SITOX

20° Congresso Nazionale

Società Italiana di Tossicologia

Sostanze di origine naturale: farmaci, veleni o entrambi

BOLOGNA 25-26-27 Ottobre 2021

www.sitox.org

SITOX
20° Congresso Nazionale
Società Italiana di Tossicologia
Sostanze di origine naturale: farmaci, veleni o entrambi
BOLOGNA 25-26-27 Ottobre 2021

Effetti di una dieta ad alto grasso arricchita con biomassa di *A. platensis* F&M-C256 sui fattori di rischio associati alla sindrome metabolica

Mario D'Ambrosio

Dipartimento di NEUROFARBA, sezione di Farmacologia e Tossicologia, Università di Firenze

These conditions leads in an **increasing risk** of heart disease, stroke and type 2 diabetes.

Current Hypertension Reports (2018) 20: 12
https://doi.org/10.1007/s11906-018-0812-z

HYPERTENSION AND OBESITY (E REISIN, SECTION EDITOR)

The Global Epidemic of the Metabolic Syndrome

Mohammad G. Saklayen[1]

Published online: 26 February 2018

Microalgae or microphytes, are unicellular microorganisms that can be found in freshwater and marine systems.

Their chemical composition varies over a wide range, depending on species and on cultivation conditions.

Arthrospira platensis (*Spirulina*) is a cyanobacterium globally used as a food supplement for human and animals.

Arthrospira platensis contains macro and micronutrients, including proteins, γ-linolenic acid and bioactive compounds such as c-phycocyanin and has been defined the "**food of the future**" according to FAO.

NASA

esa
European Space Agency

SPIRULINA: Food for Astronauts

According to NASA Studies: "1 gram of Spirulina is equivalent to the nutrients of 1 Kilogram of assorted fruits and vegetables"

Reference	Years	Study design	Location	Sample size	Target population	Mean age (year)	BMI (kg/m^2)	Intervention		Dose (g/d)	Duration (week)	Main outcomes
								Treatment group	Control group			
Anitha et al[19]	2010	Parallel-group trial	India	80	Male volunteers with type 2 diabetes	45–60	NA	Spirulina intervention	No intervention	1	12	TC, LDL-C, HDL-C, TG, vLDL-C, FBG
Lee et al[29]	2008	Randomized, parallel study	Korea	37	Patients with type 2 diabetes	53.30	23.60	Freeze-dried spirulina	No intervention	8	12	TC, LDL-C, HDL-C, TG, vLDL-C, FBG, SBP, DBP
Jensen et al[28]	2016	Randomized, double-blind, placebo-controlled parallel study	USA	24	Adult men and women 25–65 years of age	45.55	29.65	Phycocyanin-enriched aqueous extract from Spirulina platensis	Received placebo	2.3	2	SBP, DBP, FBG
Marcel et al[20]	2011	Randomized, parallel study	Cameroon	33	HIV-infected patients	37.50	24.25	Spirulina platensis	Received soybean	19	8	TG, TC, FBG
Miczke et al[21]	2016	Randomized, double-blind, placebo-controlled parallel study	Poland	40	Overweight hypertensive Caucasians	53.30	26.30	Received Hawaiian spirulina	Received placebo	2	12	SBP, DBP, body weight, BMI
Ngo-Matip et al[22]	2014	Randomized, single-blind, multicenter study	Cameroun	159	HIV-infected antiretroviral-naive patients	35.72	25.65	Spirulina supplementation	No intervention	10	24	TC, LDL-C, HDL-C, TG, FBG, BMI
Parikh et al[23]	2001	Randomized placebo-controlled, parallel-group trial	India	25	Subjects with type 2 diabetes mellitus	54.20	25.15	Spirulina tablets supplementation	Received placebo	2	8	TC, LDL-C, HDL-C, TG, FBG
Park et al[20]	2008	Randomized double-blind placebo-controlled parallel trial	Korea	78	Individuals aged 60–87 years	65.90	24.35	Receive freeze-dried spirulina pills	Received placebo	8	16	TC, LDL-C, HDL-C, TG
Ramamoorthy_a et al[21]	1996	Parallel-group trial	India	20	Ischemic heart disease patients without any complications of the disease and with blood cholesterol levels above 250 mg/dL	40–60	NA	Received spirulina	No intervention	2	12	TC, LDL-C, HDL-C, TG, Body weight,
Ramamoorthy_b et al[21]	1996	Parallel-group trial	India	20	Ischemic heart disease patients without any complications of the disease and with blood cholesterol levels above 250 mg/dL	40–60	NA	Received spirulina	No intervention	4	12	TC, LDL-C, HDL-C, TG, body weight
Samuels et al[22]	2002	Parallel-group trial	India	23	Patients with hyperlipidemic nephrotic syndrome	7.28	15.24	Spray-dried spirulina capsules supplementation	No intervention	1	8	TC, LDL-C, HDL-C, TG, vLDL-C, FBG, body weight, BMI
Zeinalian et al[24]	2017	Randomized double-blind placebo-controlled parallel trial	Iran	57	Obese individuals	34.33	33.03	Received spirulina platensis	Received placebo	1	12	TC, LDL-C, HDL-C, TG, FBG, body weight, BMI
Szulinska et al[23]	2017	Randomized double-blind placebo-controlled parallel trial	Poland	50	Subjects with treated hypertension	49.75	33.40	Received spirulina	Received placebo	2	12	TC, LDL-C, HDL-C, TG, FBG, body weight, BMI

Huang et al., 2018

ELSEVIER

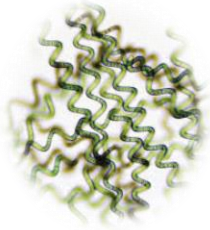
Food Research International

Volume 102, December 2017, Pages 380-386

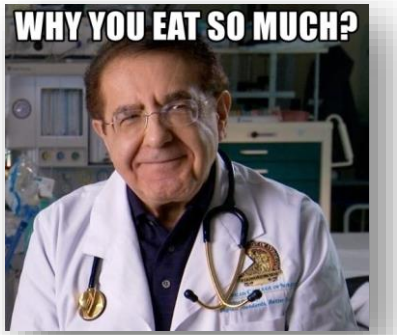
20%

Safety evaluations and lipid-lowering activity of an *Arthrospira platensis* enriched diet: A 1-month study in rats

Elisabetta Bigagli [a], Lorenzo Cinci [a], Alberto Niccolai [b], Mario R. Tredici [b], Natascia Biondi [b], Liliana Rodolfi [b], Maura Lodovici [a], Mario D'Ambrosio [a, b], Giulia Mori [a], Cristina Luceri [a]



The purpose of this study was to investigate the effects of a diet enriched in ***A. platensis*** **F&M-C256** biomass on risk factor associated with metabolic syndrome in **high fat** fed rats fed and the mechanisms involved.



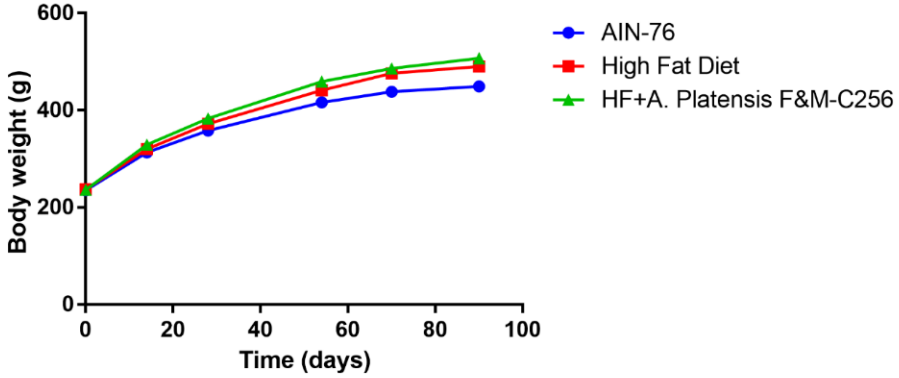
DIET COMPONENTS (g/100g)	AIN-76	High Fat Diet	HF + *A. platensis*
Biomass	-	-	5
Corn Oil	5	3	2,7
Lard	-	30	30
Sucrose	50	34	33,4
Cornstarch	15	-	-
Casein	20	24,6	21
Cellulose	5	2	1,8
Mineral mix	3,5	4,1	4,1
Vitamin mix	1	1,3	1,3
Choline bitartrate	0,2	0,26	0,26
Methionine	0,3	0,4	0,4

