

## **Supplemental Material to:**

**Richard A. Burkhart, Danielle M. Pineda, Saswati N. Chand,  
Carmella Romeo, Eric R. Londin, Edward D. Karoly,  
Joseph A. Cozzitorto, Isidore Rigoutsos, Charles J. Yeo,  
Jonathan R. Brody, Jordan M. Winter**

**HuR is a post-transcriptional regulator of  
core metabolic enzymes in pancreatic cancer**

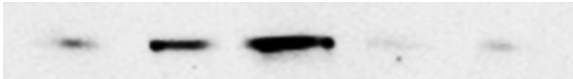
**2012; 10(8)**

**<http://dx.doi.org/10.4161/rna.25274>**

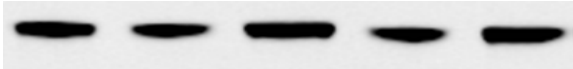
**[www.landesbioscience.com/journals/rnabiology/article/25274/](http://www.landesbioscience.com/journals/rnabiology/article/25274/)**

**A**      **Supplemental Figure 1**

cytoplasmic HuR



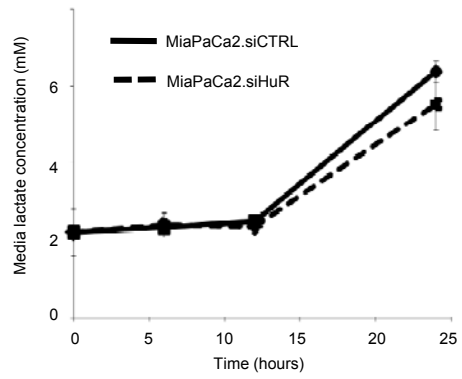
$\alpha$ -tubulin



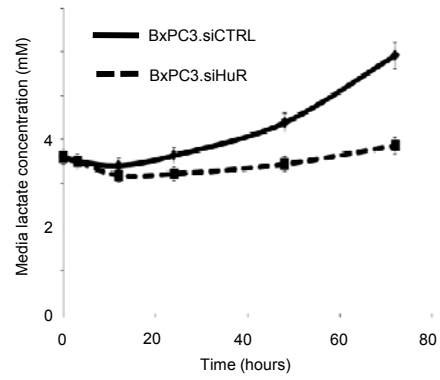
0      6      12      24      48

Time (hours)

