A comprehensive list of chemically synthesized genes

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Received May 24, 1988; Accepted July 12, 1988

ABSTRACT

A databank for chemically synthesized genes has been compiled.

INTRODUCTION

The first paper on the chemical synthesis of a gene was published by H.G. Khorana and his co-workers in 1970 (1), but altogether not more than 40 reports on the subject have appeared until 1981. Recent years on the one hand have seen a dramatic improvement on the chemical methods of gene synthesis, and apparatus for mechanized gene synthesis have been made commercially available. On the other hand the increased rate at which biological proteins are isolated and at which their structure is elucidated, together with the development of protein engineering and protein design, have greatly increased the demand for synthetic genes and furthered their application. As a result the entries on synthetic genes have multiplied by a factor of approximately 12 in only six years between 1982 and 1987.

Being aware of the fact that for researchers as well as for industrialists it will become more difficult to keep track of the rapidly increasing reports on synthetic genes, we have started to compile a data bank which contains references and structural informations of all chemically synthesized genes and their modifications, as far as their preparation has been disclosed to the public.

The present list (updated until May 1st, 1988) is the result of extensive search done partially on-line and partially manually. Our compilation is based on search in journals as listed in Chemical Abstracts, BIOSIS, MEDLARS and Biological Abstracts.

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Publications in non-refereed journals or congress proceedings as well as personal communications could not be taken into account. The compilation we publish here has the purpose of being a guide to the literature that is contained in our data bank. In this data bank, information, to-date, is available only through citations of the pertinent references. Implementation of the data bank to give information on the physical structure of all published synthetic genes is in progress. In this context we greatly urge authors of cited papers to help us maintain the data bank as accurate as possible by scrutiny and correction of data. We are also aware that in view of the enormous influx of scientific information we may have missed some entries. If this be the case, we encourage the authors to let us share their data.

It is our hope that the establishment of this data bank will be useful for all researchers involved in the field of gene synthesis. Currently there are the following routes of access to our data: 1. Upon request, we will be pleased to send the latest release by mail; 2. Electronic mail is available through

PSI-mail: PSI% 26245731072102::RZ 8600, USER=ORTIGAO

EAN: ORTIGAO @ RZ.UNI-ULM.DBP.DE

EARN: ORTIGAO @ DULRUU51

GENE	NOTE	CODE	AUTHOR	SOURCE	VOLUME	PAGE	YEAR
ACP	sp	SC	Ohlrogge	BST	14	579-81	1986
ACP	sp	SCE	Beremand	ABB	256	90-100	1987
ACTH	-	P	Itakura	PatSp	AUS 546092	-	1985
Amylase,A	a	SC	Gorbunov	BK	12	647-54	1986
Angiotenin	-	SEC	Denefle	Gene	56	61-70	1987
Angiotensin	h	S	Köster	CSNAISym	7	39-60	1980
Angiotensin I	h	SCE	Kumarev	DANS	252	1506-10	1980
Angiotensin I	-	C	Kumarev	FEBS	11	273-7	1980
Angiotensin II	-	S	Köster	JLAC	6	839-53	1978
Angiotensin II	-	S	Köster	JLAC	6	854-93	1978
Art. Protein	-	SCE	Biernat	ProtEng	1	353-8	1987
Aspartame	-	SCE	Doel	NAR	8	4575-92	1980
Aspartame	-	P	Searle	NePat	NL 81/437	-	1981
Aspartame	-	P	Bahl	EPatAp	EP36258	-	1981
ATPase	mt	S	Gearing	BioInt	10	907-15	1985
Bradykinin	-	SCE	Korobko	BK	5	1802-15	1979
Bradykinin	-	CE	Gorodetskii	DANS	250	208-12	1980
Bradykinin	-	CE	Korobko	BK	7	1881-4	1981
C5a	h	SCE	Mandecki	PNAS	82	3543-47	1985
Calcitonin	h	P	Lau	PCTIntAp	WO83/4028	-	1983
Calcitonin	-	P	Tanaka	EPatAp	EP95351	-	1983
Calcitonin	h	S	Golova	DANS	277	1258-60	1984
Calcitonin	h	SC	Kaneoka	JpnKo	JP60/168388	-	1985
Calcitonin	Val8	CE	Rubtsov	DANS	283	1507-9	1985
Calcitonin	CGRP	P	Craig	PCTIntAp	WO85/43	-	1985