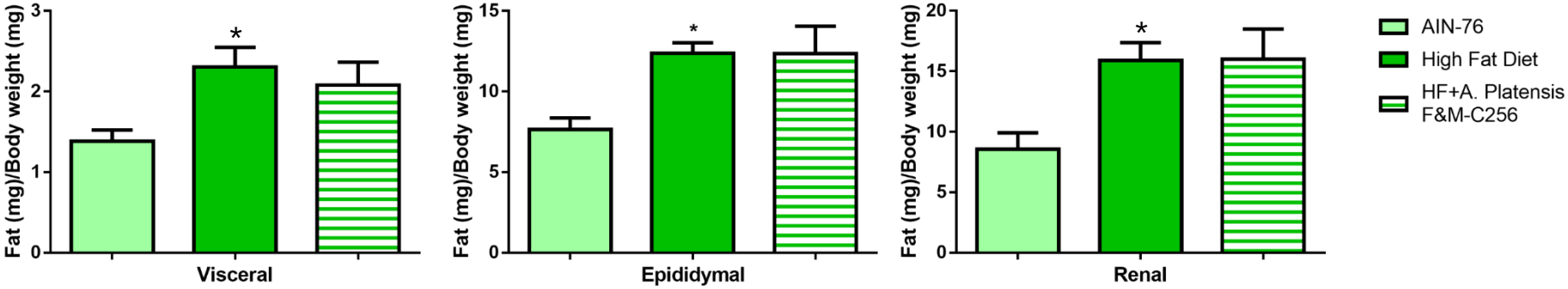
Sprague Dawley rats
(n=6 for each experimental group)

1. AIN-76;
2. High Fat Diet (30% LARD and 3% CORN OIL);
3. HF + 5% ***A. platensis*** **F&M-C256**.

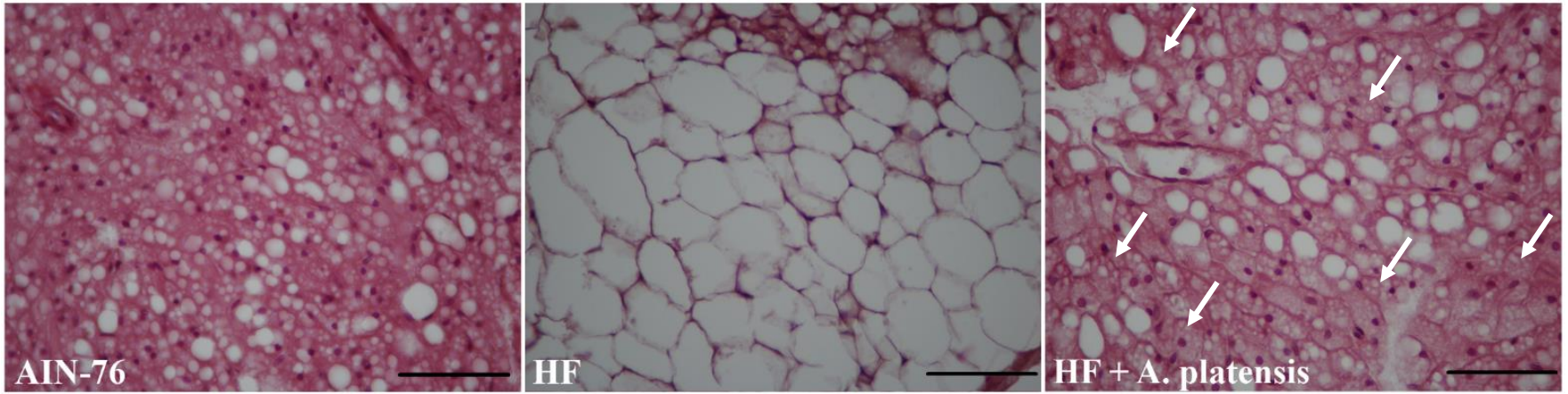
3 months of treatment

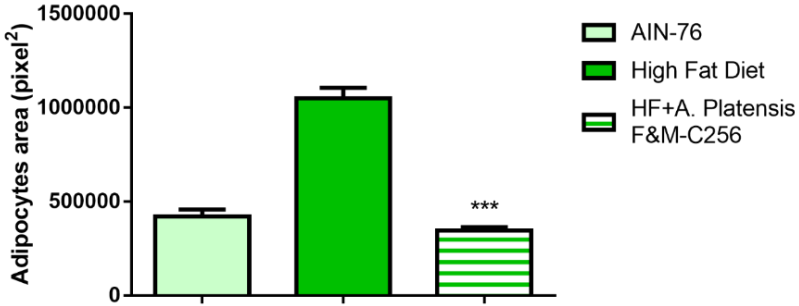
RESULTS





*** p<0.05 vs AIN-76**, by one-way ANOVA and Dunnett's multiple comparisons test.



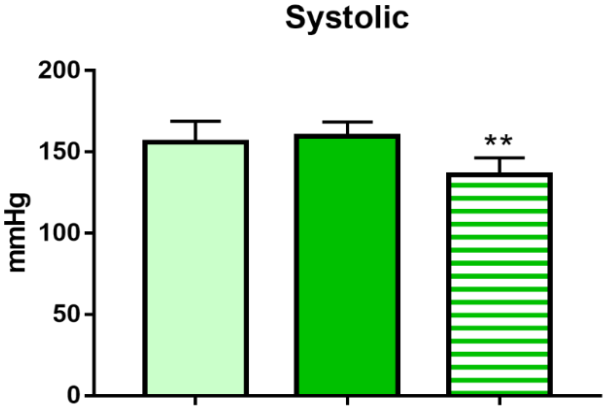


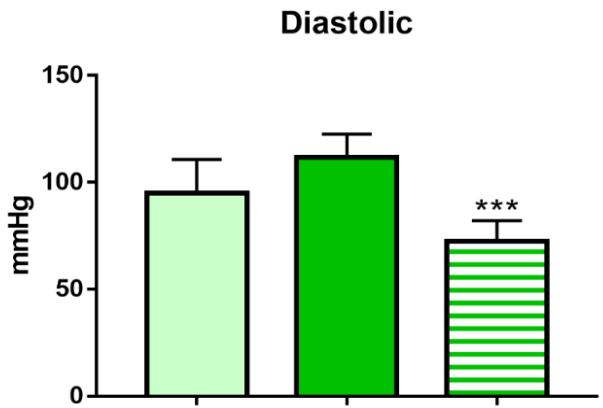
***** p<0.001 vs HF**, by one-way ANOVA and Dunnett's multiple comparisons test.

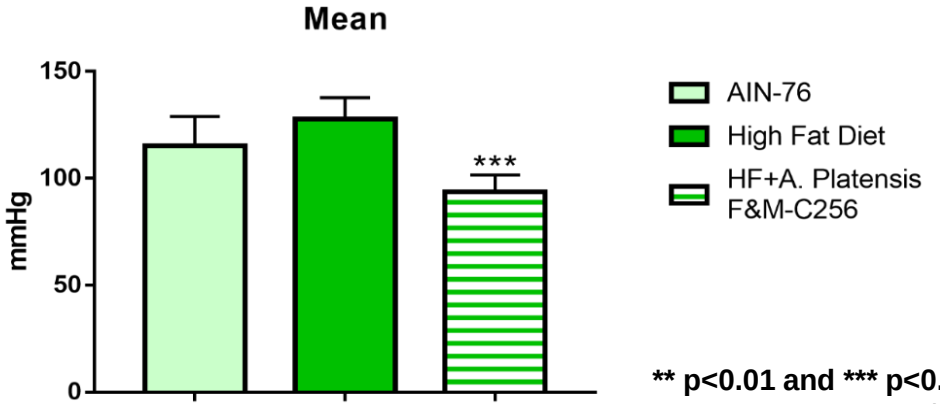
	Triglycerides (mg/dL)	Total Cholesterol (mg/dL)
AIN-76	205 ± 25.06	128 ± 5.13
High Fat Diet	258 ± 55.43	134 ± 6.98
HF + *A. Platensis* F&M-C256	**155 ± 12.62 ***	**107 ± 3.45 ****

	Fecal lipid excretion (%)
AIN-76	13.7 ± 2.5
High Fat Diet	2.48 ± 0.25
HF + *A. Platensis* F&M-C256	**21.4 ± 2.7 ***

