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Supplemental Information

Proteome Imbalance of Mitochondrial Electron Transport Chain in Brown Adipocytes Leads to Metabolic Benefits

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SUPPLEMENTAL INFORMATION

Supplemental Information includes seven figures and three tables.

Table S1: List of primer sequences for q-PCR. Related to Figure 2.

Table S2: Mass spectrometry dataset of BAT from $Lkb1^{BKO}$ mice. Related to Figure 2.

Table S3: Mass spectrometry dataset of BAT from $Tfam^{BKO}$ mice. Related to Figure 4.

Supplementary Figure 1. Related to Figure 1. (A) Representative H&E staining of BAT from ~8-10-week old male CON and $Lkb1^{BKO}$ mice housed at RT. Scale bar: 50 μm. Relative cell size **(B)** and percentage of unilocular adipocytes **(C)** in BAT from ~8-10-week old CON and $Lkb1^{BKO}$ mice housed at RT. Glycerol released *in vitro* prior to and after Forskolin (FSK) stimulation from BAT **(D)** and eWAT **(E)** from ~8-10-week old male CON and $Lkb1^{BKO}$ mice. Sample size: CON (n=7) and $Lkb1^{BKO}$ (n=6). **(F)** Serum glycerol levels prior to and one-hour after CL injection in ~8-10-week old male CON and $Lkb1^{BKO}$ mice. Sample size: CON (n=13) and $Lkb1^{BKO}$ (n=10). **(G)** Core temperature of ~8-10-week old male CON and $Lkb1^{BKO}$ mice housed at RT and 30°C upon 4°C cold challenge. Sample size: CON/RT (n=14), $Lkb1^{BKO}$/RT (n=14), CON/30°C (n=10) and $Lkb1^{BKO}$/30°C (n=14). Scatter plots of energy expenditure (EE) during night **(H)** and day **(I)** over body weight in ~8-10-week old male CON and $Lkb1^{BKO}$ mice housed at RT and 30°C. **(J)** Post hoc (Tukey's HSD) pairwise comparison showing the mean difference in EE between genotypes and ambient temperatures. Average EE **(K)**, respiratory exchange ratio (RER) **(L)**, VO2 per body weight **(M)**, VO2 per mouse **(N)**, food intake **(O)** and physical activity **(P)** during night and day in ~8-10-week old male CON and $Lkb1^{BKO}$ mice housed at RT and 30°C. Sample size: CON/RT (n=5), $Lkb1^{BKO}$/RT (n=4), CON/30°C (n=5) and $Lkb1^{BKO}$/30°C (n=4). Student t-test. *: $p<0.1$, **: $p<0.05$ and ***: $p<0.01$.

Supplementary Figure 2. Related to Figure 2. (A) Blue native staining of ETC complexes (C-I, C-II, C-III, C-IV and C-V) and super complexes (Super C) of BAT from ~8-10-week old male and female CON and Lkb1^{BKO} mice housed at 30°C. **(B)** Mitochondrial cocktail immunoblot showing amounts of representative subunit proteins of each ETC complex, Ndufb8 (C-I), Sdhb (C-II), Uqcrc2 (C-III), mt-Co1 (C-IV) and Atp5a (C-V), of BAT of ~8-10-week old male and female CON and Lkb1^{BKO} mice housed at RT and 30°C. (**C)** Quantification of band intensity in panel B. **(D)** Frequency of mitochondrial and non-mitochondrial proteins identified by mass spectrometry from isolated mitochondria of ~8-10-week old male CON and Lkb1^{BKO} mice housed at RT and 30°C. Sample size: n=3 for each condition (CON/RT, CON/30°C, Lkb1^{BKO}/RT and Lkb1^{BKO}/30°C). **(E)** Principle component analysis of mitochondrial proteome in the four conditions. **(F, G)** Volcano plots showing significantly ($p<0.1$) down- or up-regulated mitochondrial proteins (over 1.5 fold) in Lkb1^{BKO} mice at RT and 30°C. **(H, I)** Venn diagrams showing numbers of down- or up-regulated proteins in Lkb1^{BKO} mice which were overlapped at RT and 30°C. Immunoblots showing protein abundance of C-IV subunits (mt-Co1, mt-Co2, Cox4, Cox5b and Cox6b1), C-II subunit Sdhb, Sdhc and Hsp60 in BAT mitochondria from ~8-10-week old male and female betaless and control mice housed at RT **(J)** and 30°C **(K)**. **(L)** Fold change of steady state mRNA levels of mtDNA-encoded and nuclear-encoded C-IV subunits in BAT from ~8-10-week-old male and female betaless and control mice at RT and thermoneutrality. **(M)** Fold change of mRNA levels of mtDNA- and nuclear-encoded C-I, C-III and C-IV subunits in the BAT of ~8-10-week-old male and female betaless mice housed at RT and 30°C. Sample size: betaless and control at RT (n=4 each) and betaless and control at 30°C (n=4 each). **(N)**

Immunoblots of Ucp1 and Hsp60 in BAT above mice. **(O)** Relative mRNA levels of *Ucp1* and *Pgc1*α in BAT from ~8-10-week-old male and female betaless mice housed at RT and 30°C. Sample size: n=4 for each genotype/condition. **(P)** Heatmap of mRNA and protein fold change (log2 FC values) of key factors involved in mtDNA replication, transcription and mitochondrial RNA processing and stability in the BAT of male Lkb1^{BKO} mice at RT and thermoneutrality. Protein Log2 FCs were determined by mass spectrometry. N.D.: not detected. mRNA Log2 FCs were calculated by q-PCR. Sample size: CON/RT (n=6), Lkb1^{BKO}/RT (n=6), CON/30°C (n=6) and Lkb1^{BKO}/30°C (n=6). Student t-test. *: $p<0.1$, **: $p<0.05$ and ***: $p<0.01$.

