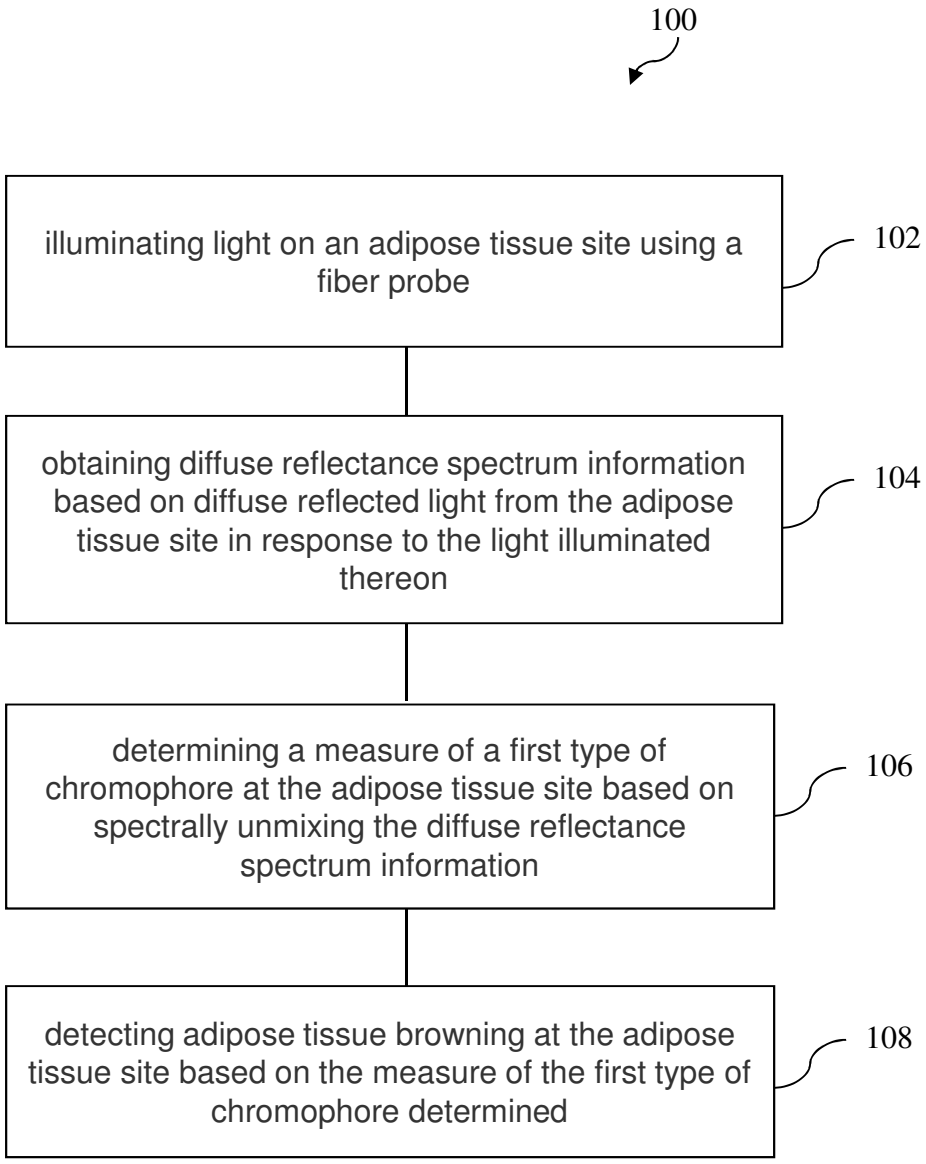

100
illuminating light on an adipose tissue site using a fiber probe
102
obtaining diffuse reflectance spectrum information based on diffuse reflected light from the adipose tissue site in response to the light illuminated thereon
104
determining a measure of a first type of chromophore at the adipose tissue site based on spectrally unmixing the diffuse reflectance spectrum information
106
detecting adipose tissue browning at the adipose tissue site based on the measure of the first type of chromophore determined
108

FIG. 1

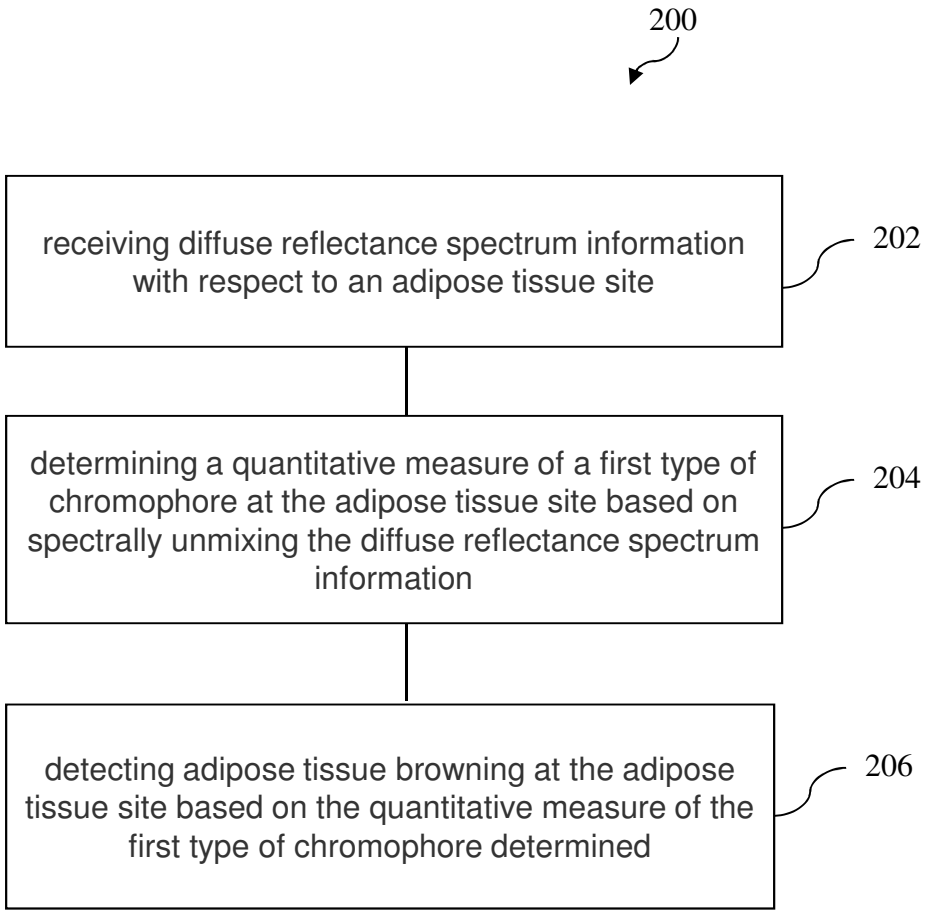

200
receiving diffuse reflectance spectrum information with respect to an adipose tissue site
202
determining a quantitative measure of a first type of chromophore at the adipose tissue site based on spectrally unmixing the diffuse reflectance spectrum information
204
detecting adipose tissue browning at the adipose tissue site based on the quantitative measure of the first type of chromophore determined
206