GENE	NOTE	CODE	AUTHOR	SOURCE	VOLUME	PAGE	YEAR
Calcitonin	fish	P	Omori	PCTIntAp	WO86/1226	-	1986
Calcitonin	h	SCE	Ivanov	BioBio	2	6-13	1986
Calcitonin	Val8	SCE	Ivanov	FEBS	210	56-60	1987
Calcitonin-gly	sal	SC	Uhlmann	NASS	18	237-40	1987
Calcitonin-I-gly	sal	SC	Hein	NuclNucl	6	489-90	1987
Calmodulin	-	SCE	Roberts	B	24	5090-8	1985
Calmodulin	-	SC	Alvarado	BCB	64	548-55	1986
Casein	b,h	S	Guenther	Z.Chem.	27	97	1987
Casomorphin-5	b,h	SC	Hoffmann	NASS	18	229-32	1987
CBP	bov	E	Brodin	B	25	5371-7	1986
Cecropin A	-	P	Lai	PCTIntAp	WO86/4356	-	1986
Chymosin	-	SC	Emtage	PNAS	80	3671-5	1983
CTAP III	h	P	Johnson	PCTIntAp	WO85/1067	-	1985
CTAP III	-	P	Mullenbach	PCTIntAp	WO86/1515	-	1986
CTAP III	-	SCE	Mullenbach	JBC	261	719-22	1986
CTI	cow	SC	Hostomsky	NAR	15	4849-56	1987
Cytochrome B5	rat	SCE	V.Brodman	PNAS	83	9443-47	1986
Dynorphin	-	SC	Lebedenko	BioactMol	3	59-64	1987
EGF	h	SC	Smith	NAR	10	4467-82	1982
EGF	h	P	Eaton	EPatAp	EP46039	-	1982
EGF	h	SCE	Urdea	PNAS	80	7461-65	1983
EGF	h	E	Flock	MGG	195	264-51	1984
EGF	h	C	Smith	Gene	32	321-7	1984
EGF	h	P	Lee	EPatAp	EP128733	-	1984
EGF	h	SCE	Oka	PNAS	82	7212-6	1985
EGF	h	P	-	JpnKo	JP60/130393	-	1985
EGF	h	CE	Sumi	JBioTech	2	59-74	1985
EGF	h	P	Banks	PCTIntAp	WO85/2198	-	1985
EGF	m	SCE	Allen	JCS	3	29-38	1985
EGF	chim	SC	Sung	NAR	14	6159-68	1986
EGF	h	SCE	Taniyama	Takken	45	136-47	1986
EGF	h	SCE	Kishimoto	Gene	45	311-16	1986
EGF	h	P	Aoki	GerOff	DE3523634	-	1986
EGF	-	SC	Stern	Science	235	321-24	1987
EGF	h	SCE	Urdea	MethEnzym	146	22-41	1987
IFN	h,a	-	Arnheiter	Nature	294	278-8	1981
IFN	h,a1	E	De Maeyer	PNAS	79	4256-9	1982
IFN	h	SC	Rossi	JBC	257	9226-29	1982
IFN	a	E	Windass	NAR	10	6639-57	1982
IFN	h,a2	SC	Rossi	MiamiSymp	-	213-34	1982
IFN	h,a1	P	Atherton	EPatAp	EP62971	-	1982
IFN	h,g	SCE	Tanaka	NASS	11	29-32	1982
IFN	h,g	E	Tanaka	NAR	11	1707-23	1983
IFN	h,a2	SCE	Edge	NAR	11	6419-34	1983
IFN	h,g	P	Alton	PCTIntAp	WO83/4053	-	1983
IFN	h,b	SCE	Nagase	NASS	12	83-6	1983
IFN	h,g	SCE	Alton	BISPCMeet	-	119-28	1983
IFN	h,g	CE	Jay	PNAS	81	2290-4	1984
IFN	h,g	SCE	Jay	JBC	259	6511-7	1984
IFN	h,g	SCE	Engels	AngewCh	96	969-70	1984
IFN	h,a2	P	Kolosov	USSR	SU1092176	-	1984
IFN	h	C	Amirkhanov	BK	11	1283-5	1985
IFN	a2	SCE	Camble	SFPAPptS	-	375-84	1985
IFN	h,g	P	Engels	GerOff	DE3414831	-	1985
IFN	h,g	P	Engels	GerOff	DE340996	-	1985
IFN	h,g	SC	Leung	BISPCMeet	-	419-24	1985
IFN	h,g	P	Okada	EPatAp	EP147175	-	1985
IFN	h,b	P	Bell	EPatAp	EP130566	-	1985
IFN	h,b	P	Bell	EPatAp	EP131816	-	1985
IFN	h,b	P	Bell	EPatAp	EP130564	-	1985
IFN	h,b	P	Bell	EPatAp	EP130565	-	1985
IFN	h,a1	SCE	Coulombe	Gene	46	89-95	1986
IFN	anal	SCE	Camble	BBRC	134	1404-11	1986
IFN	b	CE	Porter	DNA	5	137-48	1986
IFN	h,a2	CE	Il'ichev	MGMV	-	19-23	1986
IFN	b	SC	Kumarev	DANS	290	244-9	1986