Supplementary Figure 3. Related to Figure 3. (A) Body weight of male CON and $Lkb1^{BKO}$ mice at normal chow (NC) at RT. Sample size: CON (n=9) and $Lkb1^{BKO}$ (n=9). **(B)** Body weight, lean mass, fat mass, and fat percentage of 18-week-old male CON and $Lkb1^{BKO}$ mice at NC at RT. Sample size: CON (n=8) and $Lkb1^{BKO}$ (n=6). **(C)** Tissue mass of BAT, iWAT, eWAT, and liver of 18-week-old male CON and $Lkb1^{BKO}$ mice at NC at RT. Sample size: CON (n=9) and $Lkb1^{BKO}$ (n=9). **(D)** Representative H&E staining of BAT from male CON and $Lkb1^{BKO}$ mice after 4-week HFD housed at RT and 30°C. Scale bar: 50 μm. Relative cell size **(E)** and percentage of unilocular adipocytes **(F)** in BAT from above mice. Body weight of male CON and $Lkb1^{BKO}$ mice under 4-week HFD at RT **(G)** and 30°C **(H)**. Sample size: CON/RT (n=14), $Lkb1^{BKO}$/RT (n=13), CON/30°C (n=17) and $Lkb1^{BKO}$/30°C (n=23). **(I)** Representative images of dissected iWAT, eWAT and BAT tissue from male CON and $Lkb1^{BKO}$ mice housed at 30°C after 4-week HFD. **(J)** Representative H&E staining of eWAT from male CON and $Lkb1^{BKO}$ mice housed at 30°C after 4-week HFD. Scale bar: 100 μm. **(K)** Representative H&E staining of liver from male CON and $Lkb1^{BKO}$ mice housed at 30°C after 4-week HFD. Scale bar: 50 μm. Insert: hepatocyte circled with dashed yellow line. Red arrowheads: lipid droplets. **(L)** Serum glucose levels during ITT in male CON and $Lkb1^{BKO}$ mice after 4-week HFD at RT and 30°C. Area under the curve (AUC) values of glucose levels showed. Sample size: CON/RT (n=21), $Lkb1^{BKO}$/RT (n=9), CON/30°C (n=5) and $Lkb1^{BKO}$/30°C (n=4). **(M)** Serum glucose levels during GTT in male CON and $Lkb1^{BKO}$ mice after 4-week HFD at RT and 30°C. Area under the curve (AUC) values of glucose levels showed. Sample size: n=7 for each genotype/condition. **(N)** Serum fasting glucose levels in above mice. **(O)** Serum insulin levels. Sample size: n=4 for each genotype/condition. **(P)** Immunoblots showing amounts of pS473-Akt, total Akt and Hsp90 in muscle in male CON and $Lkb1^{BKO}$ mice after 4-week HFD at RT and 30°C. Insulin stimulation indicated below. **(Q)** Quantitative analysis of pAkt immunoblots in panel P. **(R)** Q-PCR analysis of mRNA levels of adipokines (*Adiponectin, Leptin,* and *Fgf21*) and macrophage markers (*Cd68, F4/80,* and *Cd11c*) in the eWAT of male CON and $Lkb1^{BKO}$ mice after 4-week HFD at RT and 30°C. Sample size: n=4 for each genotype/condition. Scatter plots of energy expenditure (EE) during night **(S)** and day **(T)** over body weight in male CON and $Lkb1^{BKO}$ mice after 4-week HFD at RT and 30°C. **(U)** Post hoc (Tukey's HSD) pairwise comparison showing the mean difference in EE between genotypes and ambient temperatures. Average EE **(V)**, respiratory exchange ratio (RER) **(W)**, VO2 per body weight **(X)**, VO2 per mouse **(Y)**, food intake **(Z)** and physical activity **(AA)** during night and day in male CON and $Lkb1^{BKO}$ mice after 4-week HFD at RT and 30°C. Sample size: CON/RT (n=3), $Lkb1^{BKO}$/RT (n=5), CON/30°C (n=6) and $Lkb1^{BKO}$/30°C (n=6). Student t-test. *: p<0.1, **: p<0.05 and ***: p<0.01.

Supplementary Figure 4. Related to Figure 4. (A) Immunoblots of Tfam and Hsp60 in BAT mitochondria from ~8-10-week old male and female CON and Tfam^{BKO} mice housed at RT. **(B)** Relative *Tfam* and *Ucp1* mRNA levels in BAT of ~8-10-week old male and female CON and Tfam^{BKO} mice housed at RT. Sample size: CON and Tfam^{BKO} (n=6 each). **(C)** Representative H&E staining of BAT from ~8-10-week old male CON and Tfam^{BKO} mice housed at RT. Scale bar: 50 μm. Relative cell size **(D)** and percentage of unilocular adipocytes **(E)** in BAT from ~8-10-week old male CON and Tfam^{BKO} mice housed at RT. Glycerol released *in vitro* prior to and after FSK stimulation from BAT **(F)** and eWAT **(G)** from ~6-8-week old male CON and Tfam^{BKO} mice. Sample size: CON (n=7) and Tfam^{BKO} (n=6). **(H)** Serum glycerol levels prior to and one-hour after CL injection in ~6-8-week old male CON and Tfam^{BKO} mice. Sample size: n=5 for each genotype. **(I)** Relative mtDNA copy numbers in BAT of ~8-week old male CON and Tfam^{BKO} mice housed at RT. Sample size: CON (n=6) and Tfam^{BKO} (n=7). **(J)** Mitochondrial cocktail immunoblot showing amounts of representative subunit proteins of each ETC complex, Ndufb8 (C-I), Sdhb (C-II), Uqcrc2 (C-III), mt-Co1 (C-IV) and Atp5a (C-V), of BAT of ~8-10-week old male and female CON and Tfam^{BKO} mice housed at RT and 30°C. **(K)** Quantification of band intensity in J. Scatter plots of energy expenditure (EE) during night **(L)** and day **(M)** over body weight in ~8-10-week old male CON and Lkb1^{BKO} mice housed at RT and 30°C. **(N)** Post hoc (Tukey's HSD) pairwise comparison showing the mean difference in EE between genotypes and ambient temperatures. Average EE **(O)**, respiratory exchange ratio (RER) **(P)**, VO2 per body weight **(Q)**, VO2 per mouse **(R)**, food intake **(S)** and physical activity **(T)** during night and day in ~8-10-week old male CON and Tfam^{BKO} mice housed at RT and 30°C.

Sample size: CON/RT (n=5), $Tfam^{BKO}$/RT (n=8), CON/30°C (n=7) and $Tfam^{BKO}$/30°C (n=5). Student t-test. *: p<0.1, **: p<0.05 and ***: p<0.01.

