Biochem. Biophys. Res. Commun. **43**, 516 (1971).
10. A. Tixier-Vidal, N. Brunet, D. Gourdji, in *Progress in Prolactin Physiology and Pathology*, C. Robyn and M. Harter, Eds. (Elsevier, Amsterdam, 1978), pp. 29–43.
11. R. E. McCaman, D. G. McKenna, J. K. Ono, *Brain Res.* **136**, 141 (1977).
12. S. B. Kater, in *Approaches to the Cell Biology of Neurones*, W. M. Conan and J. A. Ferrendelli, Eds. (Society for Neuroscience, Bethesda, Md., 1976), pp. 195–212.
13. Surprisingly, this effect was more marked and was observed in 50 percent of the total population when TRH (50×10^{-6} to $125 \times 10^{-6} M$) had been added to the medium 4 to 6 hours before. At present, we are unable to explain the fact that TRH apparently enhances the sensitivity of GH_3 cells to the action of 17β-E.
14. A. H. Tashjian, M. E. Lomedico, D. Maina, *Biochem. Biophys. Res. Commun.* **81**, 798 (1978).
15. W. W. Douglas, *Biochem. Soc. Symp.* **39**, 1 (1974).
16. D. H. York, F. L. Baker, K. Kraicer, *Neuroendocrinology* **11**, 212 (1973).
17. R. J. Pietras and C. M. Sezgo, *Nature (London)* **265**, 69 (1977).
18. ———, *Endocrinology* **97**, 1445 (1975).
19. A. Morin, A. Tixier-Vidal, D. Gourdji, *Mol. Cell. Endocrinol.* **3**, 351 (1975).
20. P. S. Dannies and A. H. Tashjian, *Nature (London)* **261**, 707 (1976).
21. Supported by grants from INSERM (U. 176 and CRL-78-1 2656), University of Bordeaux II, and CNRS (ERA 493 and E.R. 89). We thank J. L. Barker for his helpful comments on the manuscript and J. B. Seal for editorial advice.

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DNA Polymerase with Characteristics of Reverse Transcriptase Purified from Human Milk

Abstract. *A DNA polymerase purified from a particulate fraction of human milk has biochemical and biophysical properties similar to those of viral reverse transcriptases. This enzyme is immunologically distinct from cellular DNA polymerases obtained from a variety of human sources.*

A number of studies (*1, 2*) have shown that some human milk samples contain an RNA-dependent DNA nucleotidyl transferase activity (reverse transcriptase). This enzyme has been isolated from a variety of human tissues and malignant cells (*3*). However, purified reverse transcriptase has been immunologically characterized only three times: from human leukemic cells (*4*), preleukemic spleen (*5*), and breast cancer cells (*6*). The leukemic and preleukemic enzymes were immunologically related to the reverse transcriptase of the gibbon ape leukemia virus and the simian sarcoma virus (*4, 5*). The DNA polymerase isolated from human breast cancer was immunologically related to the reverse transcriptase of the Mason Pfizer monkey virus (*6*).

We report here the purification of a DNA polymerase from high-density particles obtained from human milk. This enzyme resembles the reverse transcriptase of RNA tumor viruses in its primer template specificities and cation requirement. The purified enzyme was devoid of terminal transferase activity and was not immunologically related to human DNA polymerase α, β, or γ.

High-density particles ($\rho > 1.20$) were obtained from defatted human milk (*2, 7–9*) and the DNA polymerase activity was purified from these particles by sequential chromatography on DEAE-52 cellulose (*8*) and polyribocytidylic acid agarose [poly(C) agarose]. Figure 1, A and B, shows elution profiles of the human milk DNA polymerase from DEAE-52 cellulose and from poly(C) agarose. The enzyme eluted as a single peak of activity from the poly(C) agarose column at a concentration of 0.22*M* KCl.