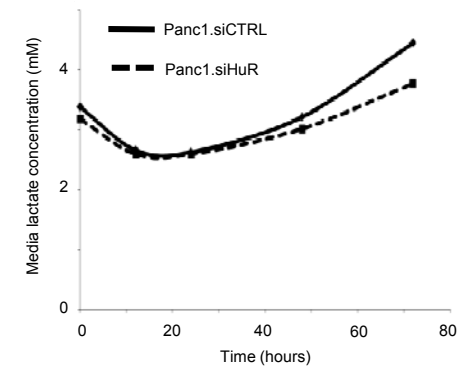
# A Supplemental Figure 2



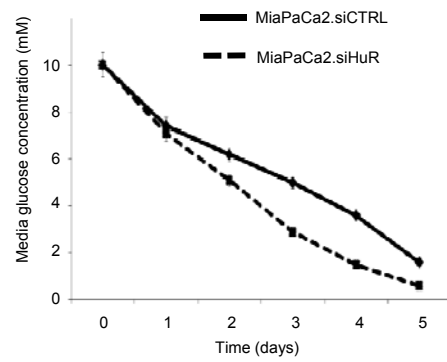
# B



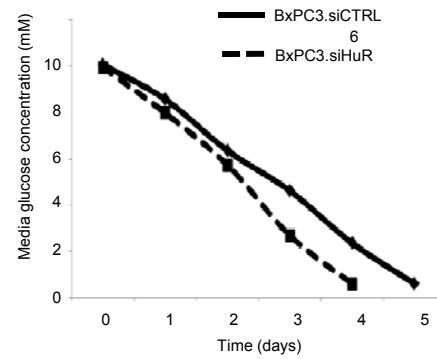
# C



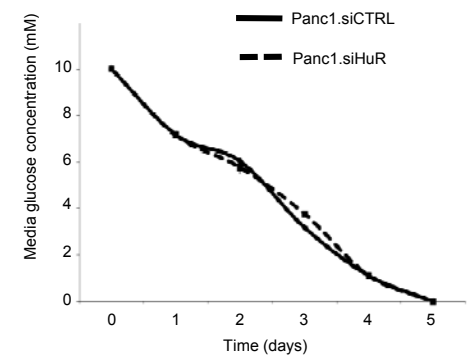
# E



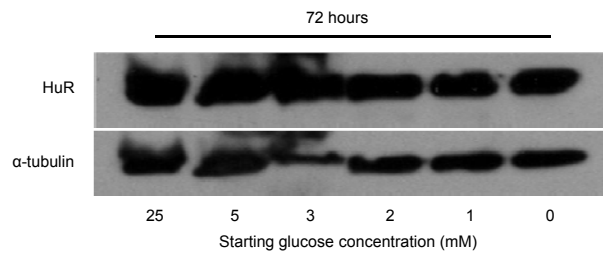
# F



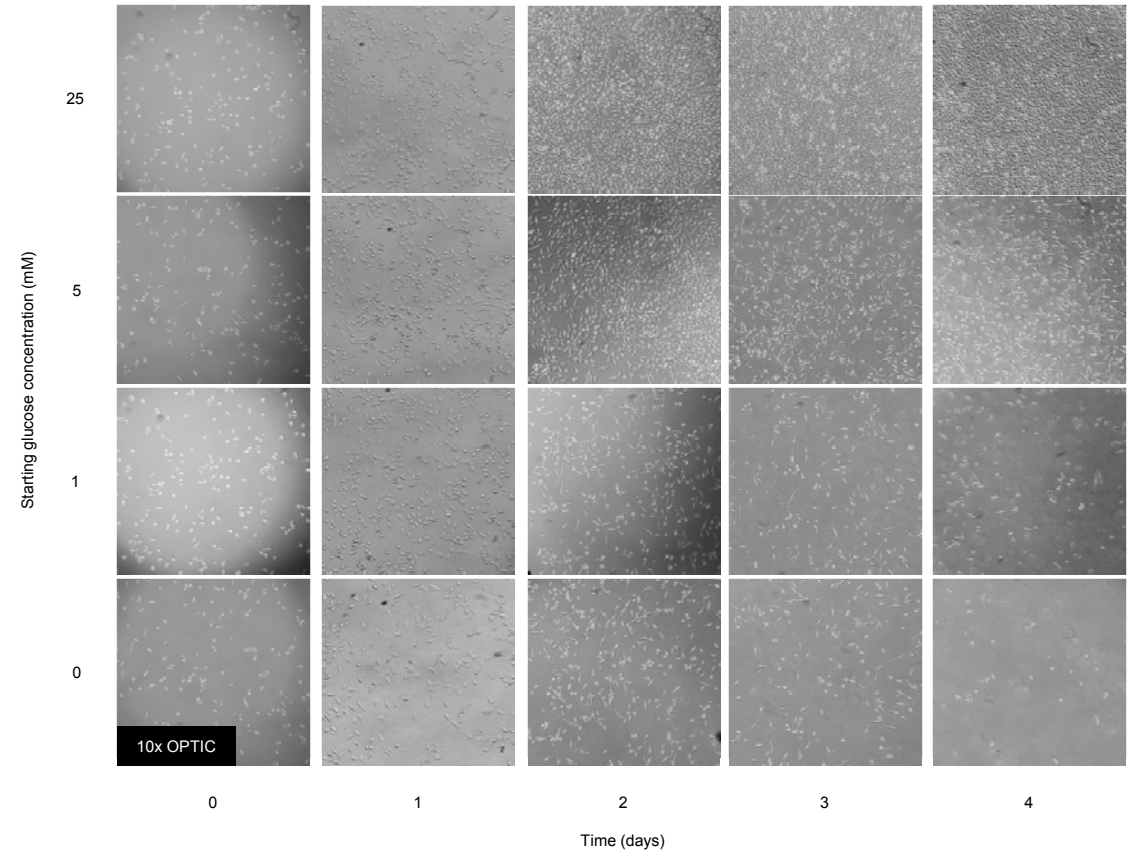
# G



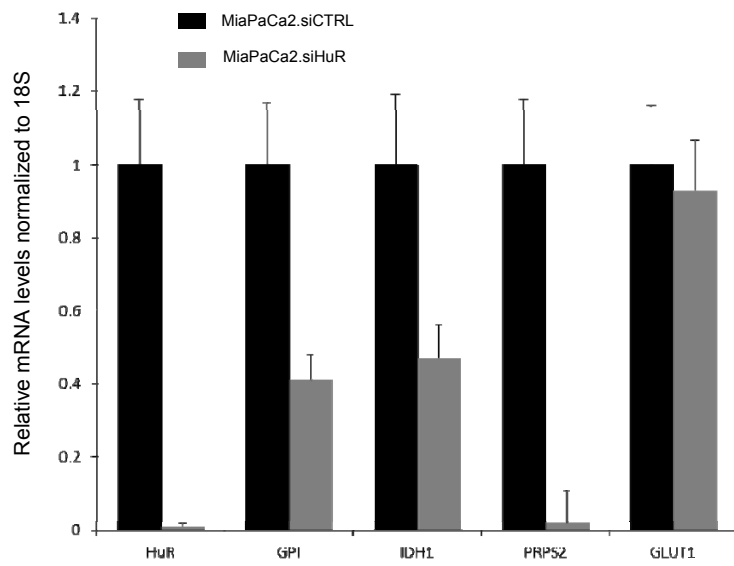
# A Supplemental Figure 3



# B



# Supplemental Figure 4



### **Supplemental Legends:**

#### **Supplemental Figure 1: Time course of HuR activation under glucose deprivation.**

Immunoblots of cytoplasmic lysates from MiaPaCa2 cells in 1 mM glucose at the indicated time points.