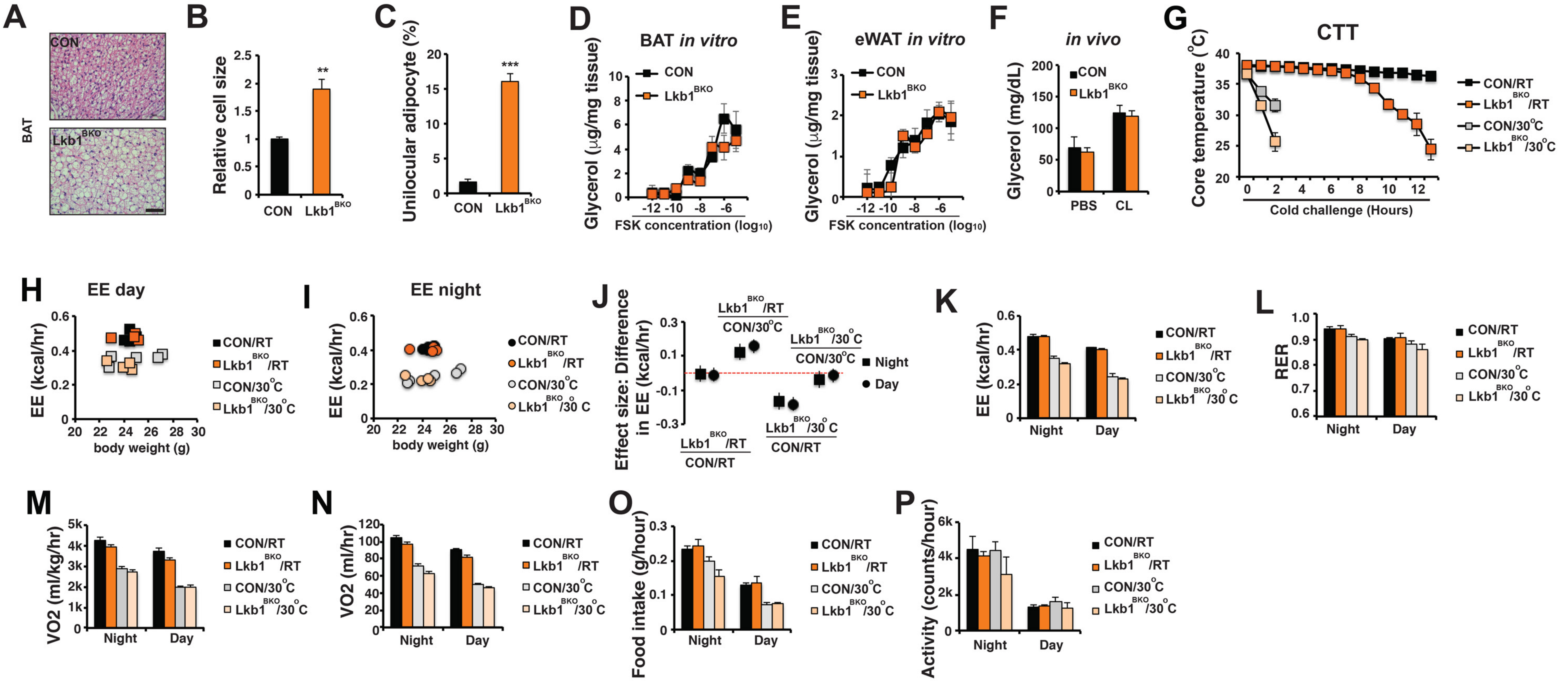
Supplementary Figure 5. Related to Figure 5. (A) Frequency of mitochondrial and non-mitochondrial proteins identified by mass spectrometry from isolated mitochondria of ~8-10-week old male CON and Tfam^{BKO} mice housed at RT and 30°C. Sample size: n=3 for each genotype/condition. **(B)** Principle component analysis of mitochondrial proteome in the four conditions. **(C, D)** Volcano plots showing significantly (p<0.1) down- or up-regulated mitochondrial proteins (over 1.5 fold) in Tfam^{BKO} mice at RT and 30°C. **(E, F)** Venn diagrams showing numbers of down- or up-regulated proteins in Tfam^{BKO} mice which were overlapped at RT and 30°C. **(G)** Shared down-regulated proteins (with p<0.1) in BAT mitochondrial proteome of Lkb1^{BKO} and Tfam^{BKO} mice. I: Proteins down-regulated at both RT and 30°C in both genotypes. II: Proteins down-regulated at both RT and 30°C in one genotype but at either RT or 30°C in another genotype. III: Proteins down-regulated at both RT and 30°C in only one genotype. *: mitoribosome, collection of 32 large and small units of mitochondrial ribosome subunits. #: Complex I, collection of 33 nuclear-encoded complex I subunits. **(H)** Shared up-regulated proteins (with p<0.1) in BAT mitochondrial proteome of Lkb1^{BKO} and Tfam^{BKO} mice. I: Proteins up-regulated at both RT and 30°C in both genotypes. II: Proteins up-regulated at both RT and 30°C in one genotype but at either RT or 30°C in another genotype. III: Proteins up-regulated at both RT and 30°C in only one genotype. Heatmaps of log2FC of proteins important for mitochondrial fusion & fission **(I)**, Glycolysis & TCA cycle **(J)**, and beta-oxidation **(K)** in Lkb1^{BKO} and Tfam^{BKO} mice at RT and 30°C. Student t-test. *: p<0.1, **: p<0.05 and ***: p<0.01.

Supplementary Figure 6. Related to Figure 6. (A) Body weight of male CON and Tfam^{BKO} mice at normal chow (NC) at RT and 30°C. Sample size: CON/RT (n=7), Tfam^{BKO}/RT (n=13), CON/30°C (n=7) and Tfam^{BKO}/30°C (n=7). **(B)** Body weight, lean mass, fat mass, and fat percentage of ~24-week-old male CON and Tfam^{BKO} mice at NC. Sample size: CON/RT (n=6), Tfam^{BKO}/RT (n=7), CON/30°C (n=7) and Tfam^{BKO}/30°C (n=7). **(C)** Tissue mass of BAT, iWAT, eWAT, and liver of ~24-week-old male CON and Tfam^{BKO} mice at NC. Sample size: CON/RT (n=7), Tfam^{BKO}/RT (n=10), CON/30°C (n=7) and Tfam^{BKO}/30°C (n=7). **(D)** Serum glucose levels during ITT in ~24-week-old male CON and Tfam^{BKO} mice at RT and 30°C. Area under the curve (AUC) values of glucose levels showed. Sample size: CON/RT (n=6), Tfam^{BKO}/RT (n=7), CON/30°C (n=7) and Tfam^{BKO}/30°C (n=7). **(E)** Serum glucose levels during GTT in ~24-week-old male CON and Tfam^{BKO} mice at RT and 30°C. Area under the curve (AUC) values of glucose levels showed. Sample size: CON/RT (n=6), Tfam^{BKO}/RT (n=7), CON/30°C (n=7) and Tfam^{BKO}/30°C (n=7). **(F)** Serum insulin levels in ~24-week-old male CON and Tfam^{BKO} mice at RT and 30°C. Sample size: CON/RT (n=4), Tfam^{BKO}/RT (n=4), CON/30°C (n=7) and Tfam^{BKO}/30°C (n=7). **(G)** Liver triglyceride contents of ~24-week-old male CON and Tfam^{BKO} mice at RT and 30°C. Sample size: CON/RT (n=5), Tfam^{BKO}/RT (n=7), CON/30°C (n=7) and Tfam^{BKO}/30°C (n=7). **(H)**, Serum triglyceride contents of ~24-week-old male CON and Tfam^{BKO} mice at RT and 30°C. Sample size: CON/RT (n=5), Tfam^{BKO}/RT (n=7), CON/30°C (n=7) and Tfam^{BKO}/30°C (n=7). **(I)**, Q-PCR analysis of mRNA levels of macrophage markers *Cd68, F4/80* and *Cd11c* in eWAT of ~24-week-old male CON and Tfam^{BKO} mice at RT and