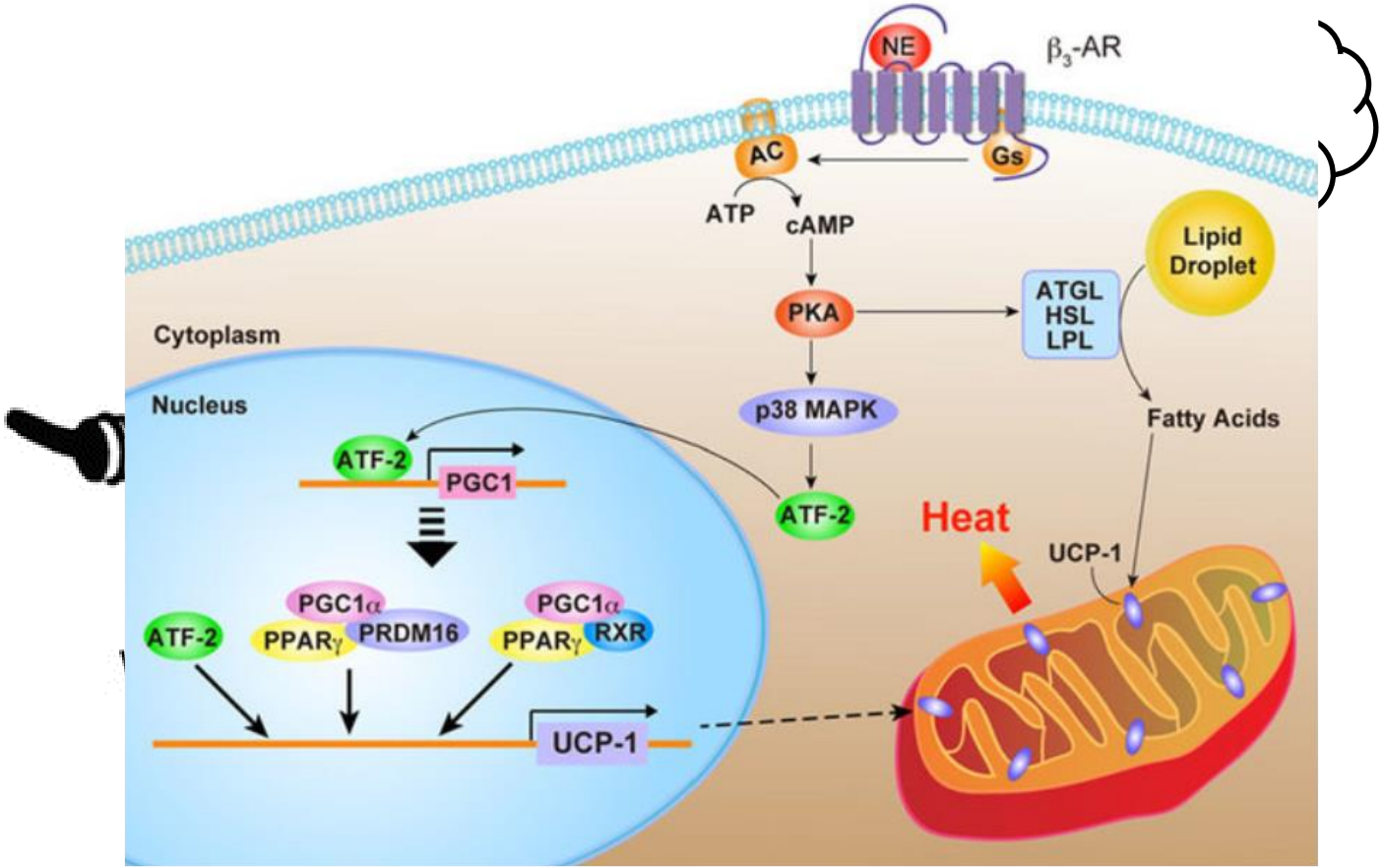
*** p<0.05 and ** p<0.01 vs HF**, by one-way ANOVA and Dunnett's multiple comparisons test.