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GENE	NOTE	CODE	AUTHOR	SOURCE	VOLUME	PAGE	YEAR
IFN	h,a	P	Caruthers	EPatAp	EP173935	-	1986
IFN	m,b	CE	Tanaka	JIntRes	6	429-35	1986
IFN	h,a2	CE	Il'ichev	MGMV	-	19-23	1986
IFN	h,g	P	AsahiChIndCo	JpnKo	JP61/33200	-	1986
IFN	g	P	Ueda	EPatAp	EP176916	-	1986
IFN	h,a	SCE	Il'ichev	Genetika	23	197-201	1987
IFN	h,a2	E	Kravchenko	BK	13	1186-93	1987
IFN	g,b	CE	Rostapshov	DANS	295	1016-20	1987
IGF I	h	SCE	Elmblad	EConBiotc	-	287-92	1984
IGF I	h	P	Barr	EPatAp	EP123228	-	1984
IGF I	h	P	Lee	EPatAp	EP128733	-	1984
IGF I	h	P	Ueda	EPatAp	EP155655	-	1985
IGF I	Val59	P	Ueda	EPatAp	EP158892	-	1985
IGF I	h	S	Sproat	NAR	13	2995-77	1985
IGF I	h	P	Elmblad	EPatAp	EP130166	-	1985
IGF I	anal	SCE	Peters	Gene	35	83-9	1985
IGF I	h	SCE	Buell	NAR	13	1923-38	1985
IGF I	-	P	Banks	PCTIntAp	WO85/831	-	1985
IGF I	Val59	SCE	Niwa	AnnASci	469	31-52	1986
IGF I	h	E	Saito	JBioch	101	123-34	1987
IGF-I	h	CE	Bayne	PNAS	84	2638-42	1987
IL 2	h	P	Bhatt	EPatAp	EP119621	-	1984
IL 2	h	P	Engels	GerOff	DE3419995	-	1985
IL 2	h	P	Lemoine	EPatAp	EP152358	-	1985
IL 2	-	P	Souza	PCTIntAp	WO85/817	-	1985
IL-1	h,b	SC	Humber	NuclNucl	6	413-14	1987
IL-1	h,a	SCE	Zurawski	Gene	49	61-8	1987
Immunoglobulin	-	CE	Nilsson	ProtEng	1	107-13	1987
Insulin	h	S	Crea	PNAS	75	5765-9	1978
EGF	m	SCE	Allen	J.Biotech	5	93-114	1987
Eglin B/C	-	P	Rink	EPatAp	EP146785	-	1985
Endonuclease V	T4	SCE	Inaoka	NASS	17	105-8	1986
Endorphin	a,neo	E	Tanaka	NAR	10	1741-45	1982
Endorphin	a,neo	SCE	Ohsuye	NAR	11	1507-18	1983
Endorphin	a,neo	CE	Tanaka	PeptCh	-	225-30	1983
Endorphin	a,neo	P	Takano	EPatAp	EP77689	-	1983
Endorphin	b,neo	P	Stabinsky	PCTIntAp	WO83/4029	-	1983
Endorphin	a,neo	SCE	Oshima	ABC	50	1161-67	1986
Endorphin	b	S	Zeh	NuclNucl	6	485-8	1987
Endorphin	neo	SC	Lebedenko	BioactMol	3	59-64	1987
Enkephalin	Leu	SCE	Sverdlov	BK	5	1112-16	1979
Enkephalin	Leu	SCE	Ovchinnikov	DBS	248	371-6	1979
Enkephalin	Leu	S	Efimov	BK	5	305-7	1979
Enkephalin	Leu	SCE	Shemyakin	NAR	8	6163-74	1980
Enkephalin	Leu	CE	Ao	SciSci	27	28-63	1984
Enkephalin	Leu	S	Tang	SciSin	27	466-77	1985
Enkephalin	Pro	SCE	Hostomsky	Gene	39	269-74	1985
Erythropoietin	-	SCE	Lin	PCTIntAp	WO85/2610	-	1985
Esterase	-	SCE	Bulow	FEBS	210	147-52	1987
Fibroblast GF	bov	SCE	Linemeyer	Bio/Tech	5	960-5	1987
FMDV	v	SC	Korobko	BK	13	69-81	1987
Galactosidase	b	CE	Kravchenko	BK	11	523-33	1985
GH	h	SC	Ohtsuka	NASS	12	79-82	1983
GH	h	SCE	Ikehara	PNAS	81	5956-60	1984
GH	h	SC	-	JpnKo	JP59/125895	-	1984
GH	h	E	Tokunkga	Gene	39	117-20	1985
GH	h	SCE	Tokunga	EJBioch	153	445-9	1985
GH	bov	P	Hsiung	EPatAp	EP159123	-	1985
GH	h,bov	P	Itakura	PatSp	AUS546092	-	1985
GH	h	P	-	USPat	4,604,359	-	1986
GH	h	SCE	Doi	Protein	1	17-21	1986
Globin	rab	S	-	ChEnNews	53	6	1975
Globin	rab	S	Krueger	MiamiSym	241	-	1977
Globin	g, h	SCE	Murray	EMBO	6	2329-35	1987
Glucagon	-	E	Moody	FEBS	212	302-6	1987
GRF	h	S	CBM	GenEnNews	3	17	1983