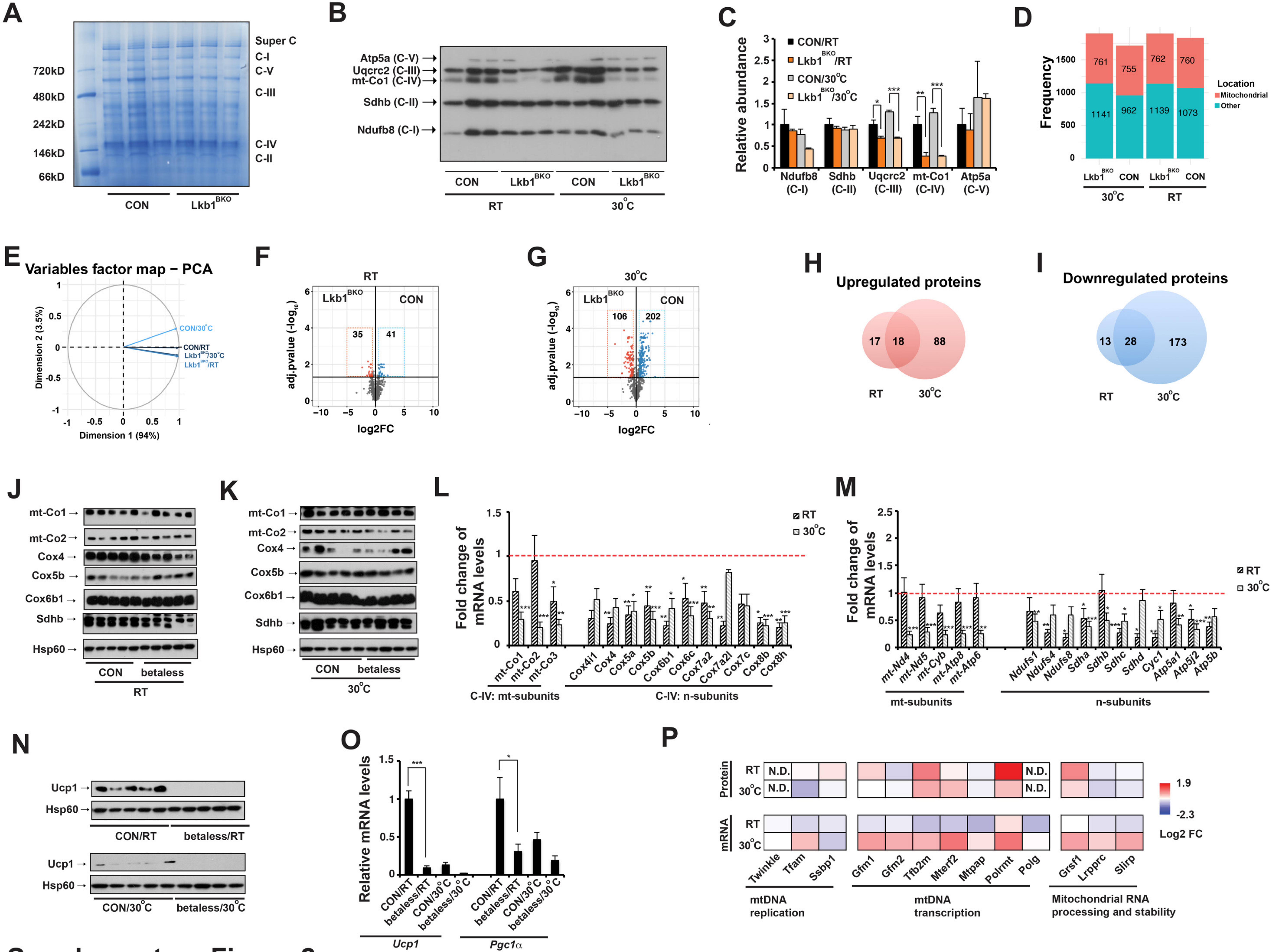
30°C. Sample size: n=6 per genotype/condition. Student t-test. *: $p<0.1$, **: $p<0.05$ and ***: $p<0.01$.

Supplementary Figure 7. Related to Figure 6. (A) Serum glucose levels during ITT in male CON and Tfam^{BKO} mice after 4-week HFD at RT and 30°C. Area under the curve (AUC) values of glucose levels showed. Sample size: CON/RT (n=8), Tfam^{BKO}/RT (n=7), CON/30°C (n=8) and Tfam^{BKO}/30°C (n=8). **(B)** Serum glucose levels during GTT in male CON and Tfam^{BKO} mice after 4-week HFD at RT and 30°C. Area under the curve (AUC) values of glucose levels showed. Sample size: CON/RT (n=5), Tfam^{BKO}/RT (n=7), CON/30°C (n=6) and Tfam^{BKO}/30°C (n=6). **(C)** Serum fasting glucose levels in above mice. **(D)** Serum insulin levels in male CON and Tfam^{BKO} mice after 4-week HFD at RT and 30°C. Sample size: n=4 per genotype/condition. **(E)** Q-PCR analysis of mRNA levels of macrophage markers *Cd68, F4/80* and *Cd11c* in eWAT of male CON and Tfam^{BKO} mice after 4-week HFD at RT and 30°C. Sample size: n=6 per genotype/condition. **(F)** Representative H&E staining of liver from male CON and Tfam^{BKO} mice after 4-week HFD at RT and 30°C. Scale bar: 50 μm. Insert: hepatocyte circled with dashed yellow line. Black arrowheads: lipid droplets. **(G)** Liver triglyceride contents of male CON and Tfam^{BKO} mice after 4-week HFD at RT and 30°C. Sample size: CON/RT (n=8), Tfam^{BKO}/RT (n=8), CON/30°C (n=5) and Tfam^{BKO}/30°C (n=3). **(H)** Serum triglyceride contents of male CON and Tfam^{BKO} mice after 4-week HFD at RT and 30°C. Sample size: CON/RT (n=7), Tfam^{BKO}/RT (n=10), CON/30°C (n=11) and Tfam^{BKO}/30°C (n=10). **(I)** Immunoblots showing amounts of pS473-Akt, total Akt and Hsp90 in muscle in male CON and Tfam^{BKO} mice after 4-week HFD at RT and 30°C. Insulin stimulation indicated below. **(J)** Quantitative analysis of pAkt immunoblots in panel I. Scatter plots of energy expenditure (EE) during night **(K)** and day **(L)** over body weight in male CON and Tfam^{BKO} mice after 4-week HFD at RT and 30°C. **(M)**