#### **Supplemental Figure 2: Lactate and glucose curves in pancreatic cancer related to HuR expression**

Replicate experiments of lactate and glucose levels in the media over time in three pancreatic cancer cell lines at 10 mM starting glucose concentration. siCTRL are solid lines; siHuR are dashed lines. Lactate levels in the media for (A) MiaPaCa2, (B) BxPC3, and (C) PANC1 cells. Media glucose concentration for (D) MiaPaCa2, (E) BxPC3, and (F) PANC1 cells.

#### **Supplemental Figure 3:**

(A) Immunoblot showing whole cell HuR protein expression at 72 hours under various levels of glucose deprivation. (B) Photomicrographs at 10x optic showing MiaPaCa2 cell growth over time when cultured in media with different starting glucose concentrations.

#### **Supplemental Figure 4:**

Quantitative PCR demonstrating HuR silenced cells (gray bars) versus control siRNA transfection (black bars). HuR target mRNA transcript levels (GPI, PRPS2, and IDH1) are shown and compared to a negative control (GLUT1). Data is normalized to 18s.

#### **Supplemental Table 1:**

Nomenclature used throughout manuscript to describe transfected cell lines.

#### **Supplemental Table 2:**

Pathway heat map (raw data) comparing metabolic intermediates in MiaPaCa2.siCTRL and MiaPaCa2.siHuR cells. Cells were incubated in DMEM with 25 mM glucose.

#### **Supplemental Table 3:**

Results of the glucose metabolism RNP-IP/qPCR Array (HuR vs. IgG antibodies). Genes in red are > 2-fold increase in the HuR group; genes in green are > 2-fold increase in the IgG group.

**Supplemental Table 1: Nomenclature used for transfected cell lines**

<b>Name</b>	<b>Transfection procedure</b>
MiaPaCa2.siCTRL	siRNA transfection of scrambled control
MiaPaCa2.siHuR	siRNA transfection against HuR
MiaPaCa2.EV	Plasmid transfection of empty vector
MiaPaCa2.HuR	Plasmid transfection of HuR
BxPC3.siCTRL	siRNA transfection of scrambled control
BxPC3.siHuR	siRNA transfection against HuR
PANC1.siCTRL	siRNA transfection of scrambled control
PANC1.siHuR	siRNA transfection against HuR
PANC1.EV	Plasmid transfection of empty vector
PANC1.HuR	Plasmid transfection of HuR



**Heat map of intracellular biochemicals profiled in this study.**  
**Normalization: Protein (Bradford assay)**

**Comparison mean values significantly different:**  
■  $p \leq 0.05$ , fold of change  $\geq 1.00$   
■  $p \leq 0.05$ , fold of change  $< 1.00$

**Comparison mean values approaching significance:**  
■  $0.05 < p < 0.10$ , fold of change  $\geq 1.00$   
■  $0.05 < p < 0.10$ , fold of change  $< 1.00$

