

Regulatory subunit interactions of the 26S proteasome, a complex problem. Katherine Ferrell, Caroline R M Wilkinson, Wolfgang Dubiel and Colin Gordon. Information additional to that published in *Trends in Biochemical Sciences*, February 2000

**Table 2. Subunit-Non-Subunit Interactions of the 19S Regulatory Complex of the 26S Proteasome**

Subunit	Interacting Proteins	Methods	Comments	References	
Rpt1/S7	HEC	P	2hb, pd	High expression in cancers, associates during M phase	36
	YME1	G	sup	ATP- and Zn-dependent sc mitochondrial protease	37
Rpt2/S4	HPV16E7	P	2hb	Human papilloma virus 16 oncoprotein E7; E7 targets retinoblastoma protein for degradation	38, 39
	Centractin	P	fb	Subunit of dynactin complex	4
Rpt3/S6b	MB67	P	2hb	Orphan member of nuclear hormone super family	6
	p28 (gankyrin)	P	2hb, pd	Ankyrin repeat protein=MS73 (S7) interacting protein	40
	HIV tat	none		Direct binding of HIV tat to TBP7 has never been shown	
Rpt4/S10b	Dynamitin	P	fb	p50 subunit of dynactin complex	4
	p27	P	co-purif	Modulator protein, facilitates assembly of rpt4 and rpt5 into 19S complex; purifies as heterotrimer	15
Rpt5/S6a	HIV1 tat	P	fw, ta	Transcriptional activator of HIV; inhibits tat transactivation	41
	pVHL	P	2hb	von Hippel-Lindau tumor suppressor protein	42
	TBPIP	P	2hb	TBP1 interacting protein, enhances TBP1 inhibition of tat transactivation	43
	TBP	P	pd	TATA box binding protein (not to be confused with TBP1)	44
	p27	P	co-purif	Modulator protein, facilitates assembly of rpt4 and rpt5 into 19S complex	15
Rpt6/S8	Gal4	G, P	sup, pd	sc transcriptional regulator of galactose activated genes	45, 46, 47
	HEC	P	2hb	High expression in cancers	36
	TR	P	2hb, pd, ta	Thyroid hormone receptor, ligand-dependent	47, 48
	RAR $\alpha$	P	2hb, pd, ta	Retinoic acid receptor, ligand-stimulated, ATP-stimulated, binds <i>via</i> AAA region of Rpt6 (S8)	48
	ER $\alpha$	P	2hb, pd, ta	Estrogen receptor, ligand-dependent, ATP-stimulated, binds <i>via</i> AAA region of Rpt6 (S8)	48
	VDR	P	tr	Vitamin D3 receptor, ligand-dependent	48, 49
	RXR	P?	2hb, pd?	Retinoid-receptor	47, 48
	Phd, PhLP, PhLOP1	P	2hb, pd	Phosphoducin, Phosphoducin-like protein, Phosphoducin-like orphan protein	50, 51
	cFos	P	2hb, pd	Transcription factor	52
	XPB	P	2hb, pd	p80 subunit of TFIIH, co-purifies through many steps with 26S	53
	VP16	P	pd	Herpes Virus protein16, activation domain	46, 47
	E1A	P	2hb	Adenovirus early region 1A, inhibits 20S proteasome activity	54
	SV40-T	P	pd	Simian virus 40 T protein	54
	TBP	P	pd	TATA box binding protein	46
	20S $\alpha$ 1	G	res	20S proteasome $\alpha$ subunit 1	55

Rpn/t=S. cerevisiae nomenclature S=previous (human) nomenclature, 2hb= 2 hybrid, sup=suppressor mutation analysis, res=multicopy expression of wild type gene rescues a mutation, enh=double mutation confers an enhanced phenotype, pd=pull-down including: glutathione sepharose-gst pull down, Ni agarose-His pull-down, immunoprecipitation, fw= far-western, fb=filter binding, tr=transcriptional activation, sc =S. cerevisiae, sp=S. pombe.

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**Table 2. Subunit-Non-Subunit Interactions of the 19S Regulatory Complex of the 26S Proteasome (continued)**

Subunit	Interacting Proteins		Methods	Comments	References
Rpn1/S2	TNFR1	P	2hb, pd	Tumor necrosis factor receptor type 1 intracellular region, upstream of death domain	56, 57
	Ste6p	G	res	sc pheromone a factor transport protein	58
Rpn2/S1	Rpn4/Son1/ufd5	G	sl	<i>son1Δ sl sen3Δ</i>	59
	bRanBP-2	P	2hb, pd	Bovine retinal Ran-binding protein 2, cyclophilin-like domain	60
	Gpa1	G	sup	GTPase α protein in sc pheromone mating response	61
Rpn3/S3	CKA?	G	res	Casein kinase II catalytic subunit	62
	CDC28	G, P?	enh, pd?	Cell cycle dependent kinase	63
	Cks1	G, P?	enh, pd?	Cyclin dependent interacting protein	63
Rpn5/p55				None reported	
Rpn6/S9	Sgn1	P	2hb	COP9 signalosome subunit 1, does not co-immunoprecipitate	17
Rpn7/S10a				None reported	
Rpn8/S12				None reported	
Rpn9/S11				None reported	
Rpn10/S5a	poly Ub	P	fb, pd	Ubiquitin chains bind C-terminus of S5a	64
	hHR23	P	2hb, pd	Human homolog of Rad23, Ub-like region binds to C-terminus of S5a	65
	Rad23	P	pd	sc DNA repair	66
	Id1, MyoD, E12	P	2hb, pd, ta	Inhibitor of DNA binding, binding via N-terminus of S5a inhibits Id1's actions, transcription factors	67
	E4	G	enh	Ubiquitin chain elongation factor ( <i>ufd2</i> )	68
	RyR	P	co-purif	Ryanodine receptor, a SR Ca <sup>2+</sup> channel which binds many endogenous proteins	69
Rpn11/S13	pap1	G	sup	<i>sp</i> AP-1 transcription factor	70
Rpn12/S14	Rpn4/Son1/ufd5	G	sl	<i>rpn12-1 sl son1Δ</i>	59
	CDC28	G	sl	sc kinase involved in cell cycle control	34

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