FIG. 2

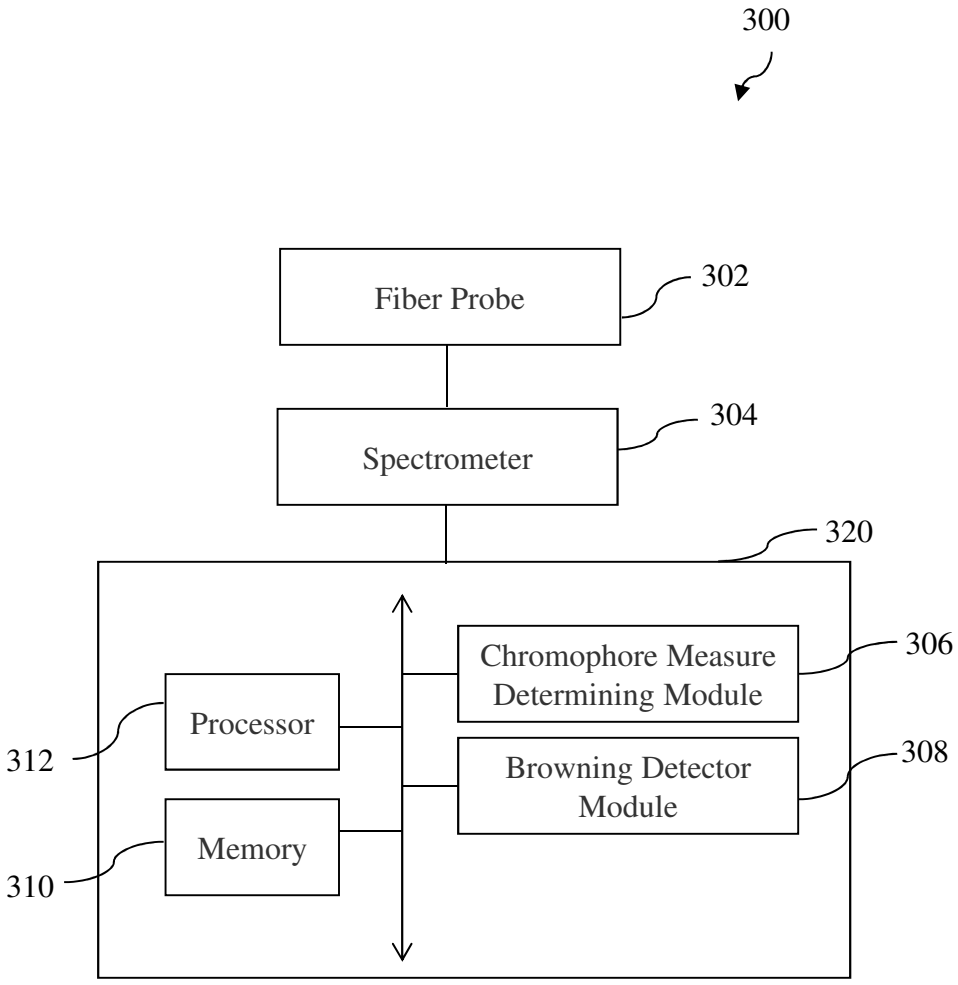

300
Fiber Probe
302
Spectrometer
304
320
Chromophore Measure Determining Module
306
Processor
312
Browning Detector Module
308
Memory
310

FIG. 3

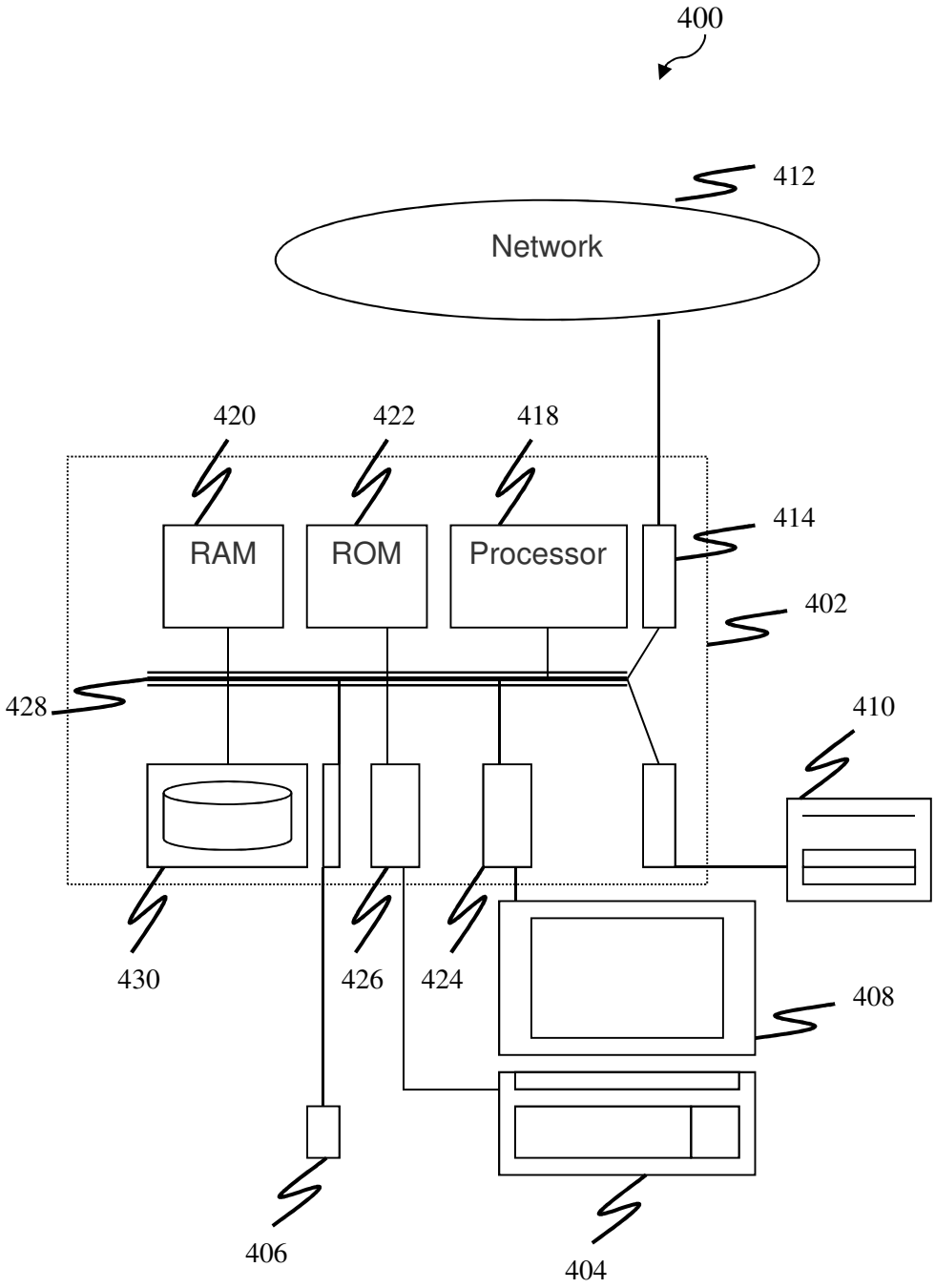

400
412
Network
420
422
418
RAM
ROM
Processor
414
402
428
410
430
426
424
408
406
404