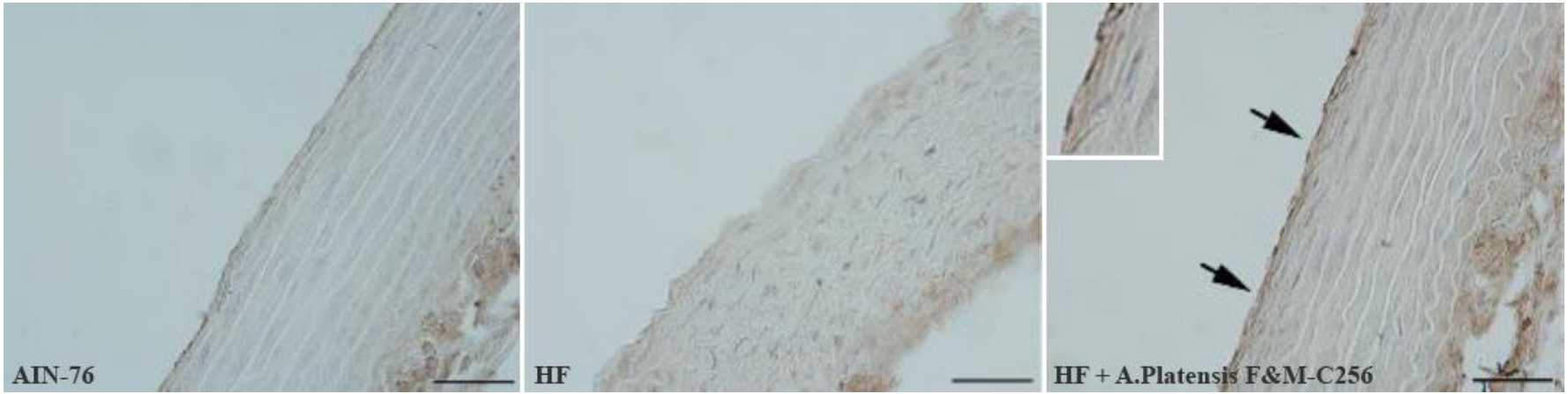


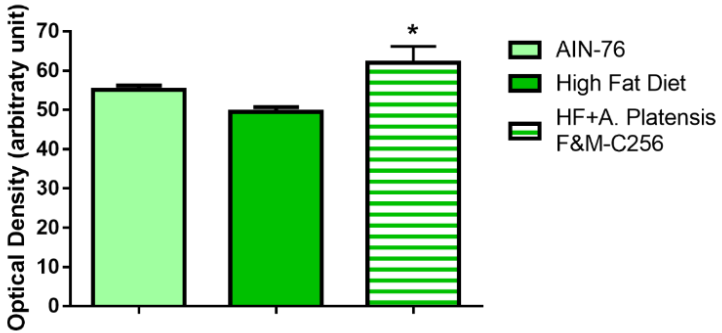




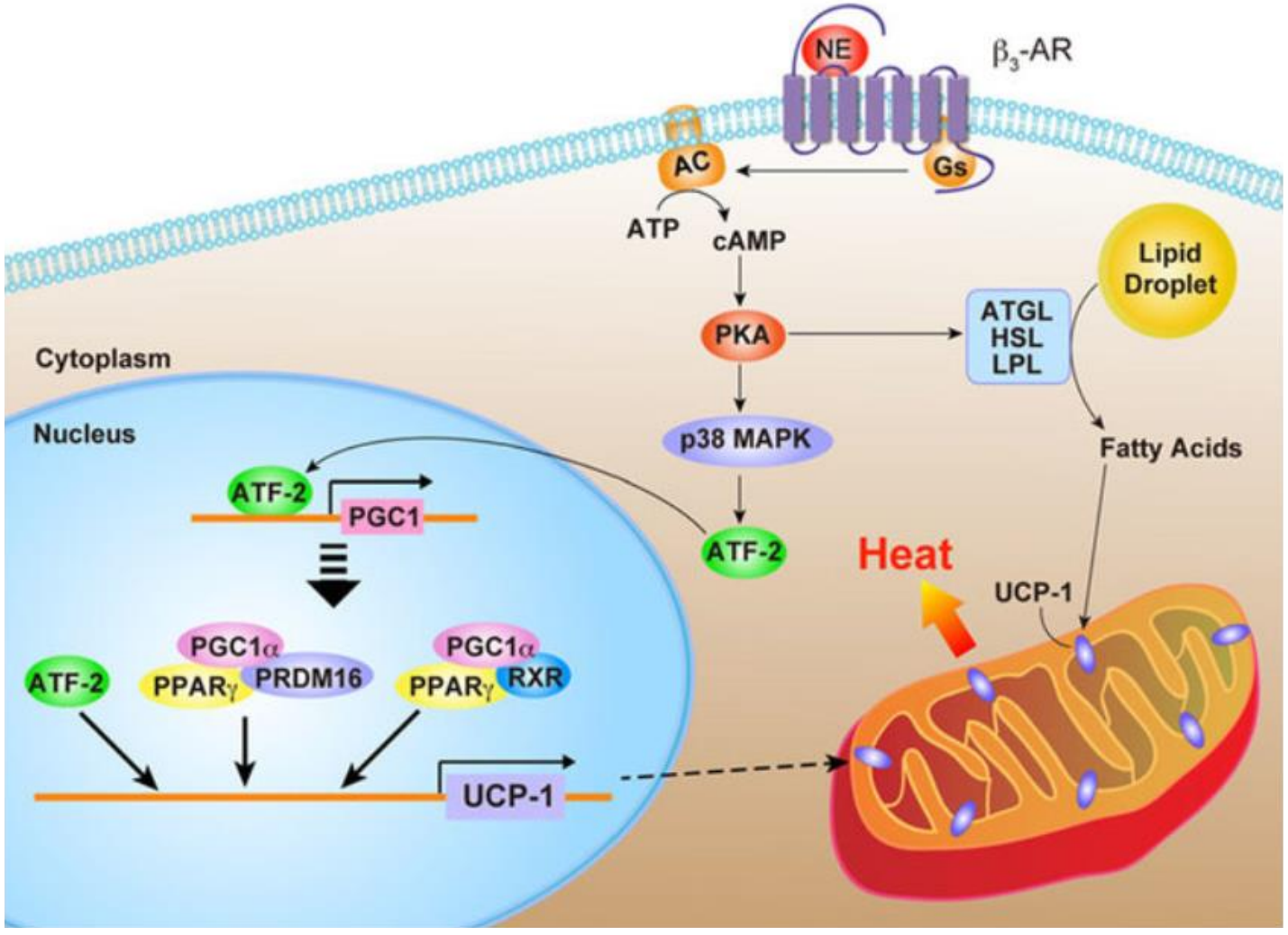
**** p<0.01 and *** p<0.001 vs AIN-76 and HF**, by one-way ANOVA and Dunnett's multiple comparisons test.

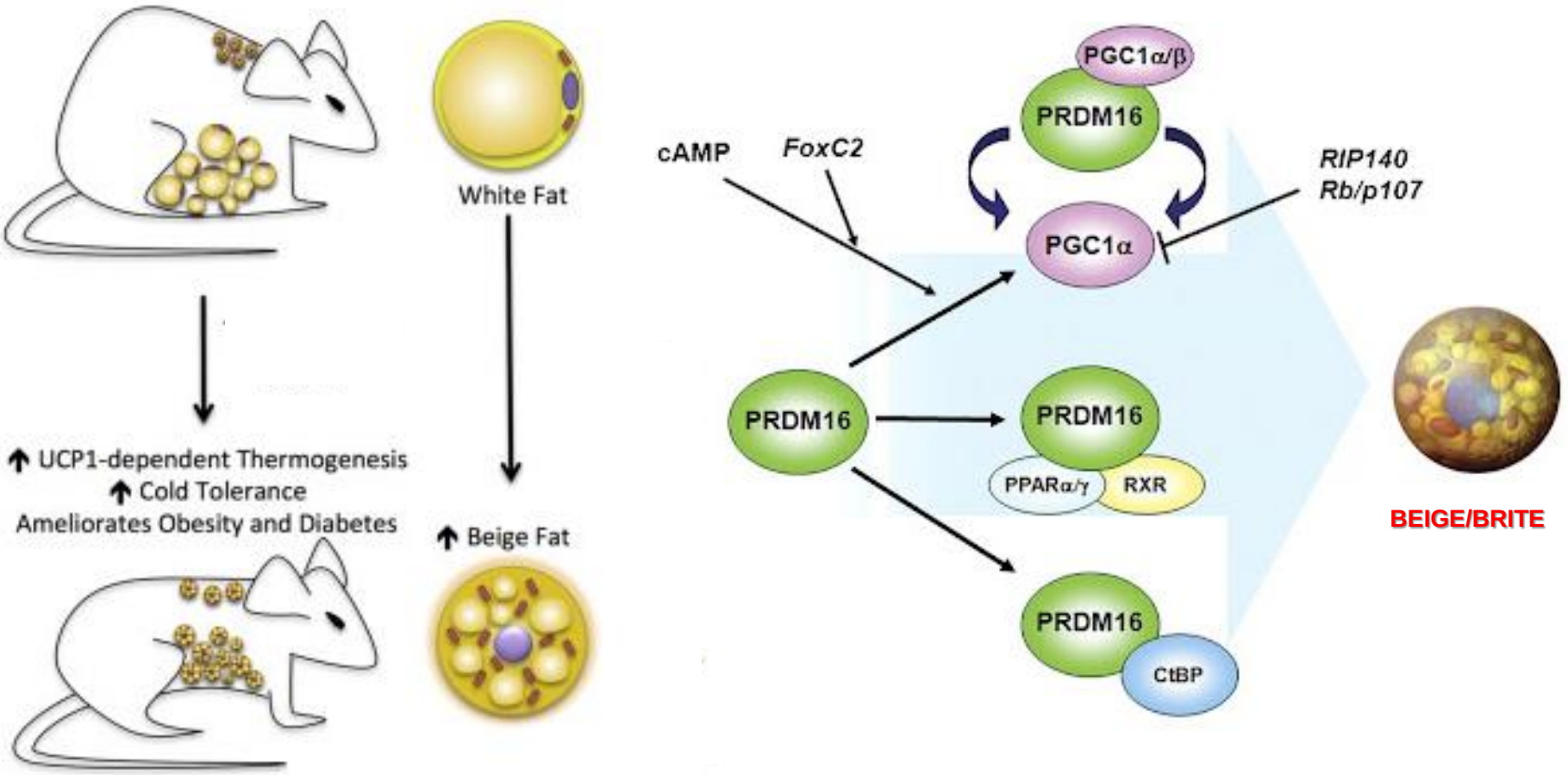

NE
β3-AR
AC
Gs
ATP
cAMP
Lipid Droplet
PKA
ATGL
HSL
LPL
Cytoplasm
Nucleus
p38 MAPK
Fatty Acids
ATF-2
PGC1
ATF-2
Heat
UCP-1
PGC1α
PPARγ
PRDM16
PGC1α
PPARγ
RXR
ATF-2
UCP-1

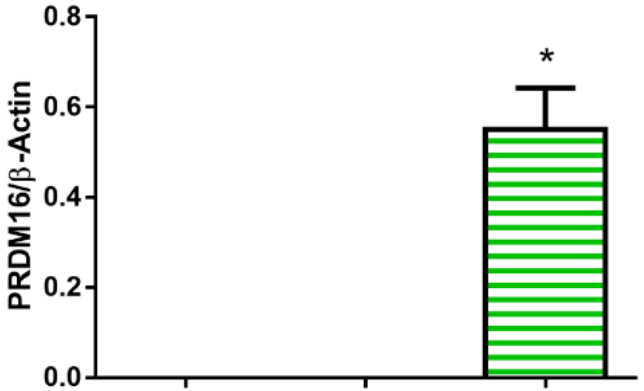


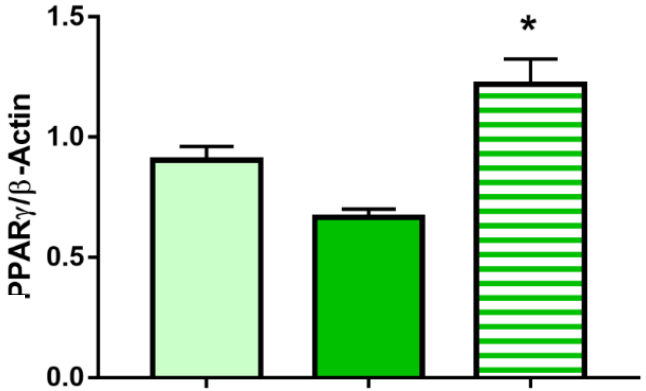


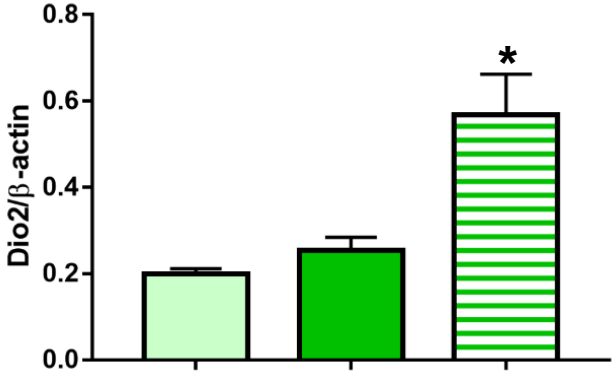
*** p<0.05 vs HF**, by one-way ANOVA and Dunnett's multiple comparisons test.