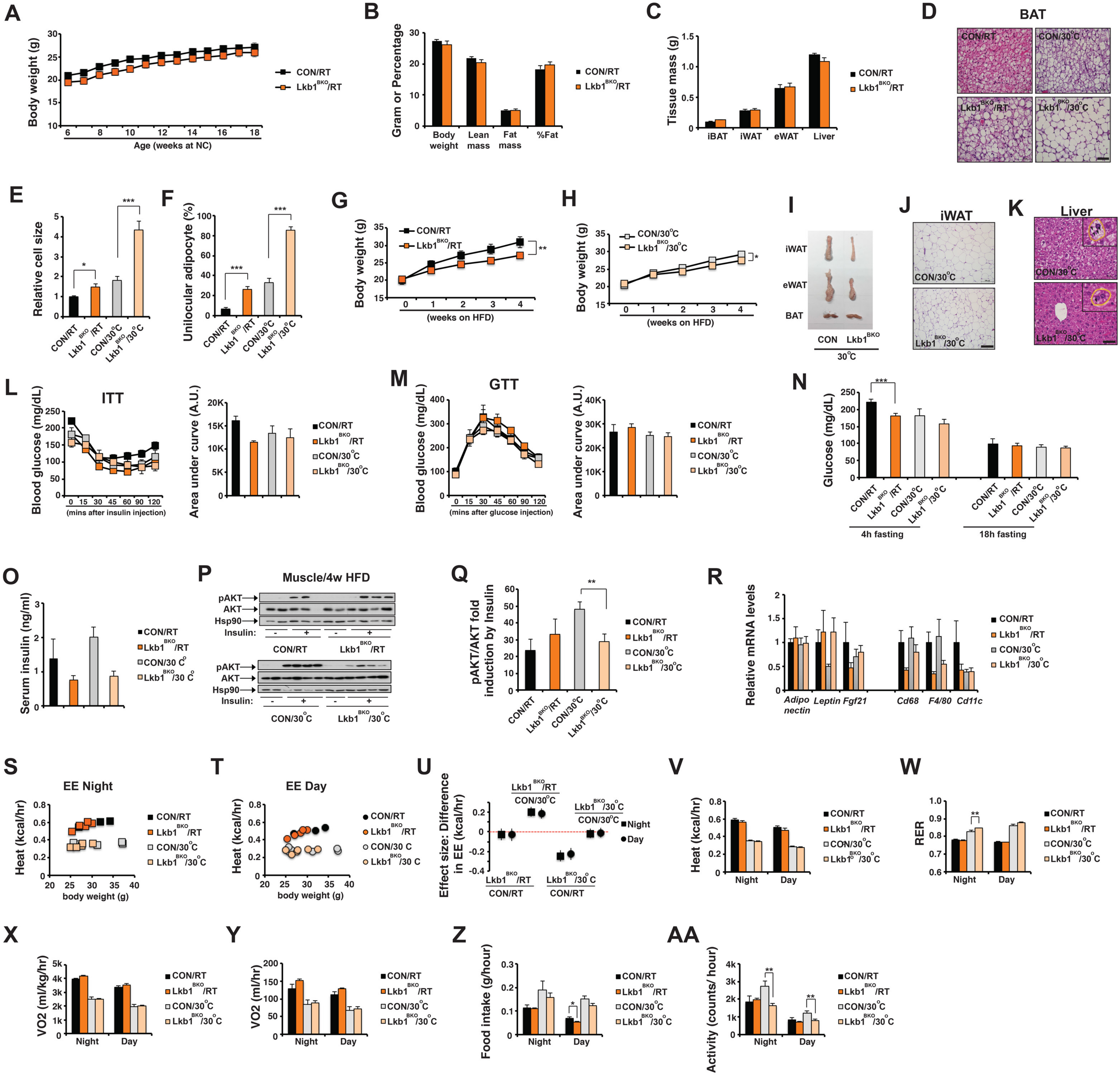
Post hoc (Tukey's HSD) pairwise comparison showing the mean difference in EE between genotypes and ambient temperatures. Average EE **(N)**, respiratory exchange ratio (RER) **(O)**, VO2 per body weight **(P)**, VO2 per mouse **(Q)**, food intake **(R)** and physical activity **(S)** during night and day in male CON and Tfam^{BKO} mice after 4-week HFD at RT and 30°C. Sample size: CON/RT (n=4), Tfam^{BKO}/RT (n=4), CON/30°C (n=7) and Tfam^{BKO}/30°C (n=5). **(T)** Relative mRNA levels of *Ucp1*, *Cox8b* and *Cidea* in iWAT of ~8-10-week old male CON and Tfam^{BKO} mice housed at RT or 30°C. Sample size: CON/RT (n=5), Tfam^{BKO}/RT (n=6), CON/30°C (n=5) and Tfam^{BKO}/30°C (n=5). **(U)** Immunoblots of Ucp1 and Hsp90 in iWAT of ~8-10-week old male CON and Tfam^{BKO} mice housed at RT and 30°C. **(V)** Representative H&E staining of iWAT from ~8-10-week-old male CON and Tfam^{BKO} mice fed with normal chow (NC) at RT and 30°C, or with HFD at RT and 30°C. Scale bar: 100 μm. Student t-test. *: $p<0.1$, **: $p<0.05$ and ***: $p<0.01$.