FIG. 4

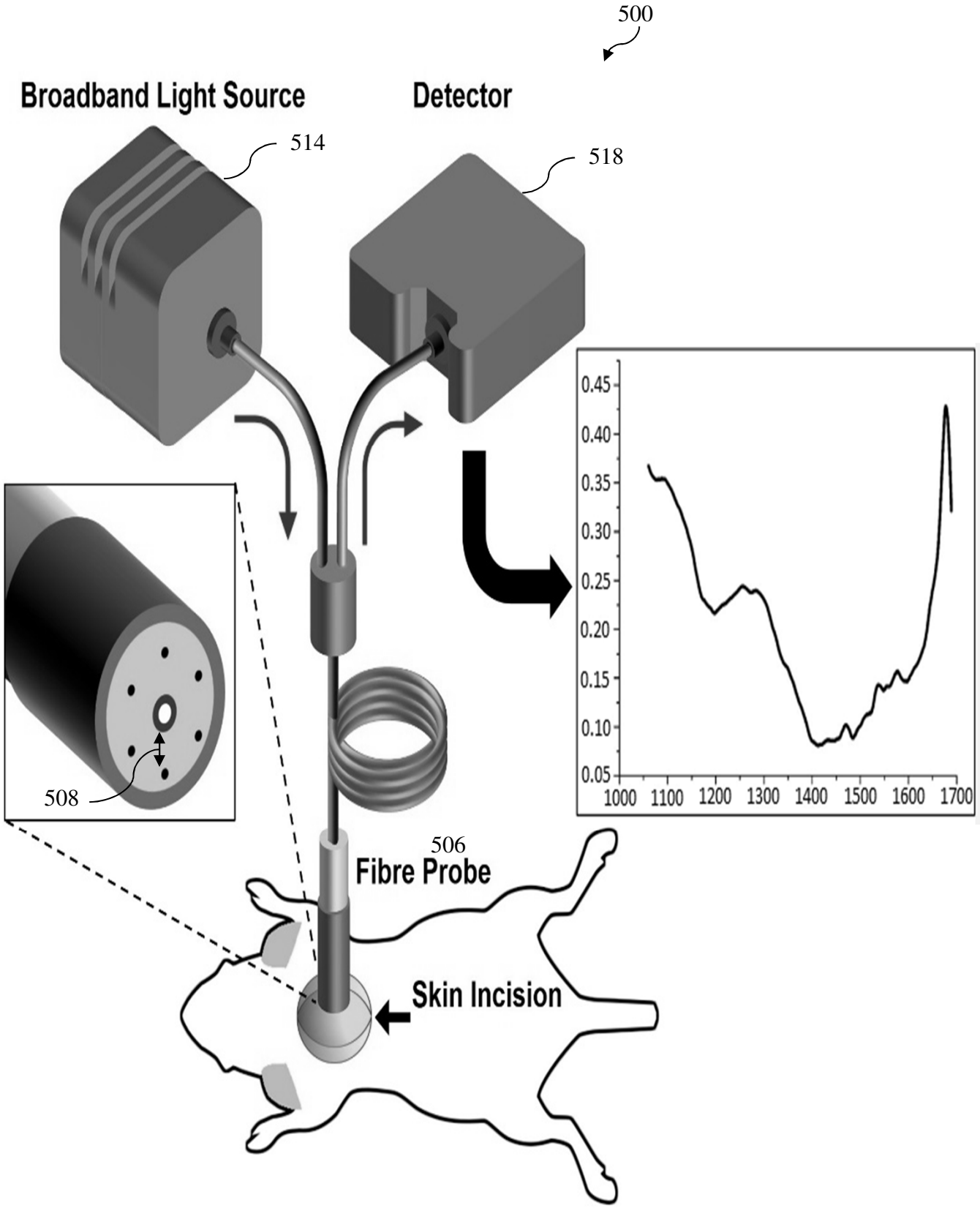

500
Broadband Light Source
Detector
514
518
508
506
Fibre Probe
Skin Incision
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
1000
1100
1200
1300
1400
1500
1600
1700

