

PROGRESS IN

Nucleic Acid Research and Molecular Biology

Volume 26

DNA: Multiprotein Interactions

edited by

WALDO E. COHN

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*Biology Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee*

1981



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Preface

As the Preface to Volume 1 (1963) indicated, this serial publication was conceived by its two original editors (the late J. H. Davidson and the undersigned) as "a continuing periodical assessment or reassessment of those areas of knowledge in the field of nucleic acids [and, a bit later, in the field of molecular biology] that have arisen or advanced notably since the publication in 1960 of the last of the three volumes of *The Nucleic Acids: Chemistry and Biology*, edited by Chargaff and Davidson." The preponderant interest in chemistry, including enzymology, at that time is shown by the fact that all but one of the eleven articles in Volume 1 dealt with the properties of nucleic acids or with the enzymes that form them. While this basic interest in the chemistry of nucleic acids and of their precursors and analogues has been retained in the 25 volumes that have since appeared, the growth of interest in the functioning and involvement of nucleic acids in biological phenomena—such as genetics, virology, and immunology—has led to an increase in contributions in those areas. The general thrust has been to explain the phenomena in terms of chemical mechanisms, these in turn stemming from the chemical properties of the nucleic acids themselves.

Whatever nucleic acids do in replication or specification of protein (translation) is done in conjunction with proteins, whether the presumably structural proteins of the ribosomes, or the polymerases or ligases or "factors" involved in transcription or translation, and we find many papers in these volumes dealing with protein-nucleic acid interactions. One aspect of the involvement of complexes of nucleic acids and proteins was explored intensively at a recent symposium entitled "DNA-Multiprotein Interactions in Transcription, Replication, and Repair," which was divided into the following sessions: Replicative DNA Polymerase and Its Complex; Mechanisms of Transcription; Chromatin Transcription and Replication; Control of Transcription in Eukaryotes; Mechanisms of DNA Repair; and Functions Induced by Damaged DNA. Those selected by the organizers to present papers were among those research leaders whom we would have been pleased to invite to present extended papers in their respective fields, so it was arranged to present the proceedings in this special, separate volume. Its form, therefore, differs somewhat from that of the typical volume, which would contain a small number of longer contributions on diverse subjects, but if each section is viewed as a multiauthored survey of its particular

area, the difference is not as great as a cursory inspection of the Table of Contents might suggest.

Comments and suggestions from readers are desired. As stated in an earlier Preface, "We seek to provide a forum for discussion and we welcome suggestions as to how this end may best be served."

WALDO E. COHN

Abbreviations and Symbols

All contributors to this Series are asked to use the terminology (abbreviations and symbols) recommended by the IUPAC-IUB Commission on Biochemical Nomenclature (CBN) and approved by IUPAC and IUB, and the Editor endeavors to assure conformity. These Recommendations have been published in many journals (1, 2) and compendia (3) in four languages and are available in reprint form from the Office of Biochemical Nomenclature (OBN), as stated in each publication, and are therefore considered to be generally known. Those used in nucleic acid work, originally set out in section 5 of the first Recommendations (1) and subsequently revised and expanded (2, 3), are given in condensed form (I-V) below for the convenience of the reader. Authors may use them without definition, when necessary.

I. Bases, Nucleosides, Mononucleotides

1. *Bases* (in tables, figures, equations, or chromatograms) are symbolized by Ade, Gua, Hyp, Xan, Cyt, Thy, Oro, Ura; Pur = any purine, Pyr = any pyrimidine, Base = any base. The prefixes S-, H₂-, F-, Br-, Me-, etc., may be used for modifications of these.

2. *Ribonucleosides* (in tables, figures, equations, or chromatograms) are symbolized, in the same order, by Ado, Guo, Ino, Xao, Cyd, Thd, Ord, Urd (Ψrd), Puo, Pyd, Nuc. Modifications may be expressed as indicated in (1) above. Sugar residues may be specified by the prefixes r (optional), d (=deoxyribo), a, x, l, etc., to these, or by two three-letter symbols, as in Ara-Cyt (for aCyd) or dRib-Ade (for dAdo).

