Supplementary table 4. All pathway maps regulated after intake of protein (FDR, q-value <0.05). The ratio indicates the number of regulated genes in our gene set compared to the total number of genes included in the pathway. Examples of genes included in each pathway are listed in the column to the right. All pathways are manually classified into selected biological processes (immune response, apoptosis and survival, signal transduction and others).

| **Biological process** | **Pathways maps** | **Ratio** | **FDR** | **Genes in this pathway** |
| --- | --- | --- | --- | --- |
| Other | Protein folding and maturation\_POMC processing | 17/30 | 7.037E-16 | POMC (ACTH), POMC (alpha-MSH), POMC (proACTH), POMC, Joining peptide (JP), N-POMC, DA-alphaMSH, beta-MSH, CLIP, POMC (beta-Endorphin extracellular region), gamma-MSH, N-POC, POC (beta-LPH), gamma-LPH, ACTH 1-17, gamma2-MSH, gamma3-MSH |
| Immune response | Immune response\_Role of DAP12 receptors in NK cells | 12/55 | 2.697E-05 | KIR2DS2, KIR3DL1, KLRC1, KIR2DL3, KLRD1, PIK3CA, KIR2DL1, KLRC3, KIR2DL4, SOS, HLA-C, VAV2 |
| IGF, mTORC1C signaling | Development\_IGF-1 receptor signaling | 11/51 | 7.228E-05 | GSK3A/B, IRS2, I-kB, PIK3CA, ELK1, RPS6KB1, SOS, IBP, NF-kB, FOXO3A, CCND1 |
| Other | Development\_Role of IL-8 in angiogenesis | 12/65 | 9.416E-05 | SREBP2 (nuclear), SCAP, FASN, I-kB, SREBP2 precursor, PIK3CA, ELK1, S1PR1, SREBP2 (Golgi membrane), NF-kB, CTSB, IL8RB |
| Other | Development\_Thrombopoietin-regulated cell processes | 10/46 | 1.409E-04 | GSK3A/B, CCNDA2, IRS22, CCNA, CCND, PIK3CA, ELK1, RPS6KB1, SOS, AFT1 |
| IGF, mTORC1C signaling | IGF family signaling in colorectal cancer | 11/60 | 2.035E-04 | GSK3A/B, IRS2, CTNNB1, I-kB, PIK3CA, CCND1, RPS6KB1, SOS, DEF6 (IBP), NF-kB, MYB (MYB) |
| Signal transduction | Ovarian cancer (main signaling cascades) | 11/65 | 3.883E-04 | MET (MET), CTNNB1 (CTNNB1), I-kB, PIK3CA (p110-alpha), CCND1, PIK3CA, ELK1, PKA-cat (cAMP-dependent), SOS, NF-kB, ERBB2 ( ERBB2) |
| Other | Translation\_Non-genomic (rapid) action of Androgen Receptor | 9/43 | 3.883E-04 | CTNNB1, ADAR, WNT, PIK3CA, RPS6KB1, SOS, NF-kB, ERBB2, FOXO3A |
| Cell growth and proliferation | Signal transduction\_AKT signaling | 9/43 | 3.883E-04 | HSP90, GSK3A/B, MET (Met), I-kB, PIK3CA, RPS6KB1, NF-kB, FOXO3A, Cyclin D |
| Immune response | PDE4 regulation of cyto/chemokine expression in arthritis | 9/49 | 1.084E-03 | GSK3A/B, NF-kB p50/p50, CCL4, I-kB, PDE4, PIK3CA, PKA-cat (cAMP-dependent), IFNG, NF-kB1 (p50) |
| Other | Some pathways of EMT in cancer cells | 9/81 | 1.238E-03 | PDGF receptor, JAK1, CTNNB1, I-kB, PIK3CA, AXIN, PDGFD, SOS, PDGFRB |