SUPER PATHWAY	SUB PATHWAY	BIOCHEMICAL NAME	siHuR siCtrl	p-Value	q-Value
Amino acid	Glycine, serine and threonine metabolism	glycine	0.91	0.1759	0.7021
		serine	0.96	0.6586	0.7543
		N-acetyserine	1.04	0.8173	0.7822
		threonine	0.76	0.0227	0.2941
	Alanine and aspartate metabolism	aspartate	0.89	0.2374	0.7078
		asparagine	1.20	0.2616	0.7078
		beta-alanine	1.68	0.1769	0.7021
		alanine	1.12	0.2589	0.7078
		N-acetylanine	0.92	0.4816	0.7400
		N-acetyl-aspartate (NAA)	1.11	0.5407	0.7509
	Glutamate metabolism	glutamate	0.72	0.0032	0.0828
		glutamine	0.80	0.0133	0.2290
		gamma-aminobutyrate (GABA)	0.86	0.5903	0.7543
		N-acetyl-aspartyl-glutamate (NAAG)	1.01	0.6515	0.7543
	Histidine metabolism	histidine	0.89	0.0772	0.5662
	Lysine metabolism	lysine	1.00	0.7090	0.7543
	Phenylalanine & tyrosine metabolism	phenylalanine	1.10	0.1897	0.7021
		tyrosine	1.08	0.3550	0.7285
		3-(4-hydroxyphenyl)lactate	1.20	0.1247	0.6459
		phenylacetyl-glycine	1.02	0.9943	0.8120
	Tryptophan metabolism	tryptophan	1.05	0.7039	0.7543
	Valine, leucine and isoleucine metabolism	isoleucine	1.07	0.4044	0.7285
		leucine	1.04	0.5258	0.7509
		valine	1.08	0.3371	0.7285
	Cysteine, methionine, SAM, taurine metabolism	cysteine	0.72	0.0333	0.4028
		cystine	1.23	0.8752	0.7822
		cystathionine	0.87	0.2310	0.7078
		N-formylmethionine	0.92	0.5422	0.7509
		S-adenosylhomocysteine (SAH)	0.87	0.0524	0.4931
		methionine	1.09	0.3840	0.7285
		N-acetylmethionine	0.96	0.4401	0.7285
		oleoyltaurine	0.79	0.6520	0.7543
	Urea cycle; arginine-, proline-, metabolism	arginine	0.84	0.4279	0.7285
		ornithine	1.15	0.4313	0.7285
		proline	0.90	0.1342	0.6459
		citrulline	0.92	0.2882	0.7285
		trans-4-hydroxyproline	1.10	0.7832	0.7717
	Creatine metabolism	creatine	0.95	0.4087	0.7285
	Polyamine metabolism	5-methylthioadenosine (MTA)	0.73	0.0031	0.0828
		glutathione, reduced (GSH)	0.74	0.0571	0.4931
	Glutathione metabolism	5-oxoproline	0.87	0.1510	0.6678
		glutathione, oxidized (GSSG)	0.79	0.0894	0.5790
		cysteine-glutathione disulfide	0.67	0.0027	0.0828
		glycylvaline	0.93	0.7477	0.7573
		glycylglycine	1.07	0.5778	0.7543
	Dipeptide	glycylisoleucine	1.15	0.6234	0.7543
		glycylleucine	1.10	0.8200	0.7822
		alanylthreonine	1.56	0.2610	0.7078
		prolylleucine	0.87	0.3063	0.7285
		phenylalanylalanine	1.30	0.3561	0.7285
phenylalanylglutamate		1.18	0.6917	0.7543	
phenylalanylglycine		1.27	0.4587	0.7394	
tyrosylvaline		1.63	0.6336	0.7543	
histidylleucine		1.32	0.5639	0.7543	
isoleucylalanine		1.17	0.7572	0.7592	
isoleucylglycine		1.10	0.6969	0.7543	
isoleucylserine		2.11	0.0111	0.2234	
leucylglutamate		1.36	0.3119	0.7285	
leucylglycine		1.86	0.0555	0.4931	
phenylalanyls erine		1.47	0.5231	0.7509	
serylleucine		1.30	0.8313	0.7822	
serylphenylalanine		1.51	0.1737	0.7021	
threonylleucine		1.54	0.4668	0.7394	
tyrosylalanine		1.03	0.7116	0.7543	
tyrosylglycine		1.18	0.6338	0.7543	
serylisoleucine*	1.07	0.9278	0.8010		
gamma-glutamyl	gamma-glutamylvaline	0.81	0.2493	0.7078	
	gamma-glutamylleucine	1.11	0.8821	0.7822	
	gamma-glutamylisoleucine*	0.91	0.3454	0.7285	
	gamma-glutamylmethionine	1.03	0.9541	0.8015	
	gamma-glutamylglutamate	0.75	0.0416	0.4435	
gamma-glutamylglutamine	0.77	0.0050	0.1135		