NE
β3-AR
AC
Gs
ATP
cAMP
PKA
Lipid Droplet
ATGL
HSL
LPL
Fatty Acids
Cytoplasm
Nucleus
p38 MAPK
ATF-2
PGC1
ATF-2
Heat
UCP-1
PGC1α
ATF-2
PPARγ
PRDM16
PGC1α
PPARγ
RXR
UCP-1


White Fat
↑ UCP1-dependent Thermogenesis
↑ Cold Tolerance
Ameliorates Obesity and Diabetes
↑ Beige Fat
cAMP
FoxC2
PGC1α/β
PRDM16
PGC1α
RIP140
Rb/p107
PRDM16
PRDM16
PPARα/γ
RXR
PRDM16
CtBP
BEIGE/BRITE

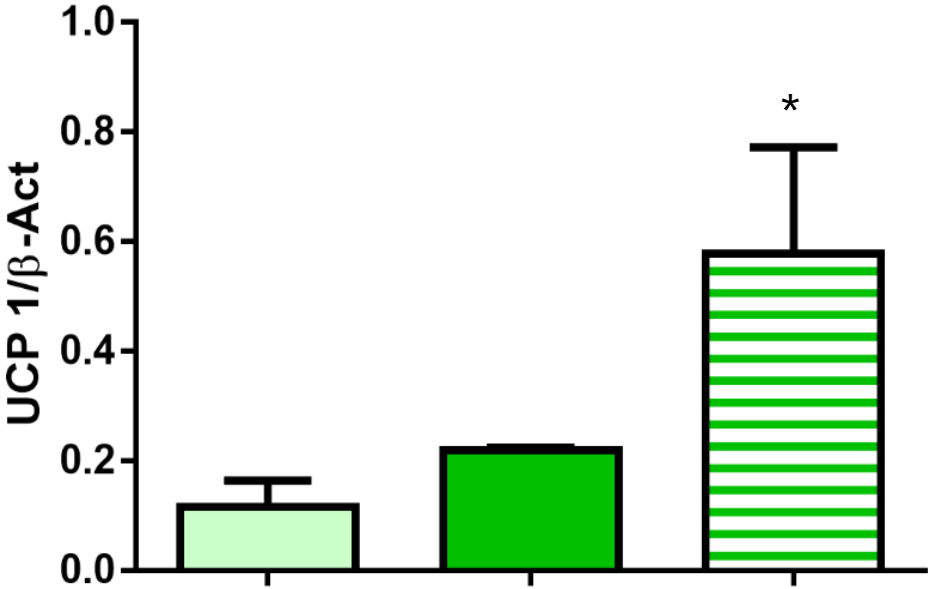






AIN-76
High Fat Diet
HF + A.Platensis F&M-C256

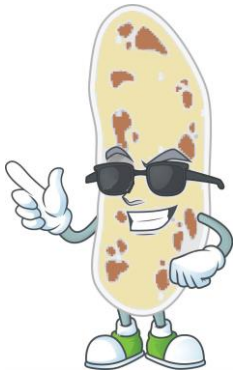
*** p<0.05 vs HF**, by one-way ANOVA and Dunnett's multiple comparisons test.