| Ubiquitination | Proteolysis\_Putative SUMO-1 pathway | 7/29 | 1.238E-03 | UBE2E3, RANBP2, NFKBIA, NF-kB, MYB, FASLG (FasR,FAS), SP3 |
| Immune response | Transcription\_Sirtuin6 regulation and functions  | 10/64 | 1.238E-03 | SREBP2 (nuclear), SCAP, ELOVL6, FASN, SREBP2 precursor, S1PR1, SREBP2 (Golgi membrane), FOXO3A, PRKDC, LKB1 |
| Immune response | Immune response\_IFN-alpha/beta signaling via PI3K and NF-kB pathways | 12/94 | 1.400E-03 | JAK1, IRS2, NF-kB2 (p52), I-kB, CCND1, p70 S6 kinases, PIK3CA, NF-kB2 (p100), RSAD2, NF-kB, FOXO3A, NIK(NIK) |
| Signal transduction | Development\_Adenosine A3 receptor signaling | 9/53 | 1.400E-03 | CTNNB1, I-kB, Adenosine A3 receptor, CCND1, ELK1, PKA-cat (cAMP-dependent), SOS, NF-kB, GNAQ |
| Immune response | Development\_PDGF signaling via STATs and NF-kB | 7/32 | 1.901E-03 | PDGF receptor, JAK1, I-kB, PIK3CA, SOS, NF-kB, PDGFRB |
| Cell growth and proliferation | Development\_HGF signaling pathway | 8/47 | 3.408E-03 | MET, CTNNB1, PIK3CA, ELK1, DOCK2, SOS, SDC1, FASR |
| Immune response | Immune response\_IL-9 signaling pathway | 7/36 | 3.774E-03 | NF-kB p50/p50, JAK1, IRS2, I-kB, PIK3CA, SOS, NIK |
| Signal transduction | Signal transduction\_IP3 signaling | 8/49 | 4.148E-03 | PDGF receptor, MET, Galpha(q)-specific nucleotide-like GPCRs, PIK3CA, ELK1, CaMKK, SOS, GNAQ |
| Signal transduction | Development\_ERBB-family signaling | 7/39 | 5.511E-03 | I-kB, PIK3CA, ELK1, SOS, NF-kB, ERBB2, NIK(NIK) |
| Immune response | Apoptosis and survival\_APRIL and BAFF signaling | 7/39 | 5.511E-03 | NF-kB p50/p50, NF-kB2 (p52), CCL4, I-kB, NF-kB2 (p100), NIK(NIK), NF-kB1 (p50) |
| Immune response | Immune response\_M-CSF-receptor signaling pathway | 10/81 | 5.738E-03 | JAK1, CTNNB1, GAB3, TSAD, CCND1, PIK3CA, ELK1, NF-kB, MAP2K5 (MEK5), SOS1 |
| Immune response | Immune response\_IL-11 signaling pathway via MEK/ERK and PI3K/AKT cascades | 9/67 | 6.060E-03 | ADAM10, I-kB, p70 S6 kinases, PIK3CA (p110-alpha), CCND1, NFKBIA, SOS, AFT1, IFNG |
| Immune response | Immune response\_T regulatory cell-mediated modulation of effector T cell and NK cell functions | 8/55 | 7.450E-03 | STAT4, CCL4, NKp30, DLL1, Granzyme A, PKA-cat (cAMP-dependent), Perforin, IFNG |
| Other | Colorectal cancer (general schema) | 6/30 | 7.450E-03 | PTCH1, MET, CTNNB1, DLL1, WNT, IL8RB |
| Other | Development\_Positive regulation of STK3/4 (Hippo) pathway and negative regulation of YAP/TAZ function | 9/70 | 7.527E-03 | CTNNB1, MARKK, MALS-3, PKA-cat (cAMP-dependent), MPP5, ADRB2,ITCH, FasR, LKB1 |
| Immune response | Immune response\_IL-3 signaling via ERK and PI3K | 11/102 | 7.531E-03 | GSK3A/B, PDE4, p70 S6 kinases, PIK3CA (p110-alpha), PIK3CA, IL3RA, ELK1, PKA-cat (cAMP-dependent), SOS, FOXO3A, Slp76 |