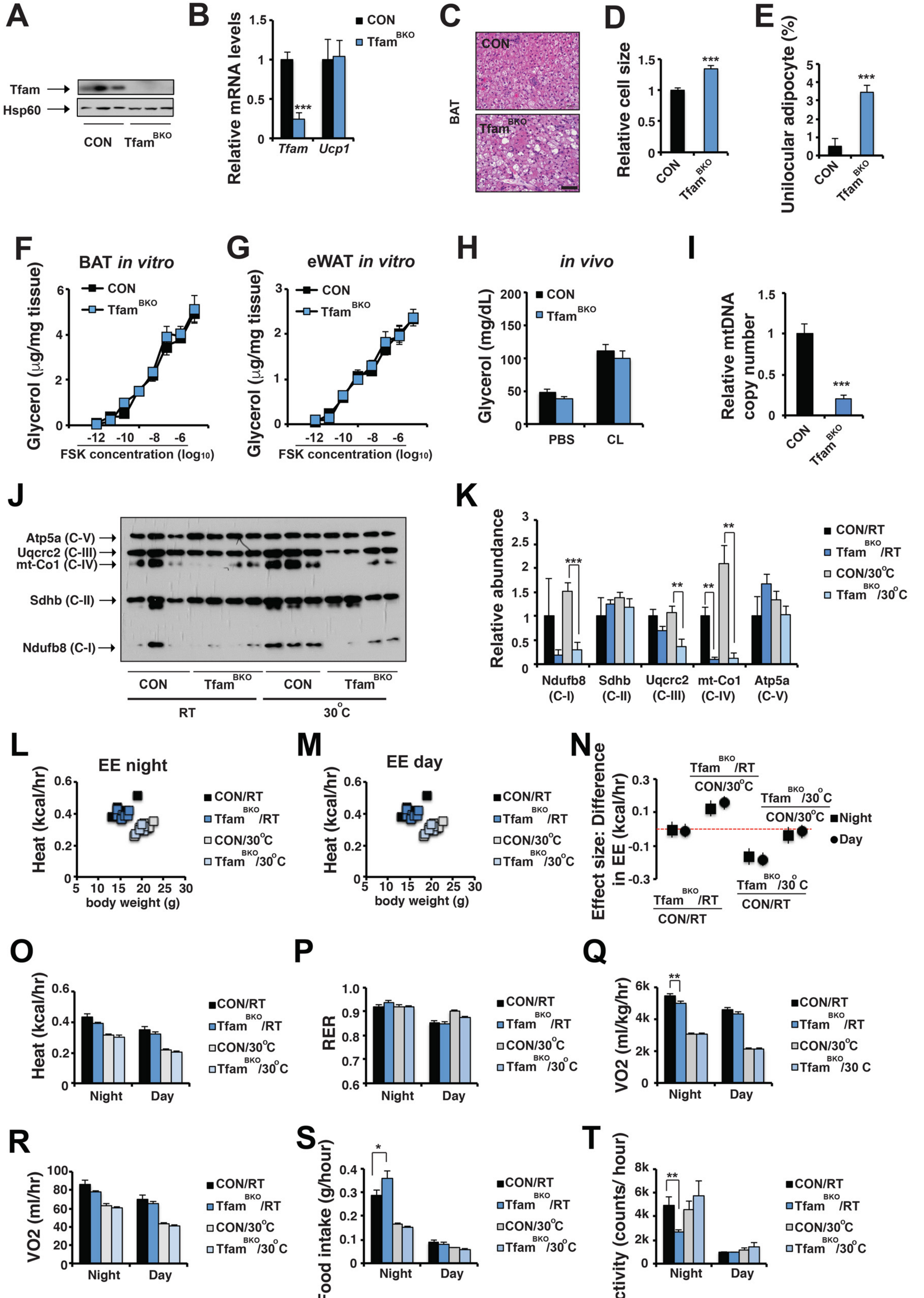
Supplementary Figure 1



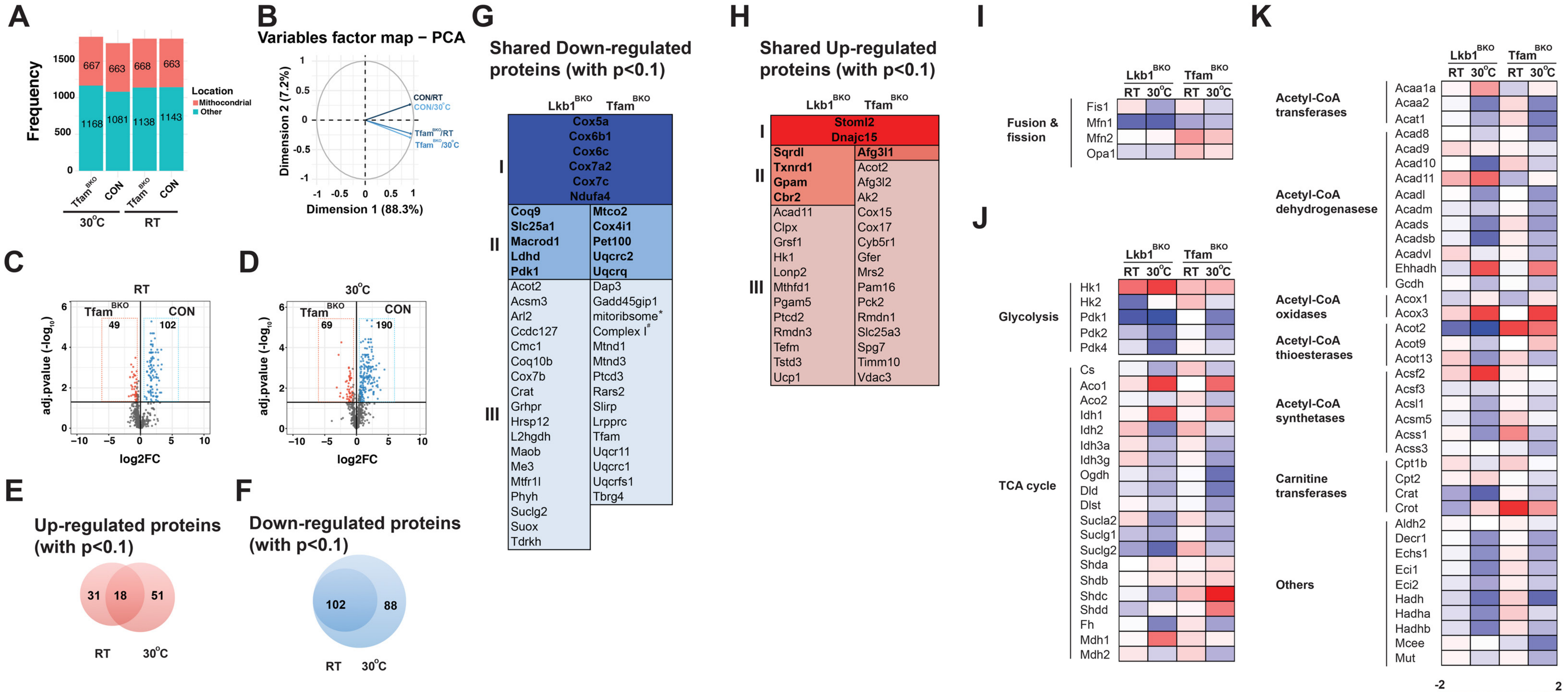
Supplementary Figure 2



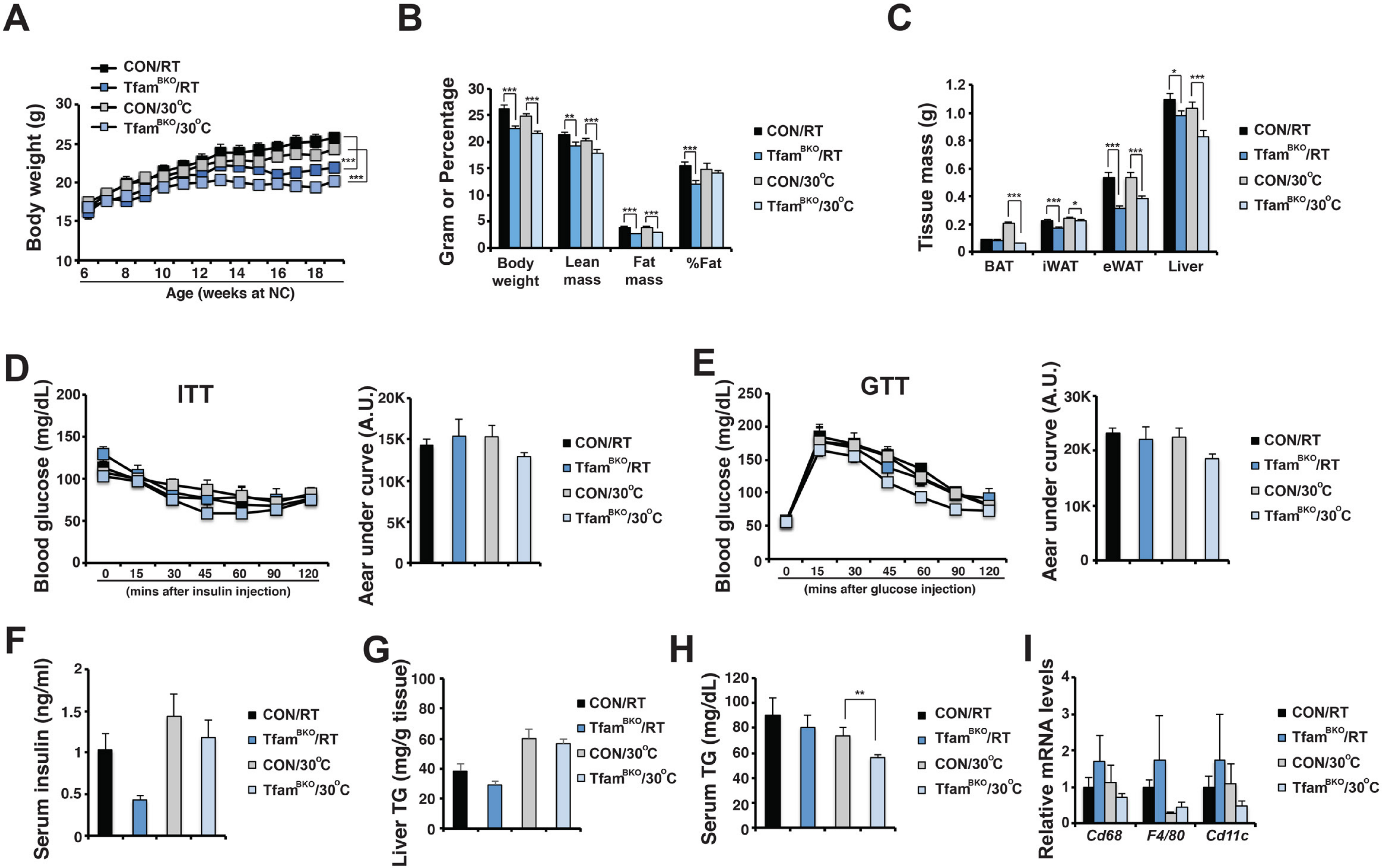
Supplementary Figure 3



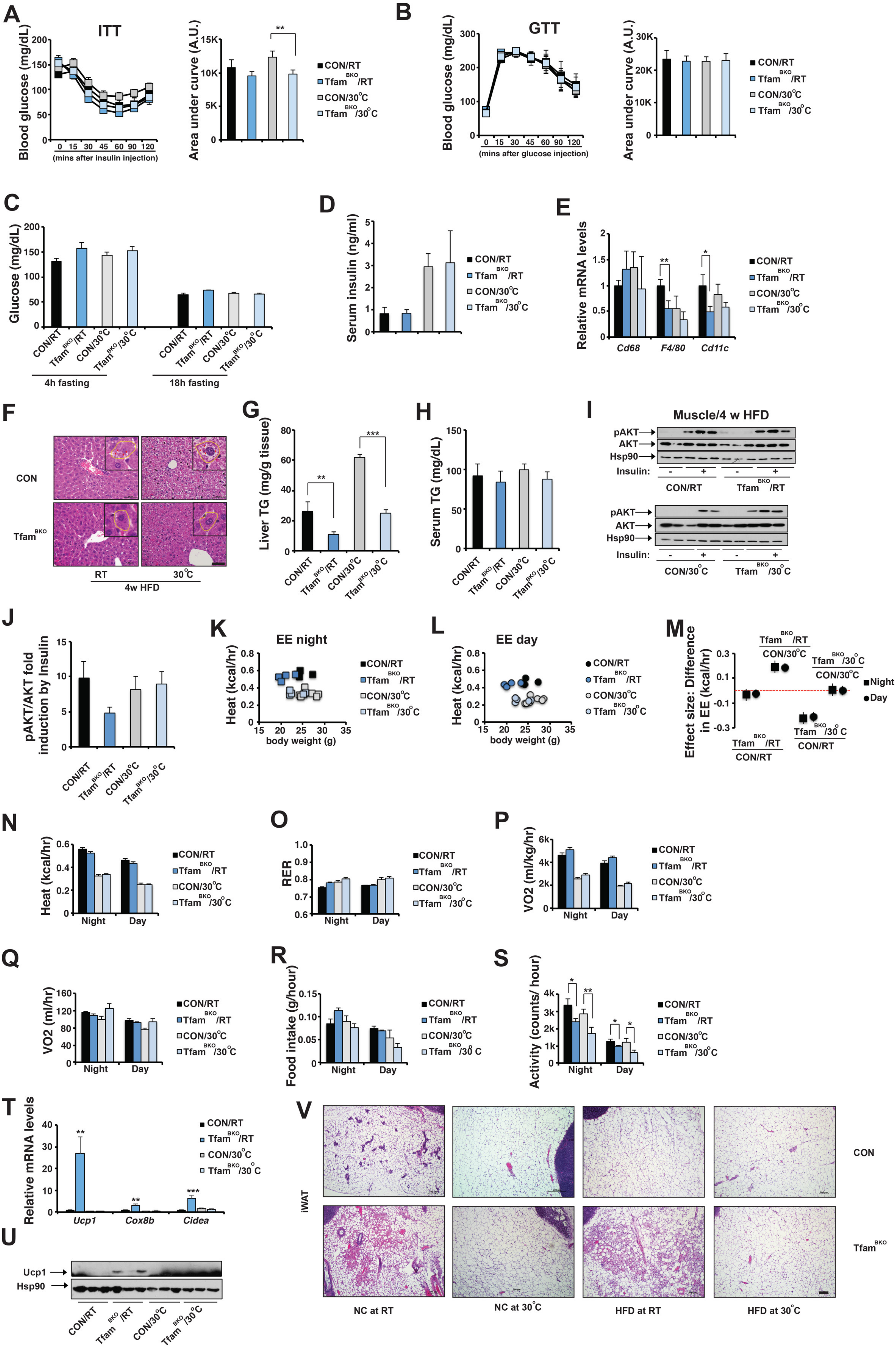
Supplementary Figure 4



Supplementary figure 5



Supplementary Figure 6



Supplementary Figure 7

Supplementary table 1: List of primer sequences for q-PCR

36B4-F	TTTGGGCATCACCACGAAAA
36B4-R	GGACACCCTCCAGAAAGCGA
Lkb1-F	GCCTCCTGAGATTGCCAATG
Lkb1-R	GGTACAGGCCCGTGGTGAT
Ucp1-F	ACTGCCACACCTCCAGTCATT
Ucp1-R	CTTTGCCTCACTCAGGATTGG
Cox8b-F	GAACCATGAAGCCAACGACT
Cox8b-R	GCGAAGTTCACAGTGGTTCC
Cidea-F	TGCTCTTCTGTATCGCCCAGT
Cidea-R	GCCGTGTTAAGGAATCTGCTG
Pgc1a-F	AGCCGTGACCACTGACAACGAG
Pgc1a-R	GCTGCATGGTTCTGAGTGCTAAG
Tfam-F	AAGGATGATTCGGCTCAGG
Tfam-R	GGCTTTGAGACCTAACTGG
mt-Nd4-F	CTAATAATCGCACATGGCCTC
mt-Nd4-R	CGTAGTTGGAGTTTGCTAGG
mt-Nd5-F	CATCCTTCTCAACTTTACTGGG
mt-Nd5-R	TTTATGGGTGTAATGCGGT
mt-Cyb-F	CCATTCTACGCTCAATCCCCA
mt-Cyb-R	AGGCTTCGTTGCTTTGAGGTA
mt-Co1-F	ACACAACTTTCTTTGATCCCG
mt-Co1-R	AGAATCAGAACAGATGCTGG
mt-Co2-F	ATAATCCCAACAAACGACCT
mt-Co2-R	CTCGGTTATCAACTTCTAGCA
mt-Co3-F	GGTATAATTCTATTCATCGTCTCGG
mt-Co3-R	AGAACGCTCAGAAGAATCCT
Ndufs1-F	AGGATATGTTCGCACAACTGG
Ndufs1-R	TCATGGTAACAGAATCGAGGGA
Ndufs4-F	CTGCCGTTTCCGTCTGTAGAG
Ndufs4-R	TGTTATTGCGAGCAGGAACAAA
Ndufs8-F	AGTGGCGGCAACGTACAAG