FIG. 5

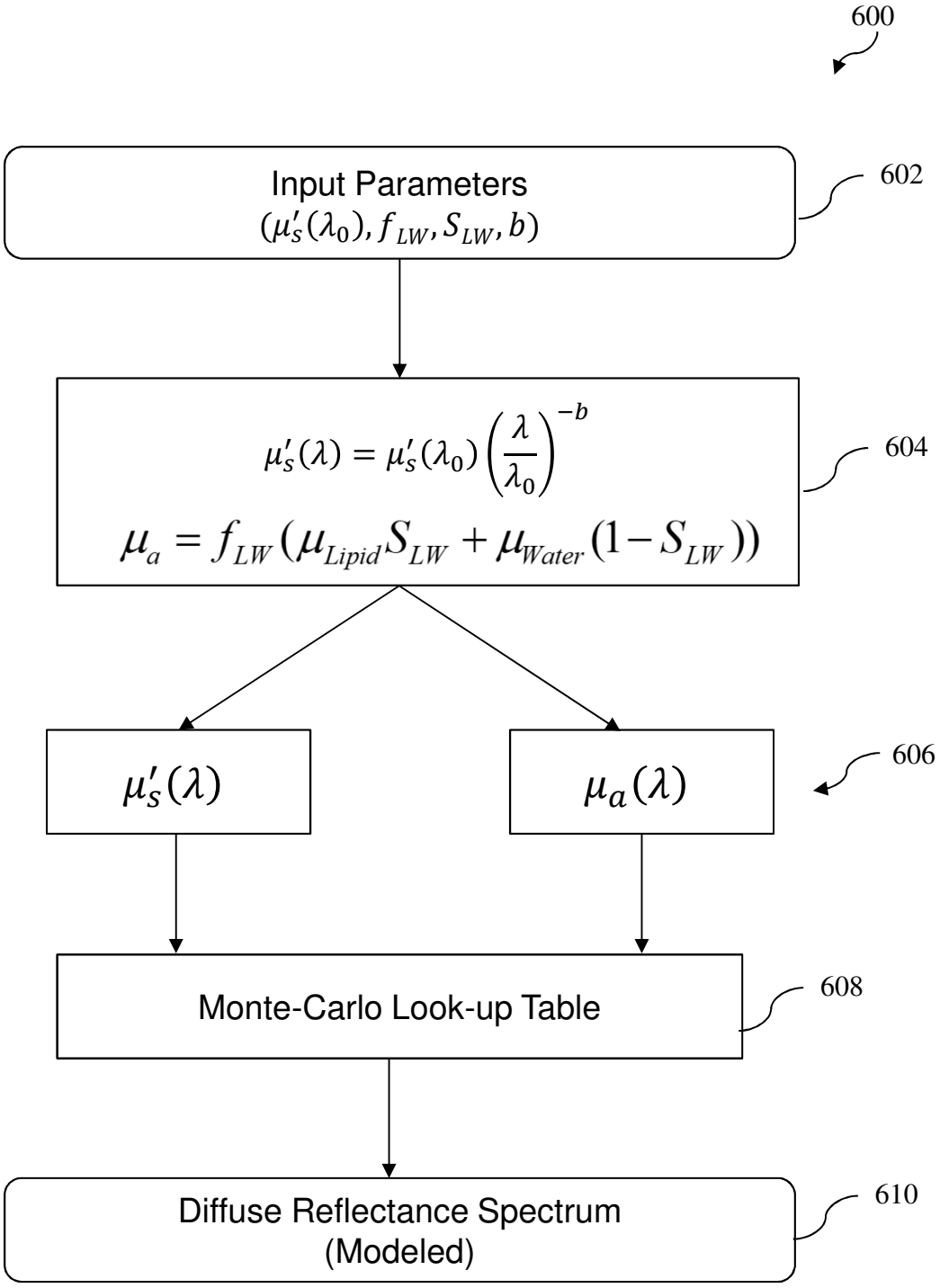

600
Input Parameters
$(\mu_s'(\lambda_0), f_{LW}, S_{LW}, b)$
602
$\mu_s'(\lambda) = \mu_s'(\lambda_0)\left(\frac{\lambda}{\lambda_0}\right)^{-b}$
$\mu_a = f_{LW}(\mu_{Lipid}S_{LW} + \mu_{Water}(1-S_{LW}))$
604
$\mu_s'(\lambda)$
$\mu_a(\lambda)$
606
Monte-Carlo Look-up Table
608
Diffuse Reflectance Spectrum
(Modeled)
610

