occurence.

While previous papers (1,2,3) have indicated the possible diminution of liver vitamin A with DDT, one study (1) has inferred the raising of serum levels concomitant with decreased liver stores. Only serial sampling of sera coupled with liver biopsy or autopsy may demonstrate such a thesis. These are unlike events and one can only speculate at this point that some event, possibly chemically mediated, may mobilize vitamin A reserves from liver to circulating blood or delay absorption of it.

Conclusion

Twenty-one pesticide-exposed participants had significantly higher serum vitamin A and plasma DDT, DDD and DDE levels than their age, race, and sex matched controls. There was also a significant positive correlation of vitamin A with DDT and its principal metabolites, which may be a natural biological event since both compounds are lipid soluble.

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References

1. PHILLIPS, W.E.J., Can. J. Biochem. and Phys. 41,1793(1963).
2. PHILLIPS, W.E.J. and HIDIROGLOU, M., J. Agr. Food Chem. 13,254(1965).
3. PHILLIPS, W.E.J., RITCEY, W.R., MURRAY, T.K. AND HOPPNER, K., Bull.Envir. Contam. and Toxicol. 6,17(1971).
4. SANDIFER, S.H. and KEIL, J.E., Trace Substances in Environmental Health - V, (1971) Univ. of Missouri, Columbia,Mo.