The molecular weight of the DNA polymerase was determined by three methods: (i) SDS-polyacrylamide gel electrophoresis, (ii) Sephadex G-200 chromatography, and (iii) velocity sedimentation analysis. Electrophoresis was performed on 10 percent polyacrylamide gels in the presence of 0.1 percent SDS (*10*). Molecular weights of the separated polypeptides were determined by using phosphorylase A (94,000), bovine serum albumin (68,000), and ovalbumin (43,000) as molecular weight markers. The poly(C) agarose peak material, with a 200-fold purification over the high-density particles, contained a major polypeptide band corresponding to a molecular weight of 70,000. Molecular sieving of the material by Sephadex G-200 in the presence of 0.5*M* KCl also indicated that the human milk DNA polymerase had a molecular weight of 70,000 (Fig. 1C). The DNA polymerase was sedimented through a linear glycerol gradient (10 to 30 percent by volume) and the enzyme-active fractions were located by assaying with the primer template $(dG)_{12-18} \cdot (C)_n$. The enzyme activity sedimented between 5*S* and 5.5*S*, slightly faster than the bovine serum albumin marker (data not shown).

Cellular DNA polymerases can be distinguished from one another and from viral reverse transcriptases by their synthetic primer-template specificities (*11*). In general, the viral reverse transcriptases show a preference for $(dT)_{12-18} \cdot (A)_n$ and not $(dT)_{12-18} \cdot (dA)_n$ (*12*). They will also use $(dG)_{12-18} \cdot (C)_n$ and $(dG)_{12-18} \cdot (Cm)_n$ (*13*) as templates for the synthesis of poly(dG). The cellular DNA polymerase, specifically polymerase γ, will inefficiently transcribe $(dG)_{12-18} \cdot (C)_n$ at low salt concentrations, that is, 0.05*M* KPO_4 or no added KCl (*13, 14*), and will not utilize poly(2′-*O*-methylcytidylate) · oligodeoxyguanylate for the synthesis of poly(dG) (*14*).

The response of the human milk DNA polymerase to synthetic primer templates appears in Table 1. The enzyme can synthesize poly(dT) in the presence of $(dT)_{12-18} \cdot (A)_n$ and Mg^{2+} (10 m*M*). It will also utilize the templates $(dG)_{12-18} \cdot (C)_n$ and $(dG)_{12-18} \cdot (Cm)_n$

Table 1. Enzymatic activity of the human milk DNA polymerase with various synthetic polynucleotides being used as templates. Assay mixtures containing 10 μl of enzyme were initiated by adding 40 μl of a mixture that gave a final concentration of 50 m*M* tris-HCl (*p*H 8.0); 60 m*M* KCl; 1 m*M* DTT; either 10 m*M* $MgCl_2$ or 0.5 m*M* $MnCl_2$, 7.6 μM [^{3}H]TTP (2000 to 4000 counts per minute per picomole) or 7.6 μM [^{3}H]dGTP (2000 to 4000 counts per minute per picomole); and bovine serum albumin (0.5 mg/ml). All reactions were performed at 37°C for 30 minutes. Acid-insoluble precipitates were collected on filters and the radioactivity was counted by means of a liquid scintillation counting system.

Template	[^{3}H]dNTP	Divalent cation	[^{3}H]dNMP, polymerized (pmole)
$(A)_n \cdot (dT)_{12-18}$	TTP	Mn^{2+}	0.16
$(A)_n \cdot (dT)_{12-18}$	TTP	Mg^{2+}	0.70
$(dA)_n \cdot (dT)_{12-18}$	TTP	Mn^{2+}	0.10
$(dA)_n \cdot (dT)_{12-18}$	TTP	Mg^{2+}	0.08
$(C)_n \cdot (dG)_{12-18}$	dGTP	Mn^{2+}	0.05
$(C)_n \cdot (dG)_{12-18}$	dGTP	Mg^{2+}	0.50
$(Cm)_n \cdot (dG)_{12-18}$	dGTP	Mn^{2+}	0.25
$(Cm)_n \cdot (dG)_{12-18}$	dGTP	Mg^{2+}	0.50
	Primer alone		
$(dT)_{12-18}$	TTP	Mg^{2+*}	< 0.01
$(dT)_{12-18}$	dGTP	Mg^{2+*}	< 0.01
$(dG)_{12-18}$	TTP	Mg^{2+*}	< 0.01
$(dG)_{12-18}$	dGTP	Mg^{2+*}	< 0.01

*Same results with Mn^{2+}

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when synthesizing poly(dG). Primer alone with either Mg^{2+} or Mn^{2+} gives no detectable activity. This pattern of primer template utilization by the human milk DNA polymerase excludes the possibility that it is terminal deoxynucleotidyl transferase.