FIG. 6A

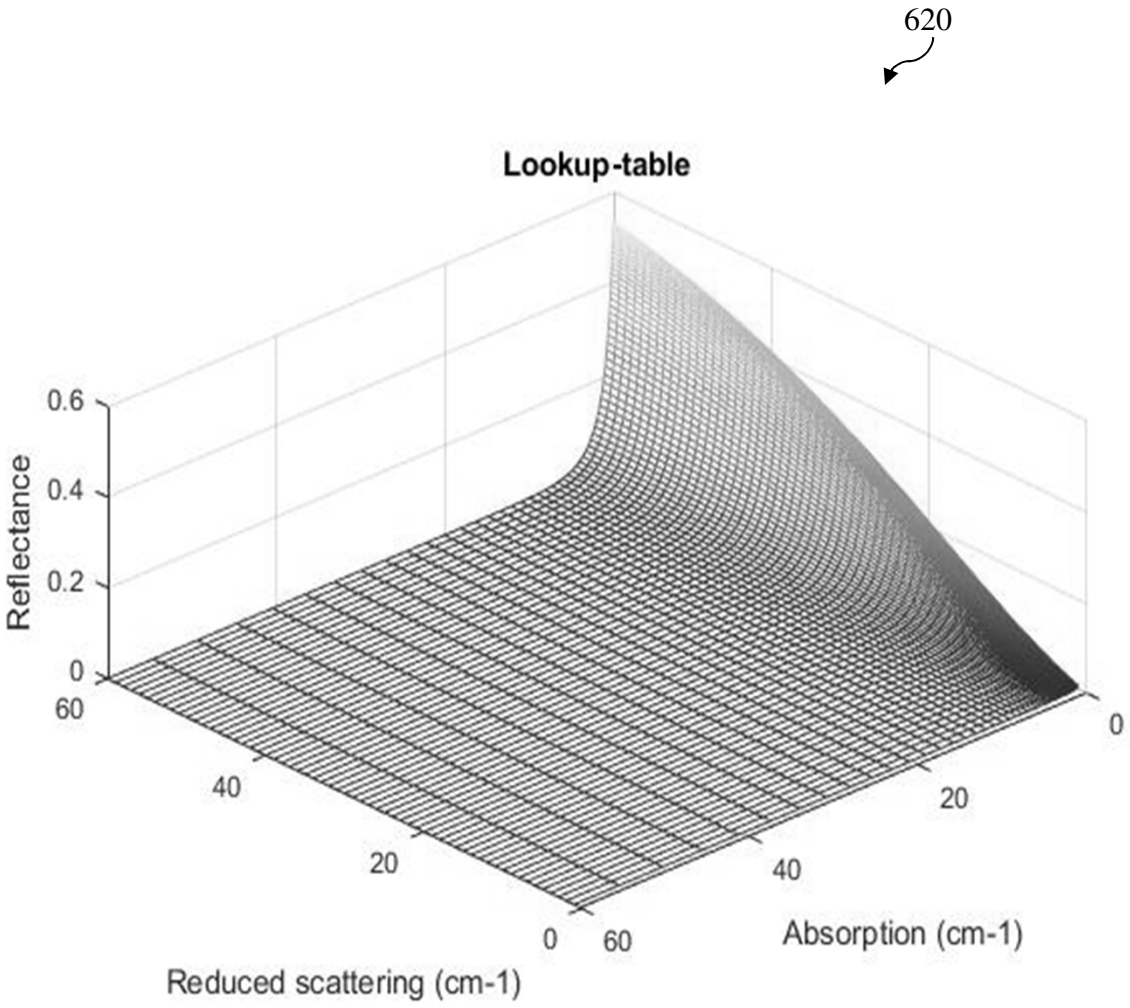

620
Lookup-table
Reflectance
0.6
0.4
0.2
0
60
40
20
0
Reduced scattering (cm-1)
0
20
40
60
Absorption (cm-1)

FIG. 6B

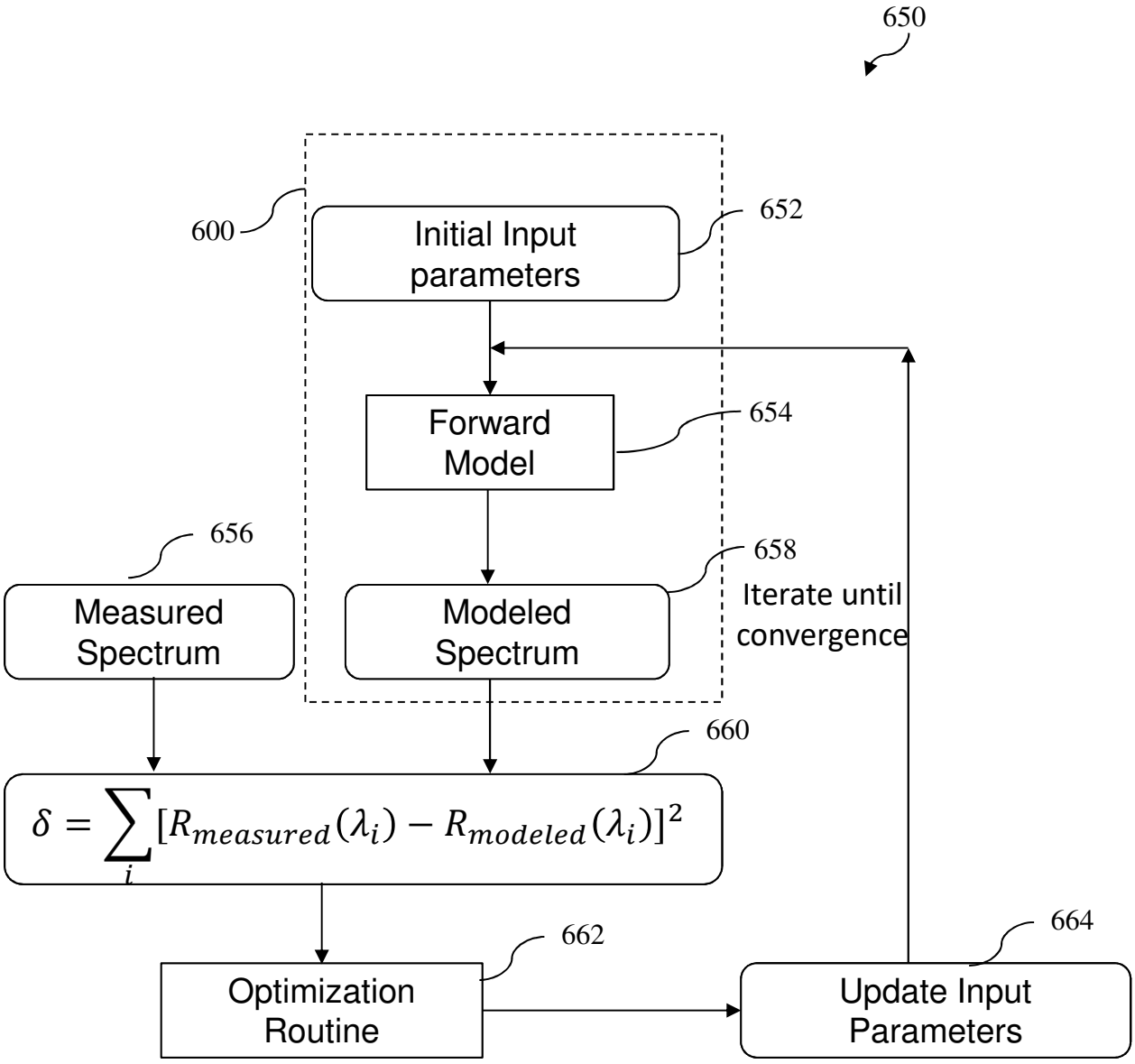

650
600
Initial Input parameters
652
Forward Model
654
656
Measured Spectrum
658
Modeled Spectrum
Iterate until convergence
660
$\delta = \sum_i [R_{measured}(\lambda_i) - R_{modeled}(\lambda_i)]^2$
662
Optimization Routine
664
Update Input Parameters

FIG. 6C

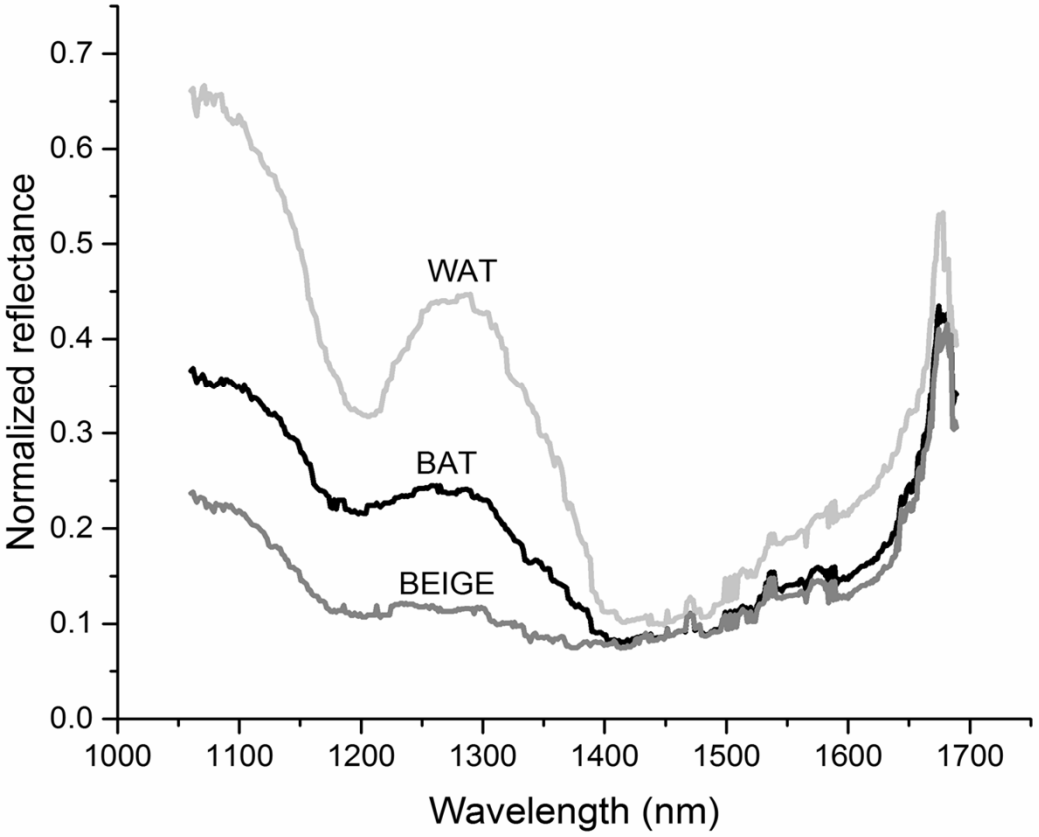

Normalized reflectance
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
1000
1100
1200
1300
1400
1500
1600
1700
Wavelength (nm)
WAT
BAT
BEIGE