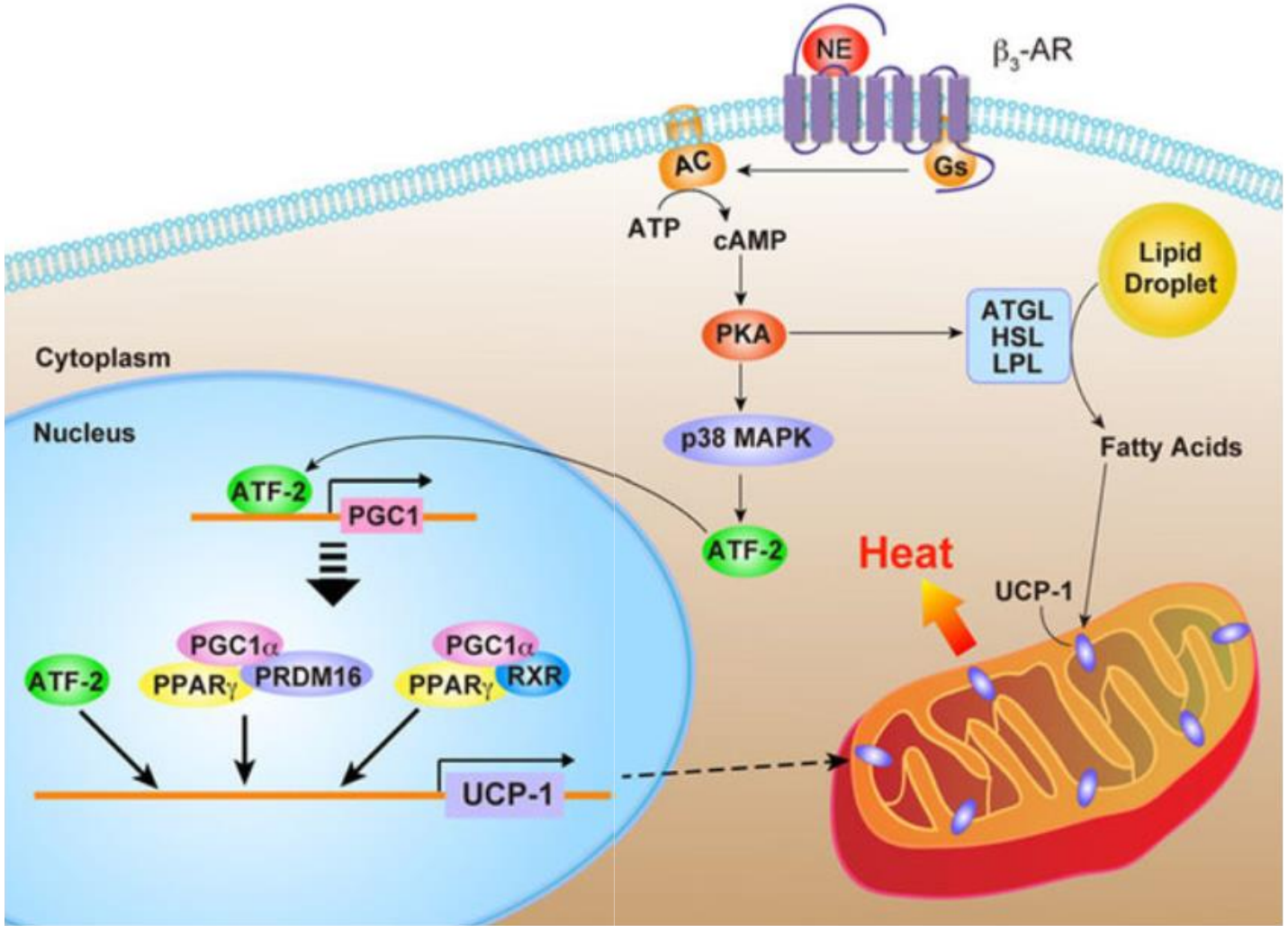
AIN-76

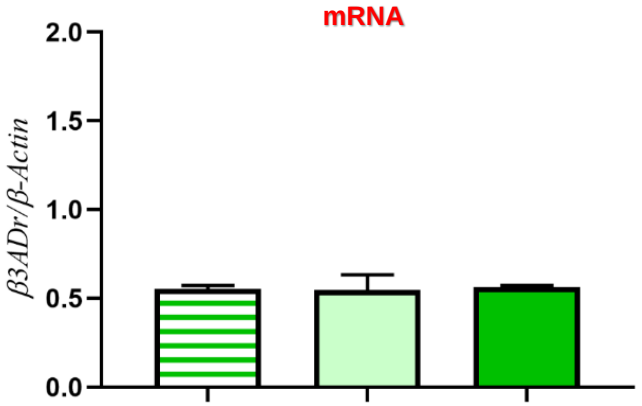
High Fat Diet

HF + A.Platensis F&M-C256

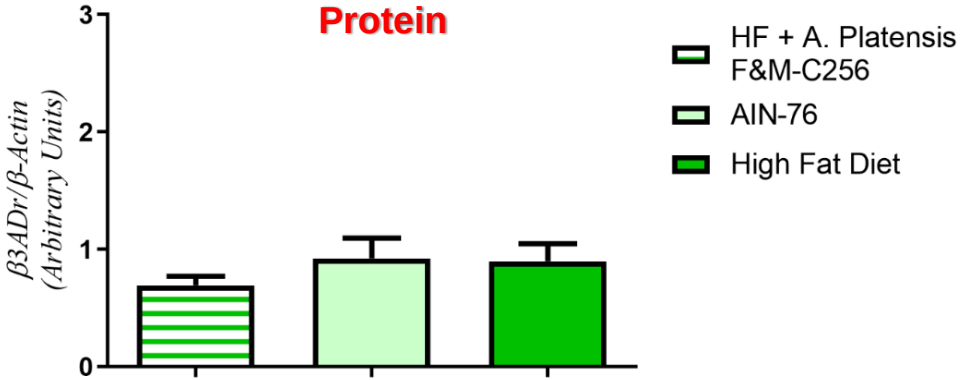


*** p<0.05 vs HF**, by one-way ANOVA and Dunnett's multiple comparisons test.


NE
β3-AR
AC
Gs
ATP
cAMP
Lipid Droplet
PKA
ATGL
HSL
LPL
Cytoplasm
Nucleus
p38 MAPK
Fatty Acids
ATF-2
PGC1
ATF-2
Heat
UCP-1
PGC1α
PGC1α
ATF-2
PPARγ
PRDM16
PPARγ
RXR
UCP-1



HF + A. Platensis F&M-C256
AIN-76
High Fat Diet



nature genetics
Published: 14 January 2002

Angptl3 regulates lipid metabolism in mice

Ryuta Koishi, Yosuke Ando, Mitsuru Ono, Mitsuru Shimamura, Hiroaki Yasumo, Toshihiko Fujiwara, Hiroyoshi Horikoshi & Hidehiko Furukawa

nature reviews endocrinology
Published: 06 October 2017

Angiopoietin-like 3 in lipoprotein metabolism

Sander Kersten

PNAS
PNAS PLUS

Increased thermogenesis by a noncanonical pathway in ANGPTL3/8-deficient mice

Serena Banfi[a,b], Viktoria Gusarova[c], Jesper Gromada[c], Jonathan C. Cohen[b,1], and Helen H. Hobbs[a,b,d,1]

[a]Department of Molecular Genetics, University of Texas Southwestern Medical Center, Dallas, TX 75390; [b]Department of Internal Medicine, University of Texas Southwestern Medical Center, Dallas, TX 75390; [c]Regeneron Pharmaceuticals, Inc., Tarrytown, NY 10591; and [d]The Howard Hughes Medical Institute, University of Texas Southwestern Medical Center, Dallas, TX 75390

Contributed by Helen H. Hobbs, December 21, 2017 (sent for review October 6, 2017; reviewed by Alan D. Attie, Sheila Collins, Ira J. Goldberg, and Rudolf Zechner)

International Journal of Molecular Sciences
Review
MDPI

Angiopoietin-Like Protein 3 (ANGPTL3) Modulates Lipoprotein Metabolism and Dyslipidemia

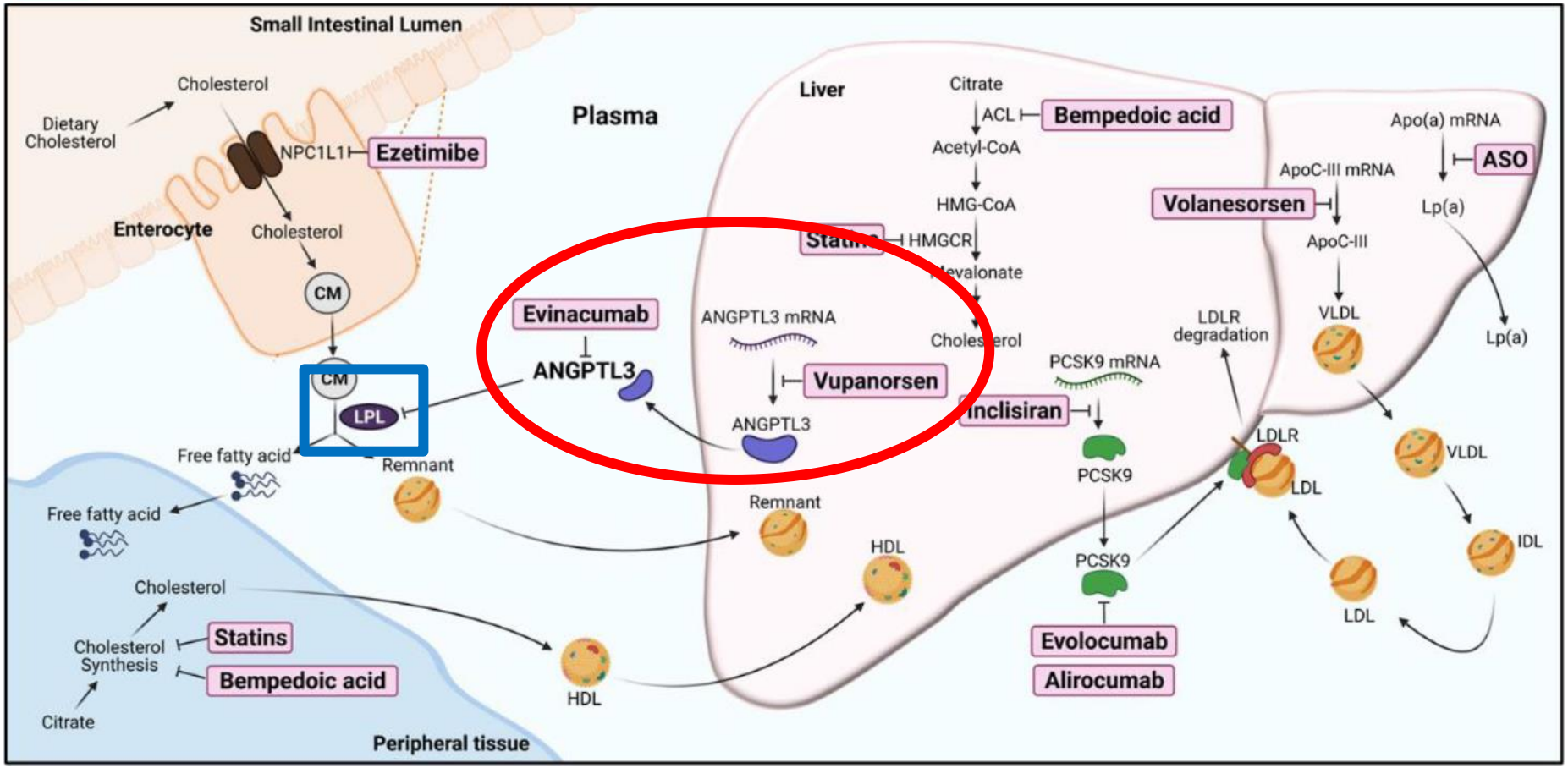
Pei-Yi Chen [1,2,†], Wan-Yun Gao [3,†], Je-Wen Liou [4], Ching-Yen Lin [2], Ming-Jiuan Wu [5] and Jui-Hung Yen [2,3,*]