The utilization of $(dG)_{12-18} \cdot (Cm)_n$ in the presence of Mg^{2+} makes it highly unlikely that this enzyme represents the cellular polymerases found in human milk. The results show a pattern of activities that are consistent with those obtained with reverse transcriptases from animal viruses (*13*).

An antibody was prepared in a rabbit against the purified DNA polymerase from human milk, and the IgG fraction was obtained (*15*). One to two micrograms of the immune IgG inhibited the DNA polymerase 70 percent but did not inhibit polymerase α, β, or γ from human milk (Fig. 2A). A number of enzyme neutralization studies were carried out with

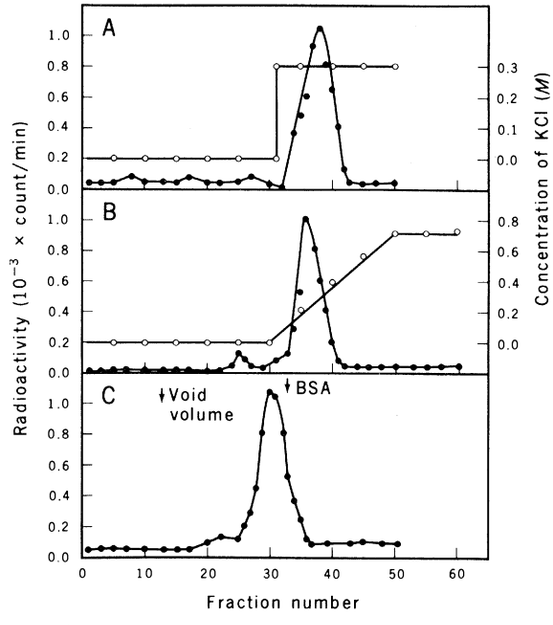

Fig. 1. Chromatographic elution profiles of human milk DNA polymerase from (A) DEAE-cellulose column, (B) a poly(C) agarose column, and (C) a Sephadex G-200 column. (A) DEAE-cellulose chromatography of milk polymerase. The desalted material obtained by centrifugation through Sephadex G-25 was applied to a 10-ml column of DEAE-cellulose (DE-52) equilibrated with buffer A [10 m*M* tris-HCl (*p*H 7.5), 20 percent glycerol, 0.2 percent N-P_{40}, and 2 m*M* DTT]. After the sample was applied, the column was washed with 30 ml of buffer A and the DNA polymerase activity was batch-eluted with buffer A to which 0.3 *M* KCl had been added. Portions (10 μl) of each fraction from the DEAE-52 column and similar portions of fractions from subsequent column purification steps were assayed for polymerase activity with $(dG)_{12-18} \cdot (C)_n$ as described in the legend of Table 1. (B) Poly(C) agarose chromatography of milk DNA polymerase. The peak fractions from the DEAE-cellulose column were pooled, desalted by centrifugation through Sephadex G-25, and applied to a 3-ml poly(C) agarose column equilibrated in buffer A. The column was washed with 10 ml of buffer A and the DNA polymerase activity was eluted with a 15-ml linear gradient of 0 to 0.8*M* KCl in buffer A. The peak enzyme activity was eluted at 0.22*M* KCl. The fractions containing the main peak of DNA polymerase activity were pooled and ovalbumin was added to 200 μg/ml. This material was kept at 4°C and was used as the starting material for characterization studies. (C) Sephadex G-200 chromatography of the milk DNA polymerase. The enzyme-active fractions from the poly(C) agarose column were pooled and applied to a 20-ml Sephadex G-200 column equilibrated in buffer A containing 0.5*M* KCl. The column had been standardized with ovalbumin (43,000), bovine serum albumin (68,000), and phosphorylase A (93,000). Fractions (250 μl) were collected and 10-μl portions were assayed for DNA polymerase activity with $(dT)_{12-18} \cdot (A)_n$ as described in Table 1. The milk DNA polymerase eluted two to three fractions before bovine serum albumin indicating an apparent molecular weight of 70,000.