Peptide

		gamma-glutamylthreonine*	1.32	0.2367	0.7078
Carbohydrate	Aminosugars metabolism	N-acetylglucosamine 6-phosphate	1.00	0.9990	0.8122
		erythronate*	0.95	0.9594	0.8015
		N-acetylneuraminic acid	1.10	0.3045	0.7285
	Fructose, mannose, galactose, starch, and sucrose metabolism	fructose	1.38	0.5162	0.7509
		sorbitol	0.84	0.3767	0.7285
	Glycolysis, gluconeogenesis, pyruvate metabolism	glycerate	0.87	0.4403	0.7285
		glucose-6-phosphate (G6P)	0.73	0.0151	0.2290
		glucose	7.61	0.0843	0.5662
		fructose-6-phosphate	0.64	0.1448	0.6562
		Isobar: fructose 1,6-diphosphate, glucose 1,6-diphosphate, m	1.43	0.1339	0.6459
		2-phosphoglycerate	1.14	0.6569	0.7543
		3-phosphoglycerate	1.00	0.8170	0.7822
		dihydroxyacetone phosphate (DHAP)	1.39	0.4033	0.7285
		phosphoenolpyruvate (PEP)	0.93	0.4306	0.7285
		lactate	1.26	0.2302	0.7078
	Nucleotide sugars, pentose metabolism	6-phosphogluconate	0.57	0.0377	0.4275
		sedoheptulose-7-phosphate	0.79	0.3868	0.7285
		ribose	0.81	0.1837	0.7021
		ribose 5-phosphate	1.05	0.8596	0.7822
		Isobar: ribulose 5-phosphate, xylulose 5-phosphate	0.96	0.6824	0.7543
Energy	Krebs cycle	citrate	0.80	0.2364	0.7078
		succinate	0.85	0.4118	0.7285
		succinylcarnitine	1.24	0.1270	0.6459
		fumarate	1.06	0.5037	0.7509
		malate	1.06	0.4420	0.7285
	Oxidative phosphorylation	phosphate	1.11	0.2799	0.7248
		pyrophosphate (PPi)	1.44	0.3966	0.7285
		linoleate (18:2n6)	1.02	0.9740	0.8039
		linolenate [alpha or gamma; (18:3n3 or 6)]	0.98	0.5938	0.7543
		dihomo-linolenate (20:3n3 or n6)	0.95	0.4632	0.7394
Lipid	Essential fatty acid	eicosapentaenoate (EPA; 20:5n3)	0.95	0.6146	0.7543
		docosapentaenoate (n3 DPA; 22:5n3)	0.98	0.6636	0.7543
		docosahexaenoate (DHA; 22:6n3)	0.89	0.1840	0.7021
		caproate (6:0)	0.79	0.5745	0.7543
		caprylate (8:0)	0.99	0.8687	0.7822
	Medium chain fatty acid	pelargonate (9:0)	0.98	0.7055	0.7543
		caprate (10:0)	0.84	0.0522	0.4931
		laurate (12:0)	0.94	0.3597	0.7285
		myristate (14:0)	1.01	0.8845	0.7822
	Long chain fatty acid	myristoleate (14:1n5)	1.04	0.9348	0.8015
		pentadecanoate (15:0)	1.32	0.1340	0.6459
		palmitoleate (16:1n7)	1.00	0.8222	0.7822
		margarate (17:0)	0.94	0.3815	0.7285
		10-heptadecenoate (17:1n7)	1.02	0.8762	0.7822
		oleate (18:1n9)	1.05	0.6979	0.7543
		cis-vaccenate (18:1n7)	1.09	0.4288	0.7285
		13-octadecenoate (18:1n5)	0.99	0.8679	0.7822
		nonadecanoate (19:0)	0.94	0.4229	0.7285
		10-nonadecenoate (19:1n9)	0.99	0.7444	0.7573
		eicosenoate (20:1n9 or 11)	1.01	0.9494	0.8015
dihomo-linoleate (20:2n6)		0.97	0.5338	0.7509	
arachidonate (20:4n6)		0.90	0.2341	0.7078	
docosadienoate (22:2n6)		0.88	0.0834	0.5662	
docosatienoate (22:3n3)		1.07	0.3696	0.7285	
adrenate (22:4n6)	0.95	0.5883	0.7543		
Fatty acid, monohydroxy	2-hydroxystearate	1.06	0.9756	0.8039	
	2-hydroxypalmitate	1.16	0.5467	0.7509	
Fatty acid, amide	oleamide	0.77	0.7672	0.7600	
Fatty acid, branched	15-methylpalmitate (isobar with 2-methylpalmitate)	1.11	0.3461	0.7285	
Fatty acid metabolism (also BCAA metabolism)	17-methylstearate	1.11	0.8594	0.7822	
Carnitine metabolism	butyrylcarnitine	0.91	0.4983	0.7509	
	deoxycarnitine	1.06	0.6096	0.7543	
	carnitine	0.95	0.4690	0.7394	
	3-dehydrocarnitine*	0.92	0.6641	0.7543	
Glycerolipid metabolism	acetylcarnitine	1.13	0.7300	0.7563	
	choline phosphate	0.59	0.0000	0.0010	
	phosphoethanolamine	0.77	0.4601	0.7394	
	choline	1.04	0.9164	0.7975	
	glycerol 3-phosphate (G3P)	2.67	0.0000	0.0002	
Inositol metabolism	glycerophosphorylcholine (GPC)	2.48	0.0000	0.0002	
	myo-inositol	1.10	0.6454	0.7543	
	inositol 1-phosphate (I1P)	1.01	0.9612	0.8015	
	scyllo-inositol	1.12	0.8466	0.7822	
	1-palmitoylglycerophosphoethanolamine	0.87	0.1867	0.7021	
	1-stearoylglycerophosphoethanolamine	0.72	0.5376	0.7509	
	1-oleoylglycerophosphoethanolamine	1.05	0.6975	0.7543	
	2-oleoylglycerophosphoethanolamine*	0.98	0.9418	0.8015	
	1-arachidonoylglycerophosphoethanolamine*	1.01	0.8829	0.7822	
	2-arachidonoylglycerophosphoethanolamine*	1.02	0.9193	0.7975	
2-docosapentaenoylglycerophosphoethanolamine*	0.85	0.2047	0.7078		