GENE	NOTE	CODE	AUTHOR	SOURCE	VOLUME	PAGE	YEAR
GRF	h	P	-	BelgPat	BE898666	-	1984
GRF	-	P	Bhatt	EPatAp	EP108387	-	1984
GRF	h	SCE	Liauzun	PrAgTGGS	-	431-6	1985
GRF	h	P	Engels	GerOff	DE3327007	-	1985
GRF	h	SC	Cravador	Bioch	67	829-34	1985
GRF	h	CE	Kempe	Bio/Tech	4	565-8	1986
GRF	h	SCE	Engels	NuclNucl	6	185-95	1987
HBV-Ag	v	SCE	Smirnov	BK	9	1388-94	1983
HBVx-related pept	v	S	Kadowaki	PeptChem	-	369-72	1987
Hirudin	-	P	Brauer	GerOff	DE3429430	-	1984
Hirudin	-	SCE	Fortkamp	DNA	5	511-7	1986
Hirudin	-	SCE	Bergmann	BCHS	367	731-40	1986
Hirudin	-	P	Fortkamp	GerOff	DE3445517	-	1986
Hirudin	-	P	Liersch	EPatAp	EP168342	-	1986
Hirudin	-	SCE	Dodt	AdvBiosci	-	189-90	1987
HIV	v	SCE	Certa	EMBOJ	5	3051-6	1986
HLA-DR-Antigen	a	SC	Stetler	PNAS	79	5966-17	1982
Homoserine	-	SC	Kempe	Gene	39	239-45	1985
HSV	v	P	Burke	USPat	4,618,578	-	1986
HTLV1	v	SCE	Rosenthal	NASS	18	233-6	1987
Hygromycin	b	SCE	Ingolia	BrUkPatAp	GB2143534	-	1985
IF 1	-	SCE	Calogero	MGG	208	63-9	1987
IFN	h,al	SC	Edge	Nature	292	756-62	1981
Insulin	h	CE	Goeddel	PNAS	76	106-10	1979
Insulin	h	S	Gait	Nature	277	429-31	1979
Insulin	h	SCE	Kraszewski	PostBio	25	257-8	1979
Insulin	h,a,b	SCE	Goedell	PNAS	76	106-10	1979
Insulin	h	SC	Narang	CSNAISym	7	377-85	1980
Insulin	h	SC	Hsiung	NAR	8	5753-65	1980
Insulin	h	SC	Narang	NASS	-	377-85	1980
Insulin	h	CE	Keefer	PNAS	78	1391-5	1981
Insulin	h,pro	SCE	Wetzel	Gene	16	63-71	1981
Insulin	h,pro	SC	Brousseau	Gene	17	279-89	1982