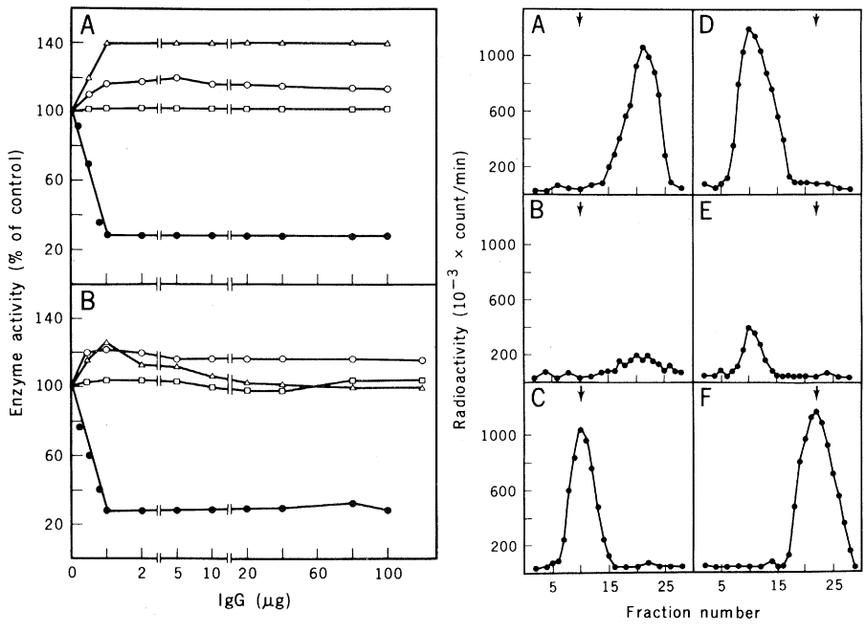

Fig. 2. Comparative inhibition of the human milk reverse transcriptase and polymerase α, β, and γ by IgG directed against the human milk reverse transcriptase. The data show antibody neutralization studies of partially purified human milk DNA polymerases with antibody (IgG fraction) to human milk reverse transcriptase. Enzyme activity in the presence of immune IgG is expressed as a percentage of the activity in the presence of an identical amount of control IgG. (A) Titration of human milk DNA polymerase with antibody (IgG) to human milk reverse transcriptase. Symbols: ○, polymerase α (assayed with nicked calf thymus DNA); □, polymerase β [(dA) · (dT) was the primer template employed]; △, polymerase γ [assayed with $(dT)_{12-18} \cdot (A)_n$]; and ●, reverse transcriptase [assayed with $(C)_n \cdot d(G)_{12-18}$]. Polymerase α, β, and γ were prepared from human milk by ion exchange chromatography according to the method described by Lewis *et al.* (*18*). (B) Titration of DNA polymerases from other human sources against antibody (IgG) to human milk reverse transcriptase. Symbols: ○, polymerase α from NC-37 cells; △, polymerase γ from NC-37 cells; □, polymerase γ from HeLa cells; and ●, reverse transcriptase from human milk. Fig. 3. Antigen-antibody complex formation analyzed by velocity sedimentation. Immune or control IgG (100 μg) was incubated with an appropriate amount of DNA polymerase at 37°C for 2 minutes, applied to a 10 to 30 percent linear glycerol gradient, and centrifuged at 40,000 rev/min at 4°C for 12 hours in an SW 50.1 rotor. Fractions were collected and assayed with conditions being maximized for the polymerase being tested. A shift or change in the sedimentation profile indicated a positive antigen-antibody complex formation. (A) Normal goat (100 μg) and NC-37 polymerase γ. (B) Antibody (IgG fraction; 100 μg) to polymerase γ and NC-37 polymerase γ. (C) Antibody (IgG fraction; 100 μg) to polymerase γ and human milk reverse transcriptase. The arrows indicate the position the human milk reverse transcriptase sediments with 100 μg of normal goat IgG. (D to F) Velocity sedimentation analyses of rabbit antibody (IgG) to human milk reverse transcriptase, normal rabbit IgG with human milk reverse transcriptase, and NC-37 cell polymerase γ. (D) Normal rabbit IgG (100 μg) and human milk reverse transcriptase. (E) Immune IgG (100μg) and human milk reverse transcriptase. (F) Immune IgG (100 μg) and NC-37 cell polymerase γ. The arrows indicate the position of the peak tube of NC-37 cell polymerase γ with normal rabbit IgG.