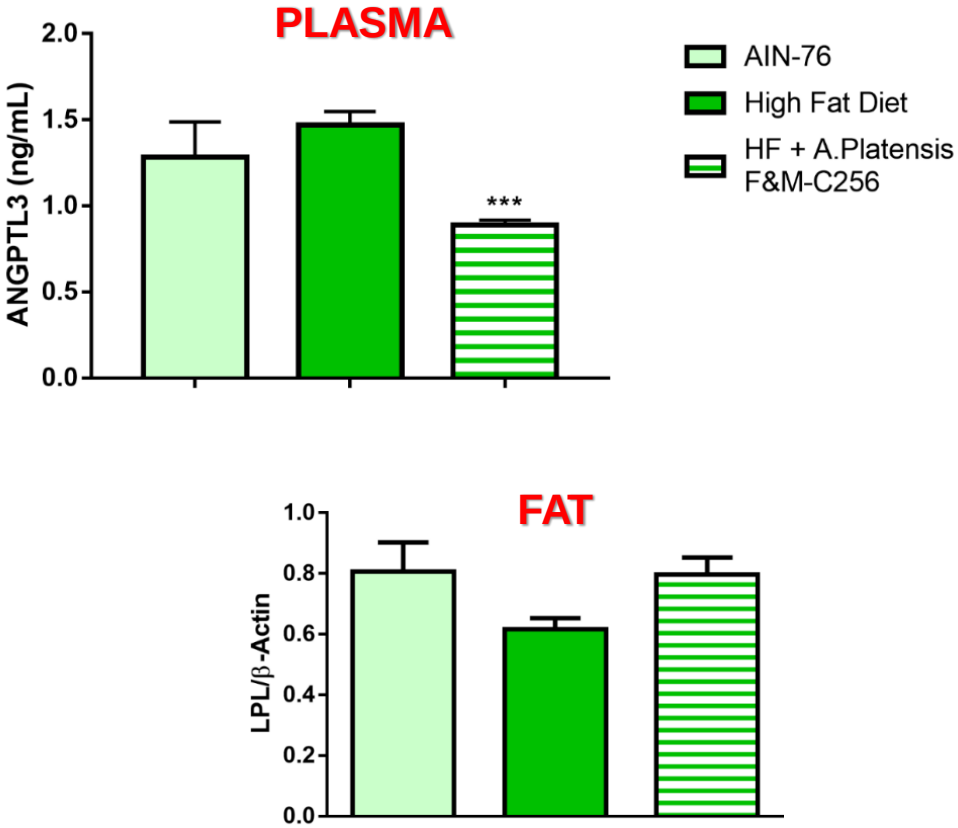
Springer Link
Cardiometabolic Disease and Treatment (E. Brinton, Section Editor) | Published: 10 March 2021

ANGPTL3 and Apolipoprotein C-III as Novel Lipid-Lowering Targets

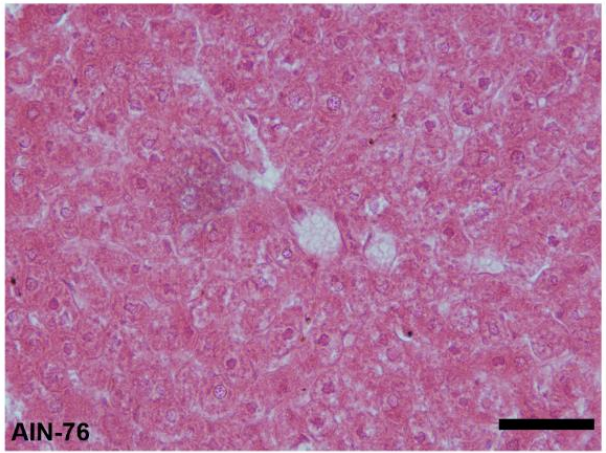
Ioannis Akoumianakis, Evangelia Zvintzou, Kyriakos Kypreos & Theodosios D. Filippatos

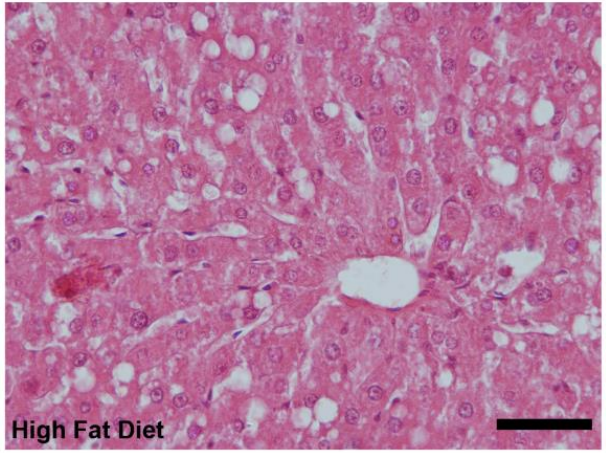
Current Atherosclerosis Reports 23, Article number: 20 (2021)

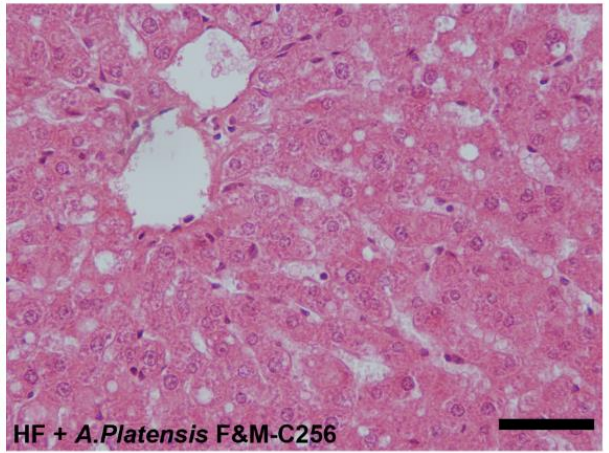

Small Intestinal Lumen
Cholesterol
Dietary Cholesterol
NPC1L1
Ezetimibe
Enterocyte
Cholesterol
CM
CM
LPL
Free fatty acid
Remnant
Free fatty acid
Cholesterol
Cholesterol Synthesis
Statins
Bempedoic acid
Citrate
Peripheral tissue
Plasma
HDL
HDL
Liver
Citrate
ACL
Bempedoic acid
Acetyl-CoA
HMG-CoA
Statin
HMGCR
Mevalonate
Cholesterol
Evinacumab
ANGPTL3
ANGPTL3 mRNA
Vupanorsen
ANGPTL3
Remnant
PCSK9 mRNA
Inclisiran
PCSK9
PCSK9
Evolocumab
Alirocumab
LDLR degradation
LDLR
LDL
Apo(a) mRNA
ASO
ApoC-III mRNA
Volanesorsen
Lp(a)
ApoC-III
VLDL
Lp(a)
VLDL
IDL
LDL