Ndufs8-R	TCGAAAGAGGTAACTTAGGGTCA
Sdha-F	GGAACACTCCAAAAACAGACCT
Sdha-R	CCACCACTGGGTATTGAGTAGAA
Sdhb-F	AATTTGCCATTTACCGATGGGA
Sdhb-R	AGCATCCAACACCATAGGTCC
Sdhc-F	GCTGCGTTCTTGCTGAGACA
Sdhc-R	ATCTCCTCCTTAGCTGTGGTT
Sdhd-F	TGGTCAGACCCGCTTATGTG
Sdhd-R	GGTCCAGTGGAGAGATGCAG
Cyc1-F	CAGCTTCCATTGCGGACAC
Cyc1-R	GGCACTCACGGCAGAATGAA
Cox4-F	ATGTCACGATGCTGTCTGCC
Cox4-R	GTGCCCCTGTTCATCTCGGC

Cox4i1-F	ATTGGCAAGAGAGCCATTTCTAC
Cox4i1-R	CACGCCGATCAGCGTAAGT
Cox5a-F	GGGTCACACGAGACAGATGA
Cox5a-R	CCAAGATGCGAACAGCACTA
Cox5b-F	GATGAGGAGCAGGCTACTGG
Cox5b-R	TGCAGCCCACTATTCTCTTG
Cox6b1-F	CCCCAACCAGAACCAGACTA
Cox6b1-R	GATCTTCCCAGGAAATGTGC
Cox6c-F	GTCTGCGGGTTCATATTGCT
Cox6c-R	CAGCCTTCCTCATCTCTTCG
Cox7a2-F	GAGGACCATCAGCACCACTT
Cox7a2-R	TTCTGCTTCTTGGGAAATGC
Cox7a2l-F	TATTTGCCACACCAACCAAA
Cox7a2l-R	GCGATCAGGCAGTAGATGGT
Cox7c-F	ATGTTGGGCCAGAGTATCCG
Cox7c-R	ACCCAGATCCAAAGTACACGG
Cox8h-F	AGGAGTGCGACCCCGAGAATC
Cox8h-R	GGCTAAGACCCATCCTGCTGG
Atp5a1-F	TCTCCATGCCTCTAACACTCG
Atp5a1-R	CCAGGTCAACAGACGTGTCAG
Atp5j2-F	TGCCGAGCTGGATAATGATGC
Atp5j2-R	ACCATGCTAATCCCCGAGATG
Atp5b-F	GCAAGGCAGGGACAGCAGA
Atp5b-R	CCCAAGGTCTCAGGACCAACA
mt-Atp8-F	GGCACCTTCACCAAAATCACT
mt-Atp8-R	GGGGTAATGAATGAGGCAAATAGA
mt-Atp6-F	CCTTCAATCCTATTCCCATCC
mt-Atp6-R	GTTGGAAAGAATGGAGACGG
Twinkle-F	TCTTAACTCAGAGCTTTGTCCCGT
Twinkle-R	GTACACAAGTCCAGGGCATAC
Ssbp1-F	AGCCAGCAGTTTGGTTCTTG
Ssbp1-R	TATTCTGTGCCACGTCGTCT