| Cell growth and proliferation | Normal and pathological TGF-beta-mediated regulation of cell proliferation | 6/33 | 1.048E-02 | PDGF receptor, CTNNB1, CCND1, AXIN, SOS, PDGFRB |
| Immune response | LRRK2 and immune function in Parkinson's disease | 5/22 | 1.048E-02 | JAK1, I-kB, HSP90 beta, IFNG, NF-kB |
| Immune response | Oxidative stress\_Role of Sirtuin1 and PGC1-alpha in activation of antioxidant defense system | 8/60 | 1.048E-02 | TXNRD2, SCPX, NRF2, GSHR, GCL reg, TXN2, FOXO3A, LKB1 |
| Signal transduction | Transcription\_Androgen Receptor nuclear signaling | 7/46 | 1.048E-02 | SCAP, CTNNB1, ADAR, WNT, CCND1, PKA-cat (cAMP-dependent), SOS |
| Signal transduction | FGF signaling in pancreatic cancer | 7/46 | 1.048E-02 | CTNNB1, CCND1, PIK3CA, NFKBIA, SOS, NF-kB, SDC1 |
| Cell growth and proliferation | Development\_The role of GDNF ligand family/ RET receptor in cell survival, growth and proliferation | 10/92 | 1.067E-02 | CCND12, GDNF, CCND1, PIK3CA, ELK1, NFKBIA, SOS, AFT1, NF-kB, VAV2 |
| Immune response | Development\_Leptin signaling via PI3K-dependent pathway | 7/47 | 1.067E-02 | GSK3A/B, IRS2, I-kB, PIK3CA, PKA-cat (cAMP-dependent), CPT1B, LKB1 |
| Signal transduction | Development\_PIP3 signaling in cardiac myocytes | 7/47 | 1.067E-02 | GSK3A/B, MET (Met), PIK3CA, RPS6KB1, SOS, FOXO3A, Cyclin D |
| Cell growth and proliferation | Development\_PDGF signaling via MAPK cascades | 7/47 | 1.067E-02 | PDGF receptor, PIK3CA, ELK1, PDGF-D, SOS, VAV2, PDGFRB |
| Immune response | Immune response\_IL-2 activation and signaling pathway | 7/48 | 1.184E-02 | JAK1, IL2RB, I-kB, PIK3CA, ELK1, SOS, NF-kB |
| Other | Transcription\_HIF-1 targets | 10/95 | 1.199E-02 | RORA, ARNT, MXI1, ENG, DEC1 (Stra13), MET (Met), Adipophilin, CX3CR1, MDR1, GPI |
| IGF, mTORC1C signaling | Transport\_Macropinocytosis regulation by growth factors | 8/63 | 1.199E-02 | PDGF receptor, EHD4, IRS2, MET, PIK3CA (p110-alpha), SOS, VAV2, PDGFRB |
| Cell growth and proliferation | Cytoskeleton remodeling\_Role of PDGFs in cell migration | 5/24 | 1.279E-02 | PDGF receptor, PIK3CA, PDGF-D, VAV2, PDGFRB |
| Other | Main pathways of Schwann cells transformation in neurofibromatosis type 1  | 9/80 | 1.304E-02 | PDGF receptor, CTNNB1, TC21, CCND1, PIK3CA, ELK1, RPS6KB1, ERBB2, PDGFRB |
| Signal transduction | Development\_Thromboxane A2 signaling pathway | 7/50 | 1.312E-02 | GSK3A/B, CTNNB1, CCND1, PIK3CA, RAP-1B, RPS6KB1, PKA-cat (cAMP-dependent) |
| Signal transduction | Development\_Adenosine A2B receptor signaling | 7/50 | 1.312E-02 | CTNNB1, PIK3CA, ELK1, PKA-cat (cAMP-dependent), SOS, NF-kB, GNAQ |