FIG. 7

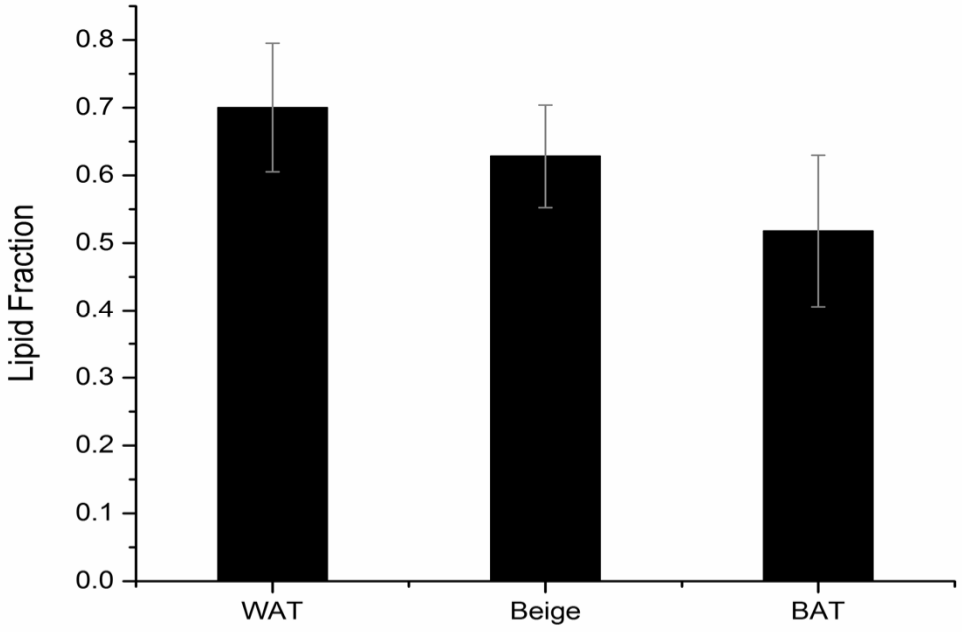

Lipid Fraction
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
WAT
Beige
BAT

FIG. 8A

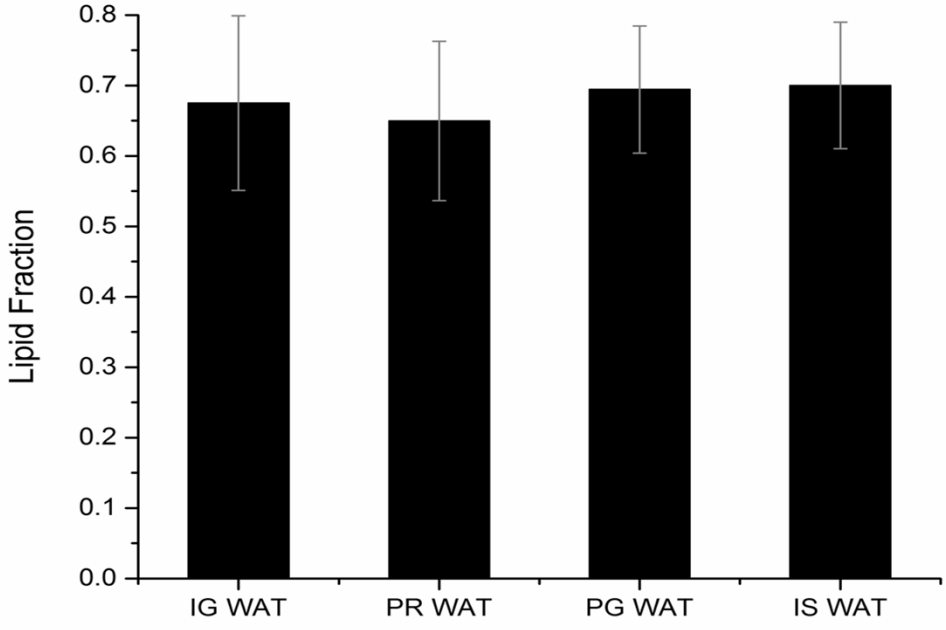

Lipid Fraction
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
IG WAT
PR WAT
PG WAT
IS WAT

FIG. 8B

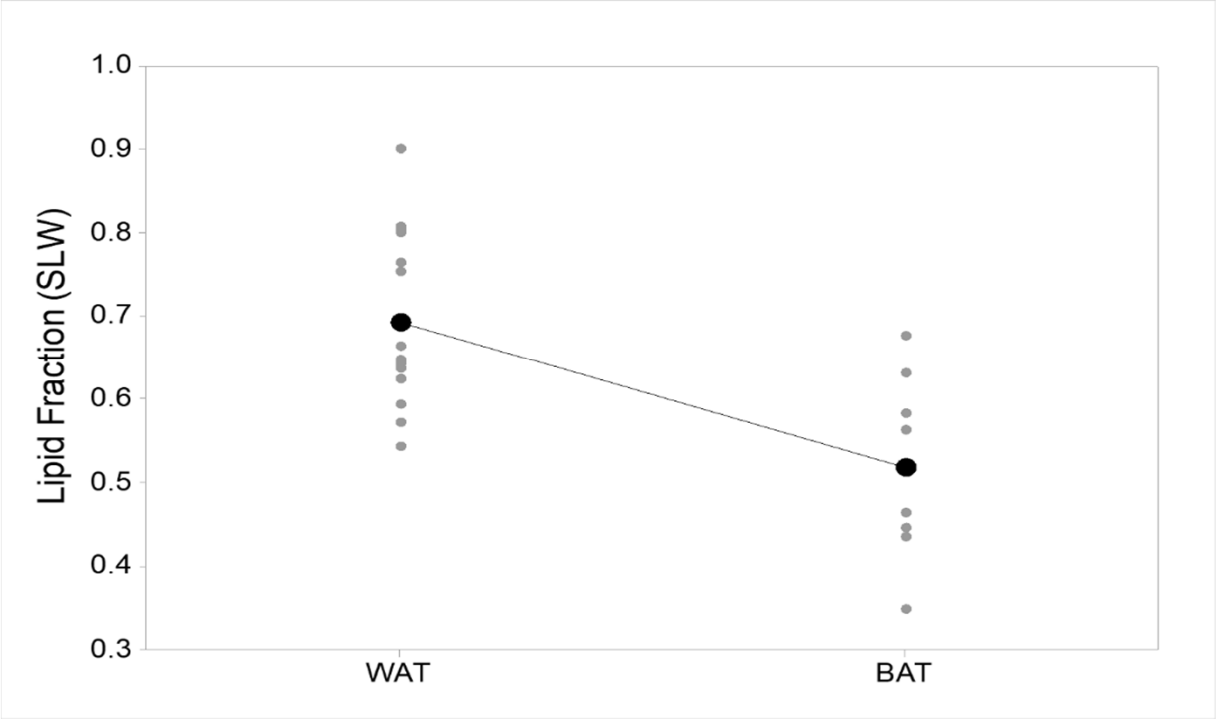

1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
Lipid Fraction (SLW)
WAT
BAT