Gfm1-F	TGGGATCTCAGCTCACATTG
Gfm1-R	TAGCTGCTGACTGGATCGTG
Gfm2-F	TTCCGTCATTAACCCTCCTG
Gfm2-R	GAGCCATGAAATCCGTCACT
Tfb2m-F	GAGGAACATGGATGGAGAGC
Tfb2m-R	AGGAACACCTGCTGACCAAG
Mterf2-F	CGACCAGCTCTGAAAATCAA
Mterf2-R	AGAAGCACCCATCCTTTCAG
Mtpap-F	TTATCCCAGCATGGACCAGT
Mtpap-R	AAATGGAATTGCAGCCTCTG
Polrmt-F	AACATGTCCTGAGGGAGTGG
Polrmt-R	GCTGGTCAACTTCCTTTTGG
PolG-F	GCAGGATGGGCAGGAACA
PolG-R	GCATCCGGGAGTCCTGAA

Grsf1-F	CCAAGCTAGGAGACGAGGTG
Grsf1-R	CATCCGGTGCTTTTCTAAGG
Lrpprc-F	AGCCTGCTCCTGTGAGAAAG
Lrpprc-R	TCCCAGATCTTGTGAGCAAA
Slip-F	AGTACTGGTCGGCCTATTGC
Slip-R	GAGGAAAACTGAACCCAACC
Cd68-F	GCAGCACAGTGGACATTCAT
Cd68-R	TTGCATTTCCACAGCAGAAG
F4/80-F	TTTCCTCGCCTGCTTCTTC
F4/80-R	CCCCGTCTCTGTATTCAACC
Cd11c-F	CAGAACTTCCCAACTGCACA
Cd11c-R	TCTCTGAAGCTGGCTCATCA
Adiponectin-F	GATGGCACTCCTGGAGAGAA
Adiponectin-R	TCTCCAGGCTCTCCTTTCCT
Leptin-F	GAGACCCCTGTGTCGGTTC
Leptin-R	CTGCGTGTGTGAAATGTCATTG
Fgf21-F	GTGTCAAAGCCTCTAGGTTTCTT
Fgf21-R	GGTACACATTGTAACCGTCCTC
Tnfa-F	CCCACGTCGTAGCAAACCA
Tnfa-R	ACAAGGTACAACCCATCGGC
Il1b-F	TGCCACCTTTTGACAGTGATG
Il1b-R	AAGGTCCACGGGAAAGACAC
Il6-F	CCAGAGATACAAAGAAATGATGG
Il6-R	ACTCCAGAAGACCAGAGGAAAT
Visfatin-F	CCCGATTGAAGTAAAGGCTGT
Visfatin-R	TGGTAAGCCAGTAGCACTCTG
Resistin-F	CTGTCCAGTCTATCCTTGCACAC
Resistin-R	CAGAAGGCACAGCAGTCTTGA
Rbp4-F	TCTGTGGACGAGAAGGGTCAT
Rbp4-R	CCAGTTGCTCAGAAGACGGAC
Ccl2-F	CTTCTGGGCCTGCTGTTCA
Ccl2-R	CCAGCCTACTCATTGGGATCA