| Signal transduction | G-protein signaling\_H-RAS regulation pathway | 6/37 | 1.385E-02 | MAGI-1(BAIAP1), GDNF, RasGRP4, PIK3CA, SOS, PDGFRB |
| Immune response | Signal transduction\_NF-kB activation pathways | 7/51 | 1.416E-02 | NF-kB2 (p52), I-kB, NF-kB2 (p100), NF-kB, NF-kB1 (p105), NIK(NIK), NF-kB1 (p50) |
| Lipid metabolism | Regulation of lipid metabolism via LXR, NF-Y and SREBP | 6/38 | 1.533E-02 | SREBP2 (nuclear), SCAP, FASN, SREBP2 precursor, S1PR1, SREBP2 (Golgi membrane) |
| Other | SLE genetic marker-specific pathways in antigen-presenting cells (APC) | 9/84 | 1.624E-02 | JAK1, IRF8, STAT4, I-kB, S1PR1, IFNG, NF-kB, NIK(NIK), TLR9 |
| Apoptose and survival | Apoptosis and survival\_Role of PKR in stress-induced apoptosis | 7/53 | 1.678E-02 | JAK1, I-kB, PP2A regulatory, NFKBIA, IFNG, NF-kB, FasR(FAS) |
| Immune response | Immune response\_OX40L/ OX40 signaling pathway | 8/69 | 1.759E-02 | NF-kB2 (p52), I-kB, PIK3CA, NF-kB2 (p100), Perforin, IFNG, NF-kB, NIK |
| IGF, mTORC1C signaling | Main growth factor signaling cascades in multiple myeloma cells | 6/41 | 2.128E-02 | GSK3A/B, IRS2, I-kB, PIK3CA, SOS, NF-kB |
| Lipid metabolism | Regulation of lipid metabolism\_Insulin regulation of fatty acid metabolism | 9/89 | 2.263E-02 | IRS2, SCAP, ELOVL6, FASN, PIK3CA, S1PR1, PKA-cat (cAMP-dependent), SOS, ODP2 |
| IGF, mTORC1C signaling | Development\_Growth hormone signaling via PI3K/AKT and MAPK cascades | 6/42 | 2.327E-02 | IRS2, Elk-4, PIK3CA (p110-alpha), ELK1, RPS6KB1, SOS |
| Immune response | Signal transduction\_Additional pathways of NF-kB activation (in the nucleus) | 5/30 | 2.785E-02 | I-kB, PRMT5, NFKBIA, NIK, NF-kB1 (p50) |
| Other | Development\_Ligand-independent activation of ESR1 and ESR2 | 6/44 | 2.805E-02 | PIK3CA (p110-alpha), CCND1, PIK3CA, PKA-cat (cAMP-dependent), SOS, ERBB2 |
| Other | Cell adhesion\_Role of CDK5 in cell adhesion | 3/9 | 2.805E-02 | CTNNB1, CDK5, ERBB2 |
| Immune response | Immune response\_IL-3 signaling via JAK/STAT, p38, JNK and NF-kB | 9/93 | 2.805E-02 | JAK1, CCND12, ARNT, I-kB, CCND1, PIK3CA, IL3RA, GZMB, NF-kB |
| Immune response | Immune response\_TNF-R2 signaling pathways | 6/45 | 3.001E-02 | NF-kB2 (p52), I-kB, PIK3CA, NF-kB2 (p100), NF-kB, NIK(NIK) |
| Cell growth and proliferation | Development\_Membrane-bound ESR1: interaction with growth factors signaling | 6/45 | 3.001E-02 | GSK3A/B, CCND1, PIK3CA, ELK1, SOS, ERBB2 |
| Immune response | Immune response\_IL-15 signaling | 7/61 | 3.139E-02 | IL2RB, I-kB, PIK3CA, RPS6KB1, SOS, MYB, NIK |
| Other | Regulation of GSK3 beta in bipolar disorder | 6/46 | 3.199E-02 | PP2A regulatory, ADAR, WNT, AXIN, DVL-1, SOS |