Lysolipid		2-docosahexaenoylglycerophosphoethanolamine*	0.91	0.2468	0.7078	
		1-myristoylglycerophosphocholine	0.85	0.3054	0.7285	
		2-myristoylglycerophosphocholine*	0.97	0.7063	0.7543	
		1-pentadecanoylglycerophosphocholine*	0.99	0.8378	0.7822	
		1-palmitoylglycerophosphocholine	1.04	0.7580	0.7592	
		2-palmitoylglycerophosphocholine*	0.95	0.5718	0.7543	
		1-palmitoleoylglycerophosphocholine*	1.34	0.3825	0.7285	
		2-palmitoleoylglycerophosphocholine*	0.98	0.7149	0.7543	
		1-heptadecanoylglycerophosphocholine	0.94	0.7189	0.7543	
		1-stearoylglycerophosphocholine	0.92	0.8984	0.7907	
		1-oleoylglycerophosphocholine	0.95	0.7263	0.7563	
		2-oleoylglycerophosphocholine*	1.02	0.9053	0.7929	
		1-linoleoylglycerophosphocholine	0.96	0.7036	0.7543	
		2-linoleoylglycerophosphocholine*	1.04	0.9605	0.8015	
		2-arachidonoylglycerophosphocholine*	1.09	0.7352	0.7573	
		2-docosapentaenoylglycerophosphocholine*	1.09	0.7123	0.7543	
		1-palmitoleoylglycerophosphoinositol*	1.14	0.7198	0.7543	
		1-stearoylglycerophosphoinositol	1.17	0.6970	0.7543	
		1-arachidonoylglycerophosphoinositol*	1.11	0.4287	0.7285	
		1-oleoylglycerophosphoserine	0.87	0.3974	0.7285	
		1-palmitoylplasménylethanolamine*	0.91	0.3452	0.7285	
	Monoacylglycerol		1-palmitoylglycerol (1-monopalmitin)	1.06	0.7965	0.7806
			2-palmitoylglycerol (2-monopalmitin)	1.04	0.7626	0.7597
			1-stearoylglycerol (1-monostearin)	1.06	0.7454	0.7573
			1-oleoylglycerol (1-monolein)	0.85	0.3174	0.7285
			1-linoleoylglycerol (1-monolinolein)	0.91	0.6338	0.7543
	Sphingolipid		sphinganine	0.88	0.6619	0.7543
			sphingosine	1.05	0.8626	0.7822
			palmitoyl sphingomyelin	1.09	0.4351	0.7285
		stearoyl sphingomyelin	1.30	0.2558	0.7078	
Sterol/Steroid		lathosterol	1.09	0.5237	0.7509	
		cholesterol	1.14	0.2439	0.7078	
		7-dehydrocholesterol	1.50	0.2221	0.7078	
		7-alpha-hydroxycholesterol	0.87	0.4806	0.7400	
		7-beta-hydroxycholesterol	1.09	0.8480	0.7822	
Nucleotide	Purine metabolism, (hypo)xanthine/inosine containing	xanthine	0.98	0.6600	0.7543	
		hypoxanthine	0.90	0.1778	0.7021	
		inosine	1.10	0.4809	0.7400	
	Purine metabolism, adenine containing	adenine	0.78	0.2015	0.7078	
		adenosine	1.00	0.9638	0.8015	
	Purine metabolism, guanine containing	guanine	1.39	0.3866	0.7285	
		guanosine	1.71	0.1176	0.6459	
	Pyrimidine metabolism, cytidine containing	cytidine	1.31	0.1179	0.6459	
	Pyrimidine metabolism, orotate containing	orotate	0.62	0.1389	0.6459	
	Pyrimidine metabolism, thymine containing	thymidine	0.94	0.2769	0.7248	
		uracil	0.72	0.0015	0.0669	
		uridine	1.18	0.0808	0.5662	
		pseudouridine	0.86	0.5430	0.7509	
Cofactors and vitamins	Nicotinate and nicotinamide metabolism	nicotinamide	0.97	0.8149	0.7822	
		nicotinamide ribonucleotide (NMN)	1.40	0.1373	0.6459	
		nicotinamide adenine dinucleotide (NAD+)	1.17	0.8715	0.7822	
		nicotinamide riboside*	0.85	0.2087	0.7078	
		adenosine 5'diphosphoribose	1.91	0.0213	0.2941	
		nicotinate ribonucleoside*	0.70	0.0152	0.2290	
	Pantothenate and CoA metabolism	pantothenate	1.07	0.6977	0.7543	
		phosphopantetheine	0.82	0.1387	0.6459	
		coenzyme A	1.56	0.3613	0.7285	
	Riboflavin metabolism	flavin adenine dinucleotide (FAD)	1.12	0.2732	0.7248	
		riboflavin (Vitamin B2)	0.90	0.3706	0.7285	
		flavin mononucleotide (FMN)	0.71	0.0649	0.5348	
	Thiamine metabolism	thiamin (Vitamin B1)	0.82	0.3791	0.7285	
	Tocopherol metabolism	alpha-tocopherol	2.81	0.0836	0.5662	
	Vitamin B6 metabolism	pyridoxamine	0.96	0.5079	0.7509	
Xenobiotics	Benzoate metabolism	benzoate	1.19	0.3342	0.7285	
		glycolate (hydroxyacetate)	0.97	0.9861	0.8089	
	Chemical	glycerol 2-phosphate	1.20	0.6572	0.7543	
		HEPES	1.09	0.5310	0.7509	
		phenol red	1.18	0.2453	0.7078	
	Drug	penicillin G	1.28	0.1006	0.6287	
Sugar, sugar substitute, starch		erythritol	1.09	0.6738	0.7543	