purified polymerases α and γ from other human sources. Neither DNA polymerase α from human lymphoid cells nor DNA polymerase γ from NC-37 cells or from HeLa cells was inhibited by the antibody (IgG) to human milk DNA polymerase (Fig. 2B). An antibody binding to polymerase γ (IgG fraction) was obtained, which bound to the enzyme to form an antigen-antibody complex but did not neutralize enzyme activity (*16*). Binding was assayed with the antibody (IgG) to polymerase γ and the human milk DNA polymerase (see Fig. 3). Complex formation was determined by velocity sedimentation through linear glycerol gradients. The fractions were assayed for DNA polymerase activity and the shape and position of the curve was compared to control gradients. The DNA polymerase from human milk did not bind to the antibody to polymerase γ (Fig. 3C). The γ polymerases from HeLa cells and NC-37 cells did not bind to the antibody to human milk DNA polymerase (Fig. 3F), indicating that this last polymerase is not immunologically related to polymerase α, β, or γ from human sources.

The human milk DNA polymerase was compared immunologically to the reverse transcriptases of some RNA viruses. Enzyme neutralization studies with the antibody (IgG fraction) to human milk polymerase against simian sarcoma virus, the baboon endogenous virus, and RD-114 were all negative. Enzyme neutralization and binding studies with antibody to the Mason Pfizer reverse transcriptase were also carried out, but consistent results could not be obtained.

Our results show that the DNA polymerase isolated from high-density particles of human milk is immunologically distinct from polymerase α, β, or γ. The milk DNA polymerase has no terminal transferase activity, as indicated by its inability to incorporate either ^{3}H-labeled deoxyguanosine monophosphate or ^{3}H-labeled thymidine monophosphate when oligo(dG) or oligo(dT) is used as primer. The biochemical and biophysical properties of the DNA polymerase isolated from human milk suggest that it may be related to viral-type reverse transcriptase.

In previous studies on human milk reverse transcriptase it has been concluded that the particle-associated enzyme in human milk is a reflection of the presence of a reverse transcriptase containing RNA virus (*1*, *2*). We believe that the assignment of a viral origin to the reverse transcriptase in human milk cannot be fully established on the basis of existing studies. Most reverse transcriptases that have been studied to date have been associated with known RNA viruses, but three recent reports (*17*) raise the possibility of the existence of nonviral or "cellular reverse transcriptases." The distinction between an endogenous type C or type B reverse transcriptase and a "cellular reverse transcriptase" may ultimately prove to be a semantic one.