| Immune response | Signal transduction\_PTMs in IL-17-induced CIKS-independent signaling pathways | 6/46 | 3.199E-02 | JAK1, STAT4, PIK3CA (p110-alpha), PIK3CA, ELK1, NF-kB |
| Signal transduction | Development\_Hedgehog signaling | 6/47 | 3.517E-02 | HSP90, PTCH1, CTNNB1, PKA-cat (cAMP-dependent), ITCH, SPOP |
| Cell growth and proliferation | Development\_EGFR signaling via small GTPases | 5/33 | 3.622E-02 | PIK3CA, ELK1, SOS, ERBB2, VAV2 |
| Signal transduction | G-protein signaling\_G-Protein alpha-q signaling cascades | 5/34 | 3.969E-02 | I-kB, PIK3CA, SOS, NF-kB, GNAQ |
| Other | Development\_Melanocyte development and pigmentation | 6/49 | 3.969E-02 | ACTH, alpha-MSH, CTNNB1, PIK3CA, PKA-cat (cAMP-dependent), SOS |
| Immune response | Immune response\_Bacterial infections in normal airways | 6/49 | 3.969E-02 | JAK1, I-kB, IFNG, NF-kB, FasR(FAS), NIK(NIK) |
| Signal transduction | Development\_PEDF signaling | 6/49 | 3.969E-02 | NF-kB p50/p50, GDNF, PIK3CA, NFKBIA, NF-kB, NF-kB1 (p50) |
| Immune response | Development\_G-CSF signaling | 6/49 | 3.969E-02 | JAK1, PIK3CA, SOS, MAP2K5 (MEK5), GFI-1, IL8RB |
| Immune response | Immune response\_T regulatory cell-mediated modulation of antigen-presenting cell functions | 7/66 | 4.153E-02 | IRF8, NF-kB2 (p52), NF-kB2 (p100), PKA-cat (cAMP-dependent), IFNG, NF-kB, NIK |
| Cell growth and proliferation | Role of growth factor receptors transactivation by Hyaluronic acid / CD44 signaling in tumor progression | 5/35 | 4.153E-02 | MET, PIK3CA, ERBB2, MDR1, VAV2 |
| Immune response | Development\_GM-CSF signaling | 6/50 | 4.153E-02 | I-kB, CCND1, PIK3CA, ELK1, SOS, NF-kB |
| Immune response | PDE4 regulation of cyto/chemokine expression in inflammatory skin diseases | 6/50 | 4.153E-02 | NF-kB p50/p50, PDE4, PKA-cat (cAMP-dependent), NFKBIA, IFNG, NF-kB1 (p50) |
| IGF, mTORC1C signaling | Development\_Growth factors in regulation of oligodendrocyte precursor cell proliferation | 7/67 | 4.331E-02 | MET, CCND1, PIK3CA, ELK1, RPS6KB1, SOS, ERBB2 |
| Immune response | Immune response\_Regulation of T cell function by CTLA-4 | 5/36 | 4.427E-02 | AP1G1, AP complex 2 medium (mu) chain, PIK3CA, SOS, NF-kB |
| Signal transduction | Development\_Hedgehog and PTH signaling pathways in bone and cartilage development | 5/36 | 4.427E-02 | PTCH1, CCND1, CCND1, PKA-cat (cAMP-dependent), GNAQ |
| Immune response | Immune response\_IL-12-induced IFNG production | 5/36 | 4.427E-02 | STAT4, I-kB, IFNG, NF-kB, NIK |
| Immune response | Immune response\_MIF-mediated glucocorticoid regulation | 4/23 | 4.543E-02 | I-kB, NFKBIA, IFNG, NF-kB |