Symbol	Unigene	Description	Fold Regulation (HuR IP vs. IgG IP)	p-value
ACLY	Hs.387567	ATP citrate lyase	1.5429	0.648673
ACO1	Hs.567229	Aconitase 1, soluble	-42.206	0.355898
ACO2	Hs.643610	Aconitase 2, mitochondrial	-6.6202	0.146843
AGL	Hs.904	Amylo-alpha-1, 6-glucosidase, 4-alpha-glucanotransferase	-9.5095	0.052489
ALDOA	Hs.513490	Aldolase A, fructose-bisphosphate	-2.1501	0.235413
ALDOB	Hs.530274	Aldolase B, fructose-bisphosphate	-10.7919	0.154068
ALDOC	Hs.155247	Aldolase C, fructose-bisphosphate	-12.0995	0.152609
BPGM	Hs.198365	2,3-bisphosphoglycerate mutase	-1.4968	0.251449
CS	Hs.430606	Citrate synthase	4.9524	0.00311
DLAT	Hs.335551	Dihydrolipoamide S-acetyltransferase	1.6224	0.516277
DLD	Hs.131711	Dihydrolipoamide dehydrogenase	-1.7434	0.275389
DLST	Hs.525459	Dihydrolipoamide S-succinyltransferase	-2.1058	0.168569
ENO1	Hs.517145	Enolase 1, (alpha)	1.2884	0.884119
ENO2	Hs.511915	Enolase 2 (gamma, neuronal)	3.5079	0.101815
ENO3	Hs.224171	Enolase 3 (beta, muscle)	-4.0191	0.552746
FBP1	Hs.494496	Fructose-1,6-bisphosphatase 1	-12.0995	0.152609
FBP2	Hs.61255	Fructose-1,6-bisphosphatase 2	-12.0995	0.152609
FH	Hs.592490	Fumarate hydratase	-2.4741	0.36243
G6PC	Hs.212293	Glucose-6-phosphatase, catalytic subunit	-12.0995	0.152609
G6PC3	Hs.294005	Glucose 6 phosphatase, catalytic, 3	-6.6317	0.156572
G6PD	Hs.461047	Glucose-6-phosphate dehydrogenase	-2.712	0.571444
GALM	Hs.435012	Galactose mutarotase (aldose 1-epimerase)	-12.0995	0.152609
GBE1	Hs.436062	Glucan (1,4-alpha-), branching enzyme 1	16.6578	0.000815
GCK	Hs.1270	Glucokinase (hexokinase 4)	-12.0995	0.152609
GPI	Hs.466471	Glucose-6-phosphate isomerase	17.0965	0.012038
GSK3A	Hs.466828	Glycogen synthase kinase 3 alpha	-2.0165	0.24973
GSK3B	Hs.445733	Glycogen synthase kinase 3 beta	5.951	0.003484
GYS1	Hs.386225	Glycogen synthase 1 (muscle)	-2.1278	0.189744
GYS2	Hs.82614	Glycogen synthase 2 (liver)	-27.8938	0.083152
H6PD	Hs.463511	Hexose-6-phosphate dehydrogenase (glucose 1-dehydrogenase)	-1.1383	0.644551
HK2	Hs.406266	Hexokinase 2	4.0506	0.009529
HK3	Hs.411695	Hexokinase 3 (white cell)	-9.9306	0.186428
IDH1	Hs.593422	Isocitrate dehydrogenase 1 (NADP+), soluble	11.7584	0.008953
IDH2	Hs.596461	Isocitrate dehydrogenase 2 (NADP+), mitochondrial	-2.9936	0.20309
IDH3A	Hs.591110	Isocitrate dehydrogenase 3 (NAD+) alpha	5.8083	0.035195
IDH3B	Hs.436405	Isocitrate dehydrogenase 3 (NAD+) beta	-1.1723	0.616736
IDH3G	Hs.410197	Isocitrate dehydrogenase 3 (NAD+) gamma	-2.3004	0.076171
MDH1	Hs.526521	Malate dehydrogenase 1, NAD (soluble)	1.0393	0.624689
MDH1B	Hs.147816	Malate dehydrogenase 1B, NAD (soluble)	-12.0995	0.152609
MDH2	Hs.520967	Malate dehydrogenase 2, NAD (mitochondrial)	-1.2221	0.52908
OGDH	Hs.488181	Oxoglutarate (alpha-ketoglutarate) dehydrogenase (lipoamide)	-1.274	0.964913
PC	Hs.89890	Pyruvate carboxylase	-7.474	0.158238
PCK1	Hs.1872	Phosphoenolpyruvate carboxykinase 1 (soluble)	-12.0995	0.152609
PCK2	Hs.75812	Phosphoenolpyruvate carboxykinase 2 (mitochondrial)	-1.9648	0.09237
PDHA1	Hs.530331	Pyruvate dehydrogenase (lipoamide) alpha 1	-1.1703	0.825068
PDHB	Hs.161357	Pyruvate dehydrogenase (lipoamide) beta	-1.4063	0.348239