3. *Mono-, di-, and triphosphates of nucleosides* (5') are designated by NMP, NDP, NTP. The N (for "nucleoside") may be replaced by any one of the nucleoside symbols given in II-1 below. 2', 3', and 5' are used as prefixes when necessary. The prefix d signifies "deoxy." [Alternatively, nucleotides may be expressed by attaching P to the symbols in (2) above. Thus: P-Ado = AMP; Ado-P = 3'-AMP] cNMP = cyclic 3':5'-NMP; Bt₄cAMP = dibutyl cAMP, etc.

II. Oligonucleotides and Polynucleotides

1. Ribonucleoside Residues

(a) Common: A, G, I, X, C, T, O, U, Ψ, R, Y, N (in the order of I-2 above).

(b) Base-modified: sI or M for thioinosine = 6-mercaptapurine ribonucleoside; sU or S for thiouridine; brU or B for 5-bromouridine; hU or D for 5,6-dihydrouridine; i for isopentenyl; f for formyl. Other modifications are similarly indicated by appropriate *lower-case* prefixes (in contrast to I-1 above) (2, 3).

(c) Sugar-modified: prefixes are d, a, x, or l as in I-2 above; alternatively, by *italics* or boldface type (with definition) unless the entire chain is specified by an appropriate prefix. The 2'-O-methyl group is indicated by *suffix* m (e.g., -Am- for 2'-O-methyladenosine, but -mA- for 6-methyladenosine).

(d) Locants and multipliers, when necessary, are indicated by superscripts and subscripts, respectively, e.g., -m₂A- = 6-dimethyladenosine; -s⁴U- or -⁴S- = 4-thiouridine; -ac⁴Cm- = 2'-O-methyl-4-acetylcytidine.

(e) When space is limited, as in two-dimensional arrays or in aligning homologous sequences, the prefixes may be placed *over the capital letter*, the suffixes *over the phosphodiester symbol*.

2. Phosphoric Residues [left side = 5', right side = 3' (or 2')]

(a) Terminal: p; e.g., pppN... is a polynucleotide with a 5'-triphosphate at one end; Ap is adenosine 3'-phosphate; C > p is cytidine 2':3'-cyclic phosphate (1, 2, 3); p < A is adenosine 3':5'-cyclic phosphate.

(b) Internal: hyphen (for known sequence), comma (for unknown sequence); unknown sequences are enclosed in parentheses. E.g., pA-G-A-C(C₂,A,U)A-U-G-C > p is a sequence with a (5') phosphate at one end, a 2':3'-cyclic phosphate at the other, and a tetranucleotide of unknown sequence in the middle. (Only codon triplets should be written without some punctuation separating the residues.)

3. Polarity, or Direction of Chain

The symbol for the phosphodiester group (whether hyphen or comma or parentheses, as in 2b) represents a 3'-5' link (i.e., a 5'...3' chain) unless otherwise indicated by appropriate numbers. "Reverse polarity" (a chain proceeding from a 3' terminus at left to a 5' terminus at right) may be shown by numerals or by right-to-left arrows. Polarity in any direction, as in a two-dimensional array, may be shown by appropriate rotation of the (capital) letters so that 5' is at left, 3' at right when the letter is viewed right-side-up.

4. Synthetic Polymers

The complete name or the appropriate group of symbols (see II-1 above) of the repeating unit, enclosed in parentheses if complex or a symbol, is either (a) preceded by "poly," or (b) followed by a subscript "n" or appropriate number. No space follows "poly" (2, 5).

The conventions of II-2b are used to specify known or unknown (random) sequence, e.g.,

polyadenylate = poly(A) or A_n, a simple homopolymer;

poly(3 adenylate, 2 cytidylate) = poly(A₃C₂) or (A₃,C₂)_n, an irregular copolymer of A and C in 3:2 proportions;

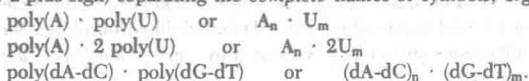
poly(deoxyadenylate-deoxythymidylate) = poly[d(A-T)] or poly(dA-dT) or (dA-dT)_n or d(A-T)_n, an alternating copolymer of dA and dT;

poly(adenylate,guanylate,cytidylate,uridylate) = poly(A,G,C,U) or (A,G,C,U)_n, a random assortment of A, G, C, and U residues, proportions unspecified.