| Cell growth and proliferation | Development\_EGFR signaling via PIP3 | 4/23 | 4.543E-02 | IRS2, PIK3CA, ERBB2, VAV2 |
| Cell growth and proliferation | Development\_TGF-beta receptor signaling | 6/52 | 4.543E-02 | SMAD7, ELK1, NFKBIA, SOS, NF-kB, ERBB2 |
| Signal transduction | G-protein signaling\_Proinsulin C-peptide signaling | 6/52 | 4.543E-02 | I-kB, CCND1, PIK3CA, ELK1, SOS, NF-kB |
| Other | Mucin expression in CF airways | 7/69 | 4.543E-02 | I-kB, PIK3CA, PKA-cat (cAMP-dependent), NFKBIA, SOS, ERBB2, GNAQ |
| Immune response | Immune response\_Gastrin in inflammatory response | 7/69 | 4.543E-02 | I-kB, PIK3CA, ELK1, SOS, MAP2K5 (MEK5), NIK(NIK), GNAQ |
| IGF, mTORC1C signaling | Development\_Insulin, IGF-1 and TNF-alpha in brown adipocyte differentiation | 6/53 | 4.655E-02 | IRS2, FASN, RPS6KB1, PKA-cat (cAMP-dependent), ADRB2, INSIG1 |
| Cell growth and proliferation | Development\_Endothelin-1/EDNRA signaling | 6/53 | 4.655E-02 | CTNNB1, CCND1, PIK3CA, ELK1, SOS, GNAQ |
| Other | Cell cycle\_Influence of Ras and Rho proteins on G1/S Transition | 6/53 | 4.655E-02 | CCND12, MLCP (reg), CCND1, PIK3CA, RPS6KB1, NFKBIA |
| Signal transduction | Development\_WNT signaling pathway. Part 2 | 6/53 | 4.655E-02 | NLK, CTNNB1, ADAR, WNT, CCND1, AXIN |
| Signal transduction | Development\_Signaling of Beta-adrenergic receptors via Beta-arrestins | 4/24 | 4.684E-02 | GRK5, PKA-cat (cAMP-dependent), SOS, ADRB2 |
| Cell growth and proliferation | CFTR folding and maturation (normal and CF) | 4/24 | 4.684E-02 | ERP29, CANX, HSP90 beta, GANAB |
| Immune response | Immune response\_Role of integrins in NK cells cytotoxicity | 5/38 | 4.684E-02 | NKG2A, CD94, SOS, IFNG, ICAM3 |
| Cell growth and proliferation | Transcription\_Role of AP-1 in regulation of cellular metabolism | 5/38 | 4.684E-02 | CCND1, GCL reg, IFNG, FASR, HMBS |
| Cell growth and proliferation | Cell cycle\_Regulation of G1/S transition (part 1) | 5/38 | 4.684E-02 | PP2A regulatory, CCND1, CCND1, RPS6KB1 |
| Cell growth and proliferation | Development\_EGFR signaling pathway | 7/71 | 4.722E-02 | JAK1, I-kB, PIK3CA, ELK1, SOS, NF-kB, ERBB2 |
| Immune response | Immune response\_Antigen presentation by MHC class I, classical pathway | 6/54 | 4.722E-02 | HLA-A, CANX, MIC2, GANAB, IFNG, THOP1 |
| Immune response | Immune response\_TSLP signalling | 5/39 | 4.969E-02 | JAK1, STAT4, PIK3CA, NFKBIA, NF-kB |
| Signal transduction | Cell adhesion\_PLAU signaling | 5/39 | 4.969E-02 | JAK1, MET, PIK3CA, ELK1, SOS |
| Immune response | Immune response\_Differentiation and clonal expansion of CD8+ T cells | 5/39 | 4.969E-02 | STAT4, GZMB, PRF1, IFNG, NF-kB |

FDR – false discovery rate