FIG. 9A

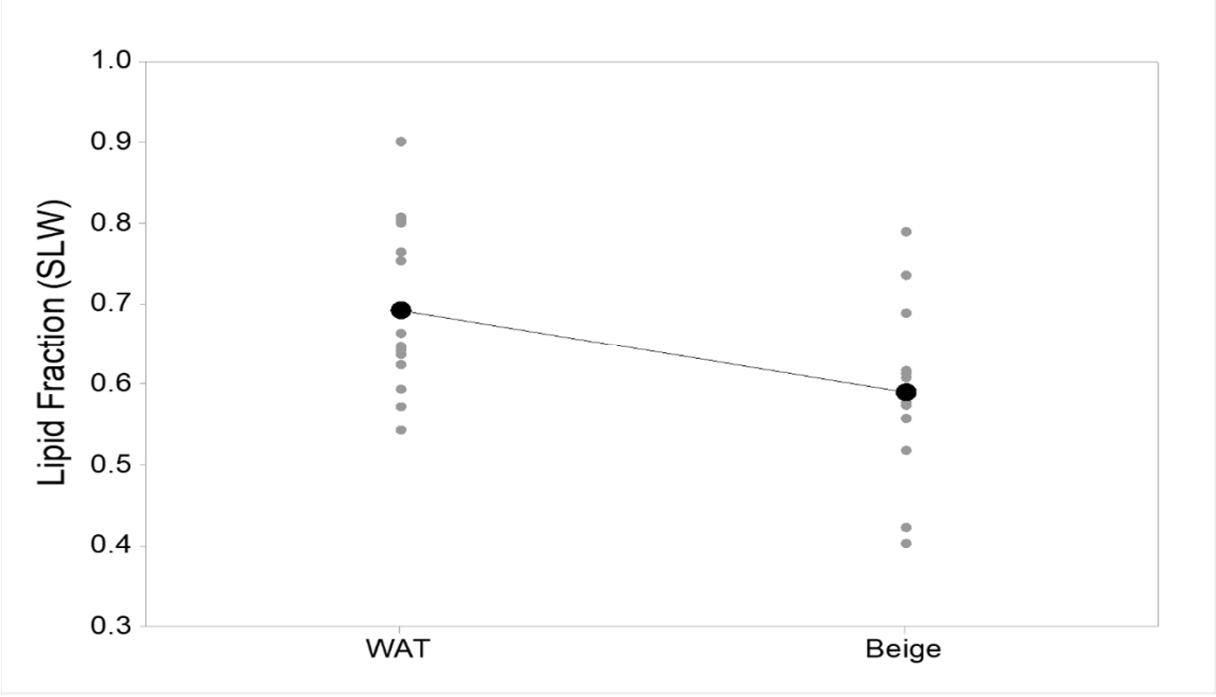

1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
Lipid Fraction (SLW)
WAT
Beige

FIG. 9B

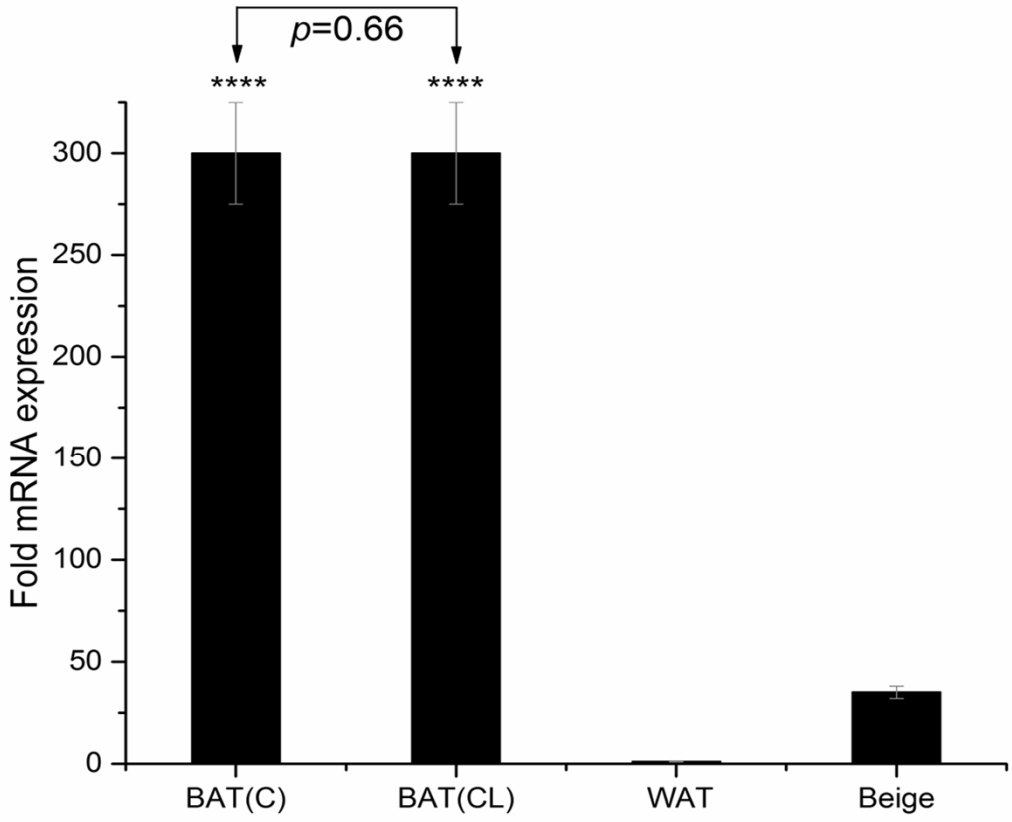


FIG. 10A

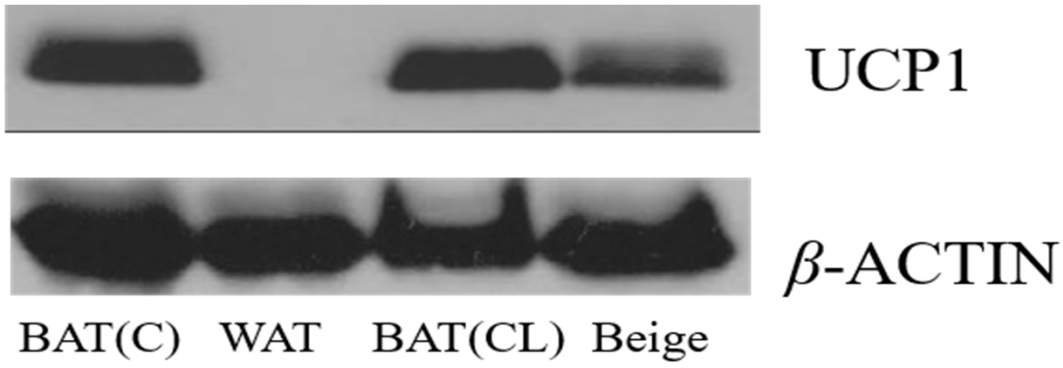
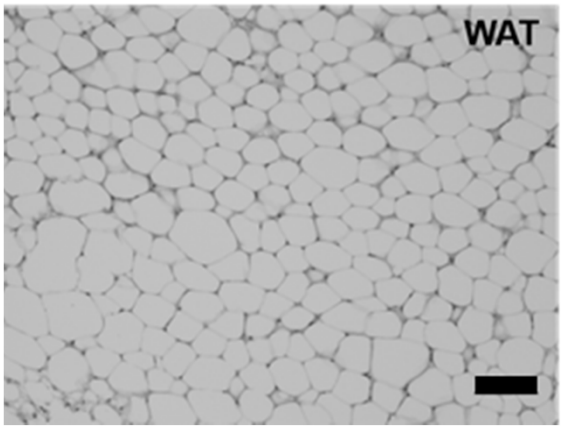
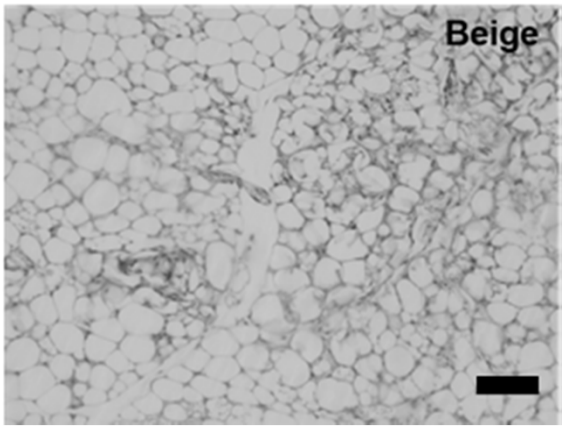