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References and Notes

1. J. Schlom, S. Spiegelman, D. H. Moore, *Science* **175**, 542 (1972); A. S. Dion, A. B. Vaidya, G. S. Fout, *Cancer Res.* **34**, 3509 (1974); B. I. Gerwin, P. S. Ebert, H. C. Chopra, S. G. Smith, J. P. Kvedar, *Science* **180**, 198 (1973); W. F. Feller and J. Kantor, *Fundamental Research on Mammary Tumors* (Editions INSERM, Paris, 1972), pp. 279–286.
2. S. P. Feldman, J. Schlom, S. Spiegelman, *Proc. Natl. Acad. Sci. U.S.A.* **70**, 1976 (1973).
3. R. C. Gallo, S. S. Yang, R. C. Ting, *Nature (London)* **228**, 927 (1970); M. G. Sarngadharan, P. S. Sarin, M. S. Reitz, R. C. Gallo, *Nature (London) New Biol.* **240**, 67 (1972); W. Baxt, R. Hehlmann, S. Spiegelman, *ibid.*, p. 240; B. I. Gerwin and R. H. Bassin, *Proc. Natl. Acad. Sci. U.S.A.* **72**, 4133 (1975); P. Chandra, L. K. Steel, H. Laube, B. Kornhuber, *FEBS Lett.* **58**, 71 (1975); G. F. Gerard, P. M. Loewenstein, M. Green, *Fed. Proc. Fed. Am. Soc. Exp. Biol.* **35**, 1592 (Abstr. 1189) (1976); T. Ohno, R. W. Sweet, R. Hu, D. Dejak, S. Spiegelman, *Proc. Natl. Acad. Sci. U.S.A.* **74**, 764 (1977).
4. R. E. Gallagher, G. J. Todaro, R. G. Smith, D. M. Livingston, R. C. Gallo, *Proc. Natl. Acad. Sci. U.S.A.* **71**, 1309 (1974).
5. L. K. Steel, H. Laube, P. Chandra, *Cancer Lett.* **2**, 291 (1977).
6. T. Ohno and S. Spiegelman, *Proc. Natl. Acad. Sci. U.S.A.* **74**, 2144 (1977).
7. Samples (N = 10 to 20) of human milk were pooled (1 to 2 liters), defatted with 0.1*M* EDTA (*p*H 8.3) (*1*, *2*), and centrifuged at 2500*g* for 10 minutes at 4°C. The skim milk was filtered through two layers of cheesecloth, mixed with glycerol to a final concentration of 20 percent, and centrifuged at 48,000 rev/min for 90 minutes at 4°C in a Beckman Ti-14 batch rotor. The fluid was aspirated and the outer wall of the rotor was scraped with a spatula and washed with 3 to 6 ml of 0.01*M* tris-HCl (*p*H 8.0) (milk concentrate). Particles with a density (ρ) greater than 1.2 g/cm^3 were prepared according to a modification of the method described by Feldman and Schlom (*2*). One milliliter of 1*M* DTT (*8*) was mixed with 1 ml of polyvinyl sulfate (1 mg/ml) and kept at 4°C; 3 ml of the milk concentrate was then added to the tube followed by 100 μl of phospholipase C (Sigma Chemical type 1; 10 mg/ml in 1 percent bovine serum albumin). The solution was incubated for 2 minutes at 37°C and then for 20 minutes at 25°C. The solution was then placed in an ice bath, 3 ml of cold anhydrous ether was added, and after being mixed gently the resulting emulsion was centrifuged at 1500*g* for 10 minutes at 4°C. The lower aqueous phase was removed, and the ether was removed from the solution by blowing a gentle stream of filtered air over the surface for 5 to 10 minutes. The resulting solution was layered over a discontinuous metrazamide gradient (*9*) (Gallard-Schlesinger) consisting of 1.5 ml of 25 percent metrazamide (ρ = 1.18), 1.0 ml of 18 percent metrazamide (ρ = 1.10) in TNE [10 m*M* tris-HCl (*p*H 8.0), 150 m*M* NaCl, and 2 m*M* EDTA] and centrifuged for 90 minutes at 48,000 rev/min at 4°C in a Spinco SW 50.1 rotor. The high-density particles were resuspended in 0.01*M* tris-HCl (*p*H 8.0) containing 1 percent N-P_{40} (Shell Oil) and 0.5*M* KCl and were gently stirred for 1 hour at 4°C. The sample was desalted by centrifugation through 30 ml of coarse Sephadex G-25.
8. The abbreviations used in this report are as follows: DEAE, diethylaminoethyl; $(dG)_{12-18}$ $(Cm)_n$, hybrid of poly(2′-*O*-methylcytidylate and deoxyguanylate that is 12 to 18 nucleotides long; SDS, sodium dodecyl sulfate; IgG, immunoglobin G; RD-114, endogenous type C virus of domestic cats; EDTA, ethylenediaminetetraacetate; tris, hydroxymethylaminomethane; DTT, dithiothreitol; N-P_{40}, Nonidet P-40; TTP, thymidine triphosphate; dGTP, deoxyguanosine triphosphate; dNTP, deoxynucleoside triphosphate; and dNMP, deoxynucleoside monophosphate.