Insulin	h,a	C	Scarpulla	AnBioch	121	356-65	1982
Insulin	h,pro	SC	Narang	MENAPrIs	-	41-52	1982
Insulin	h,pro	P	Goedell	EPatAp	EP55945	-	1982
Insulin	h,pro	P	Narang	EPatAp	EP68701	-	1983
Insulin	h,pro	E	Stepien	Gene	24	289-97	1983
Insulin	h,pre	SCE	Georges	Gene	27	201-11	1984
Insulin	h,pro	E	Guo	Gene	29	251-54	1984
Insulin	h,pro	SC	Ovichinnikov	Gene	31	65-78	1984
Insulin	h,pre	SCE	Narang	NFPriCong	-	81-90	1984
Insulin	h,pre	SCE	Narang	JBiosci	6	739-55	1984
Insulin	h,pro	E	Vernet	Gene	34	87-93	1985
Insulin	h,pro	CE	-	EPatAp	EP154539	-	1985
Insulin	a	CE	Ingolia	BrUKPatAp	GB214534	-	1985
Insulin	a,b	P	Itakura	PatSp	AUS546092	-	1985
Lactalbumin	a	SCE	Jaynes	AMicBiot	21	200-5	1985
Leghemoglobin	-	C	Marcker	Praeger	-	63-71	1981
LH	-	S	Itakura	PatSp	AUS546092	-	1985
LHRH	prs	S	Seliger	ChemScr	26	569-77	1986
Lysozyme	chk	C	Sippel	NAR	5	3275-94	1978
Lysozyme	h	SCE	Muraki	ABC	49	2829-31	1985
Lysozyme	h	S	Ikehara	CPB	34	2202-8	1986
Lysozyme	h	P	Ikehara	EPatAp	EP181634	-	1986
Lysozyme	h	P	Ikehara	PCTIntAp	WO86/2947	-	1986
Lysozyme	h	P	Muraki	JpnKo	JP61/78383	-	1986
Lysozyme	h	P	Muraki	JpnKo	JP61/78378	-	1986
Lysozyme	h	SCE	Muraki	ABC	50	713-23	1986
Lysozyme	h,chk	CE	Jigami	Gene	43	273-78	1986
Lysozyme	h	S	Horn	NuclNucl	6	335-40	1987
MSH	a,b	P	Murphy	PCTIntAp	WO83/3971	-	1983
MSH	g	S	Seliger	NuclNucl	6	137-46	1987
Myoglobin	whale	SCE	Springer	PNAS	84	8961-5	1987
Myosin	chk	SC	Arnold	B	18	5641-47	1979
NGF	h,b	SC	Iwai	CBP	34	4724-30	1986