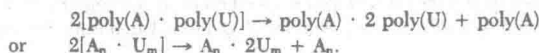
The prefix copoly or oligo may replace poly, if desired. The subscript "n" may be replaced by numerals indicating actual size, e.g., A_n·dT₁₂₋₁₈.

III. Association of Polynucleotide Chains

1. *Associated* (e.g., H-bonded) chains, or bases within chains, are indicated by a center dot (not a hyphen or a plus sign) separating the complete names or symbols, e.g.:



2. *Nonassociated* chains are separated by the plus sign, e.g.:



3. Unspecified or unknown association is expressed by a comma (again meaning "unknown") between the completely specified chains.

Note: In all cases, each chain is completely specified in one or the other of the two systems described in II-4 above.

IV. Natural Nucleic Acids

RNA	ribonucleic acid or ribonucleate
DNA	deoxyribonucleic acid or deoxyribonucleate
mRNA; rRNA; nRNA	messenger RNA; ribosomal RNA; nuclear RNA
hnRNA	heterogeneous nuclear RNA
D-RNA; cRNA	"DNA-like" RNA; complementary RNA

mtDNA	mitochondrial DNA
tRNA	transfer (or acceptor or amino-acid-accepting) RNA; replaces sRNA, which is not to be used for any purpose
aminoacyl-tRNA	"charged" tRNA (i.e., tRNA's carrying aminoacyl residues); may be abbreviated to AA-tRNA
alanine tRNA or tRNA ^{Ala} , etc.	tRNA normally capable of accepting alanine, to form alanyl-tRNA, etc.
alanyl-tRNA or alanyl-tRNA ^{Ala}	The same, with alanyl residue covalently attached. [Note: fMet = formylmethionyl; hence tRNA ^{fMet} , identical with tRNA ^{Met}]

Isoacceptors are indicated by appropriate subscripts, i.e., tRNA₁^{Ala}, tRNA₂^{Ala}, etc.

V. Miscellaneous Abbreviations

P _i , PP _i	inorganic orthophosphate, pyrophosphate
RNase, DNase	ribonuclease, deoxyribonuclease
<i>t_m</i> (not <i>T_m</i>)	melting temperature (°C)

Others listed in Table II of Reference 1 may also be used without definition. No others, with or without definition, are used unless, in the opinion of the editor, they increase the ease of reading.

Enzymes

In naming enzymes, the 1978 recommendations of the IUB Commission on Biochemical Nomenclature (4) are followed as far as possible. At first mention, each enzyme is described either by its systematic name or by the equation for the reaction catalyzed or by the recommended trivial name, followed by its EC number in parentheses. Thereafter, a trivial name may be used. Enzyme names are not to be abbreviated except when the substrate has an approved abbreviation (e.g., ATPase, but not LDH, is acceptable).

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5. "Nomenclature of Synthetic Polypeptides," *JBC* 247, 323 (1972); *Biopolymers* 11, 321 (1972); and elsewhere.†

Abbreviations of Journal Titles

Journals	Abbreviations used
Annu. Rev. Biochem.	ARB
Arch. Biochem. Biophys.	ABB
Biochem. Biophys. Res. Commun.	BBRC

*Contractions for names of journals follow.

†Reprints of all CBN Recommendations are available from the Office of Biochemical Nomenclature (W. E. Cohn, Director), Biology Division, Oak Ridge National Laboratory, Box Y, Oak Ridge, Tennessee 37830, USA.

Biochemistry	Bchem
Biochem. J.	BJ
Biochim. Biophys. Acta	BBA
Cold Spring Harbor Symp. Quant. Biol.	CSHSQB
Eur. J. Biochem.	EJB
Fed. Proc.	FP
Hoppe-Seyler's Z. physiol. Chem.	ZpChem
J. Amer. Chem. Soc.	JACS
J. Bacteriol.	J. Bact.
J. Biol. Chem.	JBC
J. Chem. Soc.	JCS
J. Mol. Biol.	JMB
Nature, New Biology	Nature NB
Nucleic Acid Research	NARes
Proc. Nat. Acad. Sci. U.S.	PNAS
Proc. Soc. Exp. Biol. Med.	PSEBM
Progr. Nucl. Acid Res. Mol. Biol.	This Series

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