FIG. 10B

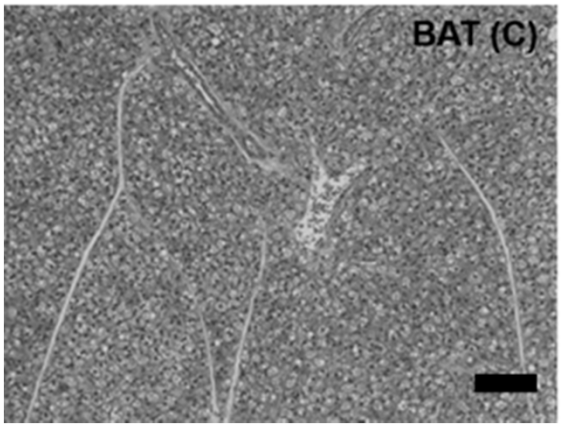


Scale bar denotes 100 µm

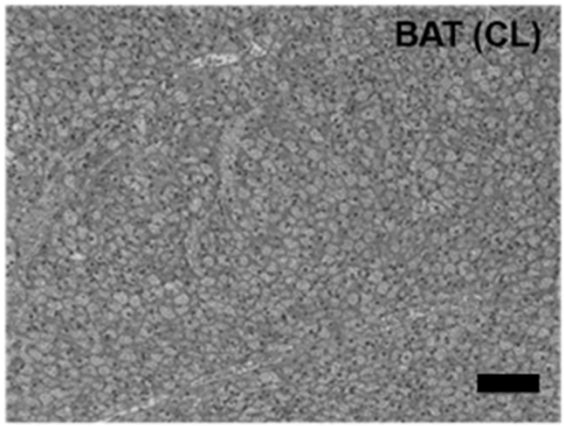


Scale bar denotes 100 µm

FIG. 11A

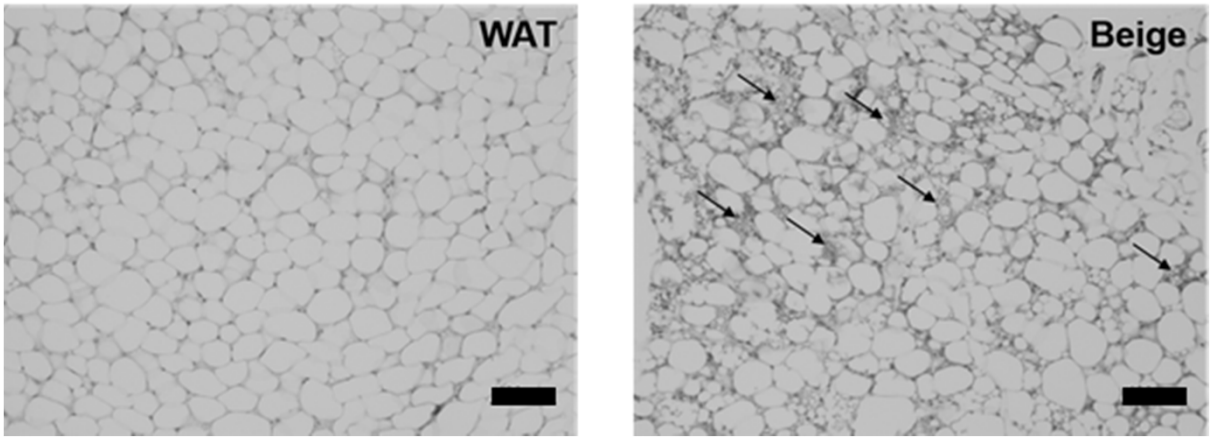


Scale bar denotes 100 µm



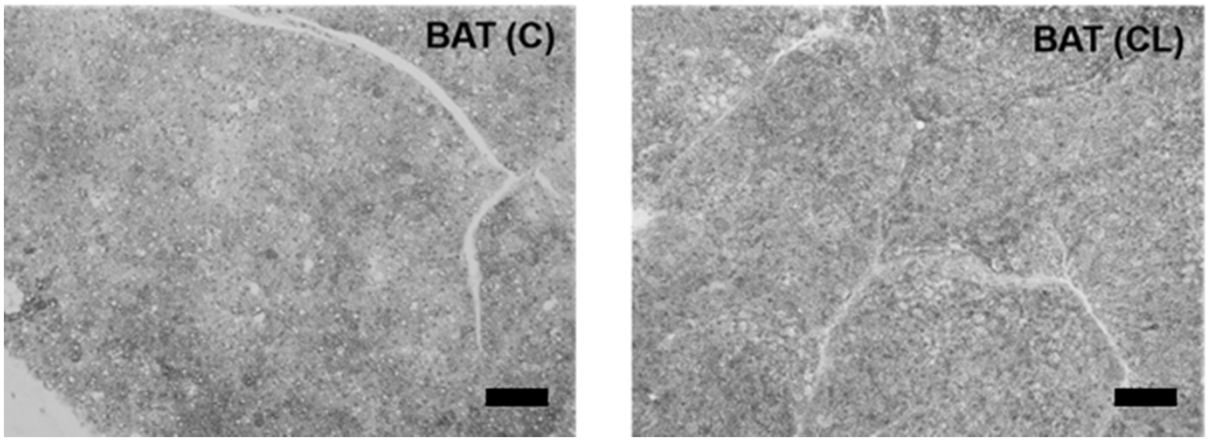
Scale bar denotes 100 µm

FIG. 11B



Scale bar denotes 100 μm Scale bar denotes 100 μm

FIG. 12A



Scale bar denotes 100 μm Scale bar denotes 100 μm

FIG. 12B