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GENE	NOTE	CODE	AUTHOR	SOURCE	VOLUME	PAGE	YEAR
Opsin	bact	SCE	Nassal	JBC	262	9264-70	1987
PF 155	-	SCE	Aslund	PNAS	84	1399-403	1987
Phage Mu	v,ep	SC	Neumyvakin	MGMV	-	19-21	1986
PTH	h	S	Kronenberg	ClRes	25	497A	1977
Ras-Protein	N-	CE	Geis	BBRC	139	771-9	1986
Ras-Protein	C-	SCE	Miura	JpnJCRes	77	45-51	1986
Ras-Protein	C-	P	Othsuka	JpnKo	JP62/48383	-	1987
Relaxin	pro,p	CE	Stewart	NAR	11	6597-609	1983
Relaxin	p	P	Stewart	EPatAp	EP68375	-	1983
Rhodopsin	bact	S	Chakmakcheva	BK	11	1533-46	1985
Rhodopsin	bact	C	Chakmakcheva	ChemScr	26	31-5	1986
Rhodopsin	bov	SCE	Oprian	ProtEng	-	111-23	1986
Rhodopsin	bov	S	Ferretti	PNAS	83	599-603	1986
Rhodopsin	bov	SCE	Oprian	ProtEng	-	111-23	1986
Rhodopsin	bov	E	Oprian	PNAS	84	8874-8	1987
RNase S	-	SC	Nambiar	Science	223	1299-301	1984
RNase T1	-	SCE	Ikehara	NASS	-	197-200	1984
RNase T1	-	E	Nishikawa	NASS	-	287-90	1985
RNase T1	-	SCE	Ikehara	PNAS	83	4695-9	1986
SAP	-	SCE	Preuss	BCHS	368	501-6	1987
Secretin	-	SCE	Miyoshi	NASS	10	197-200	1981
Secretin	p	SCE	Suzuki	PNAS	79	2475-9	1982
Secretin	-	P	WakungaPhCo	JpnKo	JP57/200343	-	1982
Secretin	-	P	WakungaPhCo	JpnKo	JP57/200400	-	1982
Secretin	-	CE	Suzuki	PNAS	79	2475-9	1982
Secretin	-	P	Suzuki	GerOff	DE3220333	-	1983
Secretin	-	E	Sumi	Gene	29	125-34	1984
Secretin	-	P	Koenig	GerOff	DE3328793	-	1985
SIP	d	SC	Dobrynin	BK	7	1745-9	1981
SIP	d	CE	Korobko	BK	7	1881-4	1981
Somastotin	h	P	Itakura	GerOff	DE28484051	-	1979
Somatostatin	h	SCE	Itakura	Science	198	1056-63	1977
Somatostatin	h	P	Riggs	GerOff	DE2848052	-	1979
Somatostatin	h	P	Itakura	GerOff	DE2848053	-	1979
Somatostatin	h	P	Riggs	USPat	US4366246	-	1982
Somatostatin	h	P	Bittner	EPatAp	EP108045	-	1984
Somatostatin	h	P	Itakura	PatSp	AUS546092	-	1985
Somatostatin	h	P	Canosi	EPatAp	EP160190	-	1985
Substance P	-	SCE	Murphy	PCTIntAp	WO83/3971	-	1983
Substance P	-	SC	Kempe	Gene	39	239-45	1985
Tetragastrin	-	P	Okada	JpnKo	Jp60/188081	-	1985
TGF	-	P	Banks	PCTIntAp	WO85/2198	-	1985
TGF	rat,a	SCE	Watanabe	PNAS	84	1258-62	1987
Thaumatococcus I	-	P	Date	EPatAp	EP139501	-	1985
Thymosin	bov	SCE	Wetzel	Bioch	19	6069-105	1980
Thymosin	al	CE	Ingolia	BrUkPatAp	GB214534	-	1985
Thymosin	al	CE	Lilly	EPatAp	EP154539	-	1985
TIG	bov	CE	v.Wilcken	EMBOJ	5	3219-25	1986
TIG	pan	S	Kikuchi	JBioch	102	607-12	1987
TMV	v,ct	E	Haynes	Biotech	4	637-41	1986
TNF	h	SCE	Ikehara	CPB	36	291-6	1988
TRNA	-	S	Contreras	AIPBioch	84	145-7	1976
TRNA	sup	E	Masson	Gene	47	179-83	1986
TRNA-Ala	prs	S	Agarwal	Nature	227	27-34	1970
TRNA-Synthetase	Ala	S	Welch	ACS	40	817-25	1986
TRNA-Tyr	sup	SCE	Ryan	JBC	254	5817-26	1979
TRNA-Tyr	sup	CE	Ryan	JBC	254	10803-10	1979
TRNA-Tyr	sup	E	Sekiya	JBC	254	5802-16	1979
TRNA-Tyr	sup	SC	Dunn	JBC	256	6109-18	1981
TRNA-Tyr	sup	SCE	Masson	Gene	47	179-83	1986
TRNA-Val	yeast	SC	Berlin	BK	9	43-51	1983
Ubiquitin	-	SCE	Ecker	JBC	262	14213-21	1987
Ubiquitin	-	SCE	Ecker	JBC	262	3524-7	1987
VIP	v	SC	Theriault	NuclNucl	5	15-32	1986