PKD1	Hs.470633	Pyruvate dehydrogenase kinase, isozyme 1	-1.111	0.343281
PKD2	Hs.256667	Pyruvate dehydrogenase kinase, isozyme 2	-12.0995	0.152609
PKD3	Hs.658190	Pyruvate dehydrogenase kinase, isozyme 3	3.1126	0.28424
PKD4	Hs.8364	Pyruvate dehydrogenase kinase, isozyme 4	-4.2043	0.785768
PDP2	Hs.654693	Pyruvate dehydrogenase phosphatase catalytic subunit 2	2.0858	0.734256
PDPR	Hs.655245	Pyruvate dehydrogenase phosphatase regulatory subunit	-4.7219	0.058316
PFKL	Hs.255093	Phosphofructokinase, liver	-2.4741	0.190138
PGAM2	Hs.632642	Phosphoglycerate mutase 2 (muscle)	-5.7135	0.108531
PGK1	Hs.78771	Phosphoglycerate kinase 1	11.4766	0.001123
PGK2	Hs.367727	Phosphoglycerate kinase 2	-12.0995	0.152609
PGLS	Hs.466165	6-phosphogluconolactonase	-5.0433	0.002385
PGM1	Hs.1869	Phosphoglucomutase 1	-2.3004	0.107363
PGM2	Hs.23363	Phosphoglucomutase 2	-1.1887	0.601879
PGM3	Hs.708038	Phosphoglucomutase 3	-2.4612	0.202776
PHKA1	Hs.201379	Phosphorylase kinase, alpha 1 (muscle)	-7.1323	0.246618
PHKB	Hs.78060	Phosphorylase kinase, beta	-2.5524	0.047759
PHKG1	Hs.715728	Phosphorylase kinase, gamma 1 (muscle)	-8.6751	0.864583
PHKG2	Hs.196177	Phosphorylase kinase, gamma 2 (testis)	-9.0278	0.154681
PKLR	Hs.95990	Pyruvate kinase, liver and RBC	-9.7431	0.380653
PRPS1	Hs.56	Phosphoribosyl pyrophosphate synthetase 1	1.6028	0.192061
PRPS1L1	Hs.169284	Phosphoribosyl pyrophosphate synthetase 1-like 1	-12.0995	0.152609
PRPS2	Hs.654581	Phosphoribosyl pyrophosphate synthetase 2	33.4312	0.00292
PYGL	Hs.282417	Phosphorylase, glycogen, liver	-1.875	0.312615
PYGM	Hs.154084	Phosphorylase, glycogen, muscle	-12.0995	0.152609
RBKS	Hs.11916	Ribokinase	-3.3738	0.174636
RPE	Hs.282260	Ribulose-5-phosphate-3-epimerase	6.345	0.023711
RPIA	Hs.469264	Ribose 5-phosphate isomerase A	11.4171	0.03605
SDHA	Hs.440475	Succinate dehydrogenase complex, subunit A, flavoprotein (Fp)	2.0358	0.029163
SDHB	Hs.465924	Succinate dehydrogenase complex, subunit B, iron sulfur (Ip)	-2.7073	0.11042
SDHC	Hs.444472	Succinate dehydrogenase complex, subunit C	2.0895	0.54811
SDHD	Hs.356270	Succinate dehydrogenase complex, subunit D	-1.6869	0.227871
SUCLA2	Hs.546323	Succinate-CoA ligase, ADP-forming, beta subunit	-1.1033	0.80614
SUCLG1	Hs.270428	Succinate-CoA ligase, alpha subunit	-1.5046	0.269024
SUCLG2	Hs.655250	Succinate-CoA ligase, GDP-forming, beta subunit	-1.4038	0.417678
TALDO1	Hs.438678	Transaldolase 1	-1.0584	0.737969
TKT	Hs.89643	Transketolase	-2.02	0.399791
TPI1	Hs.524219	Triosephosphate isomerase 1	1.6767	0.899637
UGP2	Hs.516217	UDP-glucose pyrophosphorylase 2	-2.1426	0.066812
B2M	Hs.534255	Beta-2-microglobulin	-2.1538	0.170991
HPRT1	Hs.412707	Hypoxanthine phosphoribosyltransferase 1	2.4848	0.050776
RPL13A	Hs.728776	Ribosomal protein L13a	-1.4112	0.742701
GAPDH	Hs.592355	Glyceraldehyde-3-phosphate dehydrogenase	1.2232	0.740027
ACTB	Hs.520640	Actin, beta	836.4439	0.000207