9. T. Sanner, *Cancer Res.* **36**, 405 (1976).
10. U. K. Laemmli, *Nature (London)* **337**, 680 (1970).
11. G. Smith and R. C. Gallo, *Proc. Natl. Acad. Sci. U.S.A.* **69**, 2879 (1974).
12. S. Spiegelman, A. Burny, M. R. Das, J. Keydar, J. Schlom, M. Travnicek, K. Watson, *Nature (London)* **228**, 430 (1970).
13. M. G. Sarngadharan, P. S. Sarin, M. S. Reitz, R. C. Gallo, *Nature (London) New Biol.* **240**, 67 (1972); G. F. Gerard, *Biochem. Biophys. Res. Commun.* **63**, 706 (1975).
14. K. W. Knopf, M. Yamada, A. Weissbach, *Biochemistry* **15**, 4540 (1976).
15. The immune IgG was prepared as follows. A solution containing 200 μg of human milk DNA polymerase obtained from the poly(C) agarose column was divided into eight portions of 1 ml each. For the first two immunizations, a portion of the DNA polymerase (25 μg) was emulsified with an equal volume of complete Freund's adjuvant and injected into six subcutaneous sites on the back of a New Zealand rabbit. Subsequent immunizations were made at weekly intervals and were similarly performed except that incomplete adjuvant was used. A total of eight immunizations were performed and the animal was bled from the ear vein at the end of the 8th week. Samples (50 ml) of blood were taken, the serum was recovered, and the IgG fraction was purified by precipitation with 50 percent $(NH_4)_2SO_4$ and by DEAE-52 cellulose chromatography. The purified IgG fractions were free of ribonuclease and deoxyribonuclease activity. Normal (nonimmune) IgG was similarly purified from serum obtained from the same rabbit prior to immunization. The IgG fractions were dialyzed against 0.01*M* tris-HCl (*p*H 8.0) and stored at −70°C. The protein concentration of IgG was determined by optical absorption at 280 nm, with an assured extinction coefficient for a 1 percent solution and 1-cm path length of 14.2 [J. R. Little and H. Donahue, *Methods Immunol. Immunochem.* **2**, 343 (1969)]. For antibody neutralization assays, a constant amount of DNA polymerase was added to the assay system optimized for the particular enzyme. The enzyme (10 to 30 μl) was mixed with varying amounts of immune and nonimmune IgG in a volume of 80 μl which contained 50 m*M* tris-HCl (*p*H 8.0), 2 m*M* DTT, 100 μg of purified BSA, and the specific cation and salt concentration optimal for the DNA polymerase being assayed. The total protein concentration was kept constant by adding BSA equal to that of the highest concentration of IgG. The mixture of the particular enzyme with the IgG was incubated for 3 hours at 4°C. At the end of this time, the template (20 μg/ml) and radioactive dNTP were added (2000 to 4000 counts per minute per picomole) in a total volume of 20 μl and the reaction mixture was incubated at 37°C for 60 minutes. Reaction mixtures were terminated by the addition of 1 ml of cold 10 percent trichloroacetic acid in 2 percent sodium pyrophosphate. Acid-insoluble precipitates were collected on glass fiber filters (Whatman GF/C) and radioactivity was measured in a liquid scintillation counting system.
16. M. Robert-Guroff and R. C. Gallo, *Biochemistry* **16**, 2874 (1977).
17. R. J. Mayer, R. G. Smith, R. C. Gallo, *Science* **185**, 864 (1974); D. L. Livingston, L. E. Serxner, D. J. Howk, J. Hudson, G. J. Todaro, *Proc. Natl. Acad. Sci. U.S.A.* **71**, 57 (1974); G. Bauer and P. H. Hofschneider, *ibid.* **73**, 3025 (1976).
18. B. J. Lewis, J. W. Abrell, R. G. Smith, R. C. Gallo, *Biochim. Biophys. Acta* **349**, 148 (1974).
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