ABBREVIATIONSGENE:

abbreviation	significance
ACP	Acyl-carrier-protein
ACTH	Adenocorticotrope hormone
Art.Protein	Artificial protein
C5a	Complement-5a-esterase
CBP	Calcium-binding-protein
CTAP III	Connective activator peptide III
CTI	Colostrum trypsin inhibitor
EGF	Epidermal growth factor
Fibroblast GF	Fibroblast growth factor
FDMV	Foot-and-mouth disease virus
GH	Growth hormone
gly	glycine
GRF	Growth hormone realising factor (Somatoliberin)
HBV	Hepatitis B virus
HIV	Human immunodeficiency virus
HLA-DR-antigen	Human histocompatible antigen
HSV	Herpes simplex virus
HTLV 1	Human T-cell lymphotropic virus 1
IF 1	Translational initiation factor
IFN	Interferon
IGF	Insulin-like growth factor
IL	Interleukin
LH	Luteinizing hormone
LHRH	Luteinizing hormone releasing factor
MSH	Melanocortin stimulating hormone
NGF	Nerve growth factor
PF	Plasmodium falciparum antigen
PTH	Parathyroid hormone
SAP	Antimicrobial protein from bull seminal plasma
SIP	Sleep inducing protein
TGF	Transforming growth factor
TIG	Trypsin inhibitor gene
TMV	Tobacco mosaic virus
TNF	Tumor necrosis factor
VIP	Vasoactive intestinal peptide

CODE:

abbreviation	significance
C	Cloning
E	Expression
S	Synthesis
P	Patent

NOTE:

abbreviation	significance
a	alpha
anal	analogue
b	beta
bact	bacterium
bov	bovine
CGRP	Calcitonin gene related protein
chim	chimeric