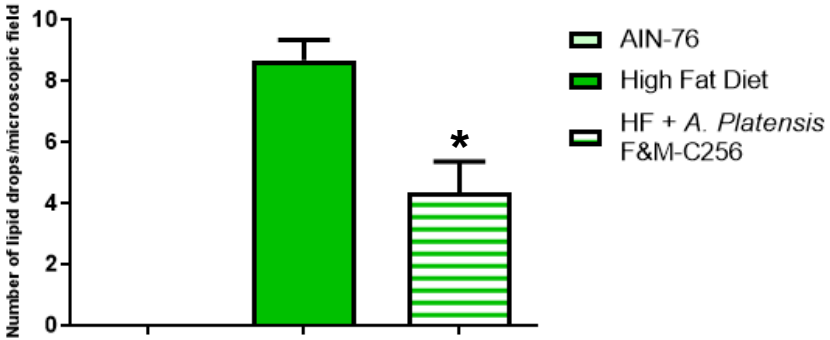


*** p<0.05 and *** p<0.001 vs HF**, by one-way ANOVA and Dunnett's multiple comparisons test.



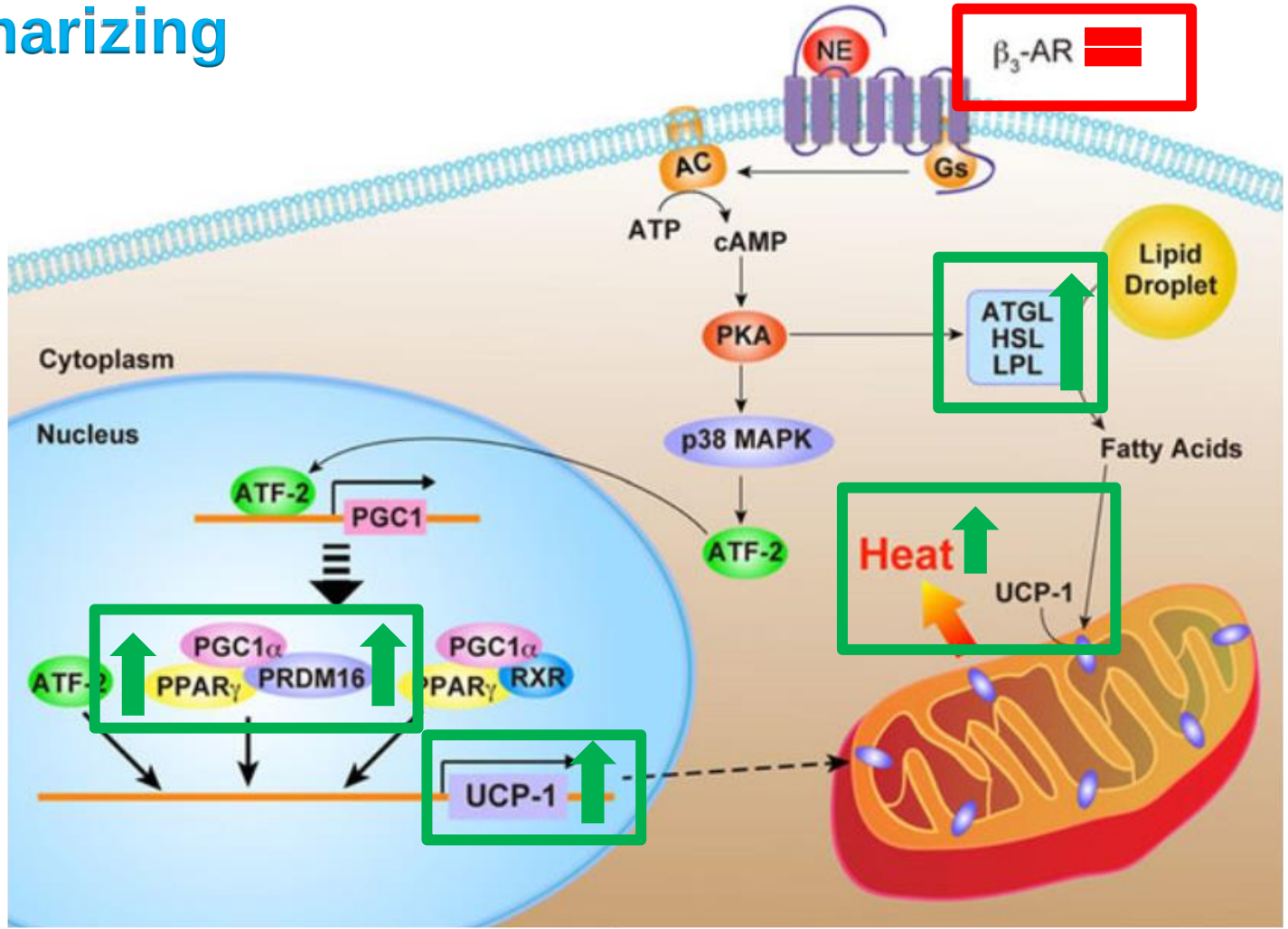






*** p<0.05 vs HF**, by one-way ANOVA and Dunnett's multiple comparisons test.

… summarizing



Hindawi
International Journal of Hypertension
Volume 2021, Article ID 6748515, 7 pages
https://doi.org/10.1155/2021/6748515

Hindawi

Research Article

Angiopoietin-Like Proteins 2 and 3 in Children and Adolescents with Obesity and Their Relationship with Hypertension and Metabolic Syndrome

Zahra Arab Sadeghabadi,[1] Mitra Nourbakhsh,[2,3] Mohammad Alaee,[1] Mona Nourbakhsh,[4] Seyedeh Sara Ghorbanhosseini,[5] Roya Sharifi,[6] and Maryam Razzaghy-Azar[1,4]

frontiers in Endocrinology | Clinical Diabetes

ORIGINAL RESEARCH article
Front. Endocrinol., 15 September 2021 | https://doi.org/10.3389/fendo.2021.695750

Association of ANGPTL8 and Resistin With Diabetic Nephropathy in Type 2 Diabetes Mellitus

Mengni Li[1], Rongping Fan[1], Xuemin Peng[1], Jiaojiao Huang[1], Huajie Zou[1], Xuefeng Yu[1,2], Yan Yang[1,2], Xiaoli Shi[1,2*†] and DeLin Ma[1,2*†]

… in conclusion

The dietary use of ***A. platensis*** is able to control some metabolic alterations induced by a **High-Fat Diet** by improving the lipid profile and the quality of body fat mass.

These data suggest the use of ***A.platensis*** as possible complementary strategy for the **control of metabolic syndrome and related complications**!

Take home message

Protein & Cell

Protein Cell 2018, 9(2):152–163
DOI 10.1007/s13238-017-0434-2

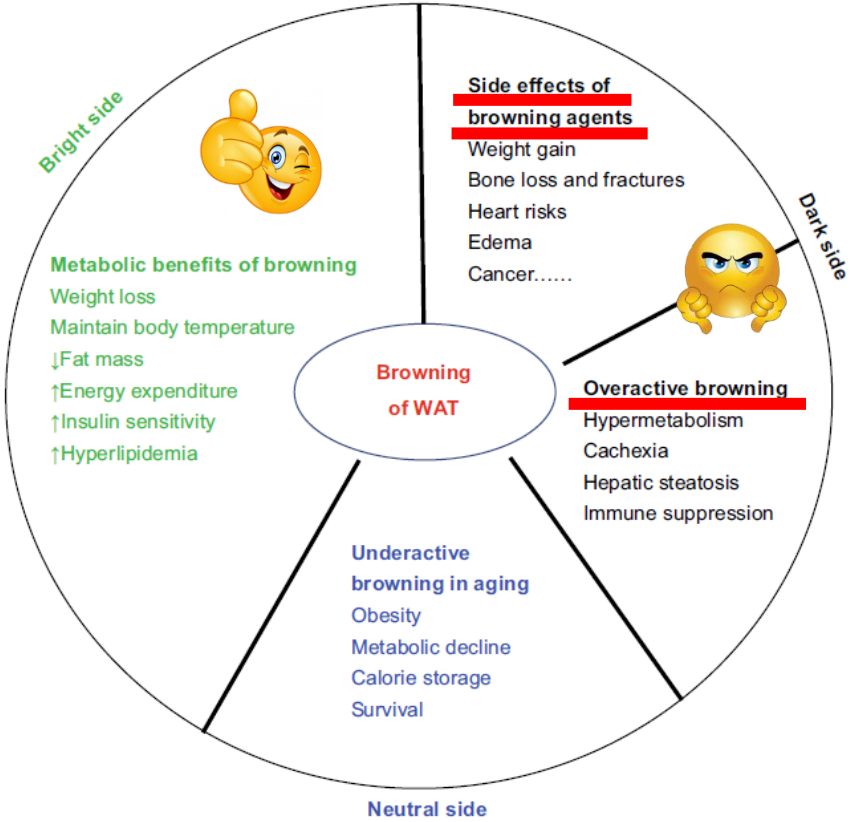
CrossMark Protein & Cell

REVIEW

The dark side of browning

Kirstin A. Tamucci[1,2], Maria Namwanje[2], Lihong Fan[2], Li Qiang[2]✉

[1] Institute of Human Nutrition, College of Physicians and Surgeons, Columbia University, New York, NY 10032, USA
[2] Department of Pathology and Cell Biology, Naomi Berrie Diabetes Center, College of Physicians and Surgeons, Columbia University, New York, NY 10032, USA



UNIVERSITÀ DEGLI STUDI FIRENZE
NEUROFARBA
DIPARTIMENTO DI NEUROSCIENZE, PSICOLOGIA, AREA DEL FARMACO E SALUTE DEL BAMBINO

Dipartimento di NEUROFARBA
sez. di Farmacologia e Tossicologia

Elisabetta Bigagli
Lorenzo Cinci
Manuela Gencarelli
Annunziatina Laurino
Laura Raimondi
Cristina Luceri

UNIVERSITÀ DEGLI STUDI FIRENZE
DAGRI
DIPARTIMENTO DI SCIENZE E TECNOLOGIE AGRARIE, ALIMENTARI, AMBIENTALI E FORESTALI

Dipartimento di Dipartimento di Scienze e Tecnologie Agrarie, Alimentari Ambientali e Forestali (DAGRI)

Natascia Biondi
Alberto Niccolai
Liliana Rodolfi
Mario Tredici


obrigado
Dank U
Merci
mahalo
Köszi
спасибо
Grazie
THANK YOU FOR YOUR ATTENTION
NO QUESTIONS, PLEASE
mauruuru
Takk
Gracias
Dziękuję
Děkuju
danke
Kiitos