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chk	chicken
ct	coat
d	delta
ep	epidermal
g	gamma
h	human
Leu	Leucine
m	mouse
mt	mitochondrial
p	porcine
pan	pancreatic
Pro	Proline
prs	precursor
rab	rabbit
sal	salmon
sp	spinach
sup	suppressor
T4	phage T4
v	virus
Val	Valine

SOURCE:

abbreviation significance

ABB	Arch. Biochem. Biophys.
ABC	Agricultural Biol. Chem.
AdvBiosci	Adv. Bioscience
AIPBioch	Arch.Int.Physiol.Biochim.
AMicBiot	Applied Microbiol. Biotechnol.
Angew.Ch.	Angewandte Chemie
AnnASci	Ann.N.Y.Acad.Sci.
AnnBioch	Annales Bioch.
B	Biochemistry
BBRC	Biochem.Biophys. Res. Commun.
BCB	Biochem.Cell.Biol.
BCHS	Biol.Chem. Hoppe-Seyler
BelgPat	belgish patent
BioactMol	Bioactive Molecules
BioBio	Biotechnol. Biotech.
BioInt	Biochem. Int.
BISPMeet	Biological Interferon Syst. Proc. TNO-ISIR-Meeting
Bio/Tech	Bio / Technology
BK	Bioorg. Khim.
BrUKPatAp	british patent
BST	Biochem.Soc. Trans.
CBM	Creative Biomolecules
ChemScr	Chemica Scripta
ChEnNews	Chem. Engineering News
ClRes	Clinical Research
CPB	Chem. Pharm. Bull. (Tokyo)
CSNAISym	Koster Chemical Synthesis of Nucleic Acids Intl. Symposium, Eggestorf
DANS	Doklady Akad. Nauk SSSR
DBS	Doklady Biological Sciences
EConBiotc	Eur. Congress Biotechnol.
EJBioch	Eur. J. Biochem.
EMBOJ	EMBO Journal
EPatAp	european patent application
FEBS	FEBS Letters
GenEnNews	Genetic Engineering News
GerOff	german patent
JBC	J. Biol. Chemistry
JBioch	J. Biochem. (Tokyo)
JBiosci	J. Bioscience

JBiotech	J. Biotechnology
JCS	J. Cell. Science
JIntRes	Journal Interferon Research
JLAC	Justus Liebig's Ann. Chem.
JpnJCRes	Jpn. Journal Cancer Research
JpnKo	japanese patent
MENAPrIS	Metab. Enzymol. Nucleic Acids, Proc. Int. Symposium
MethEnzym	Methods in Enzymology
MGG	Mol. Gen. Genet.
MGMV	Mol. Genet., Microbiol. Virusol.
MiamiSym	Miami Winter Symposium
NASS	Nucleic Acids Symp. Series
NAR	Nucleic Acids Research
NePat	dutch patent
NFPPrICong	New Front., Proc. Int. Congress
NuclNucl	Nucleosides / Nucleotides
PatSp	australian patent
PCTIntAp	interanational patent application
PeptCh	Peptide Chem.
PNAS	Proc.Natl.Acad.Sci.USA
PostBio	Postemky Biochem.
Praeger	Praeger:Genetic Engineering in the Plant Science
PrAgTGGS	Prod. Agents Ther. Genie Genet., Symp. Satell., Montpellier
ProtEng	Protein Engineering
SciSin	Sci. Sin. Ser. B (Engl.)
SFPAPpts	Struct. Funct., Proc. Am. Pept. Symp. (SFPAPSym)
TakKen	Tekeda Kenkyushoho
USPat	US-patent
USSRPat	USSR-patent
Z.Chem.	Zeitschrift für Chemie

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REFERENCES

1. Agarwal, K.L., Büchi, H., Caruthers, M.H., Gupta, N., Khorana, H.G., Kumar, A., Ohtsuka, E., Rajbhandary, U.L., van de Sande, J.H., Sgaramella, V. Weber, H. Yameda, T. Nature 227, 27-34 (1970)