

# proGsterol

The Key Solution for  
Metabolic Syndrome



Deglusterol is approved  
as a NDI in US FDA

# Deglusterol

The Clinical Approaches in Insulin Resistance-related Diseases  
like Type II diabetes, pre-diabetes, Obesity, Metabolic dysfunction-  
associated steatotic liver disease (MASLD), Non-Alcoholic fatty  
liver disease (NAFLD) and PCOS.



**proGsterol**

# proGsterol : The Key Solution for Metabolic Syndrome



## Food Supplement

World First "NDI" as Synthetic Peptides



## Resistance↓

Increases Insulin receptor sensitivity



## NAFLD

(Non-Alcoholic Fatty Liver Disease)

## Body Weight Control

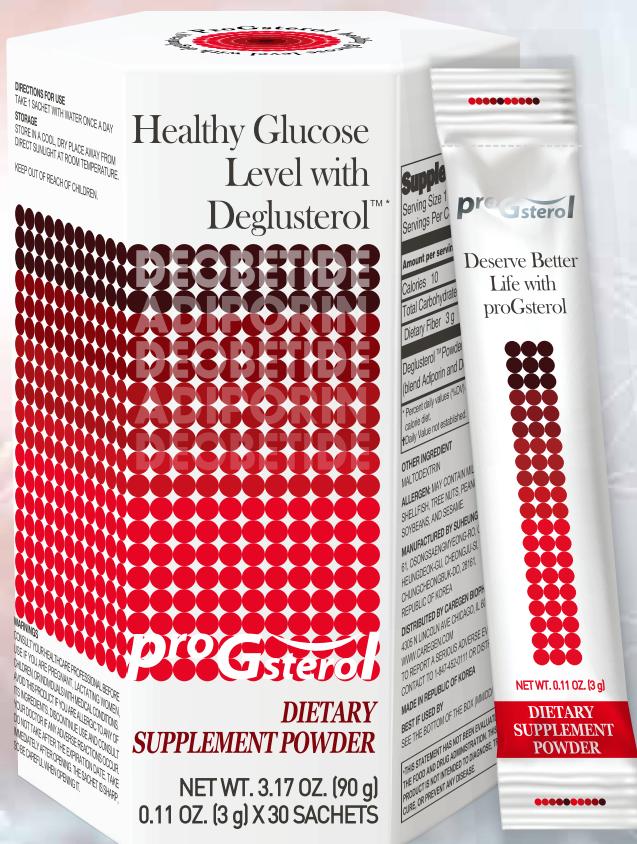


## Diabetes Care

For Pre-diabetes & Type II diabetes

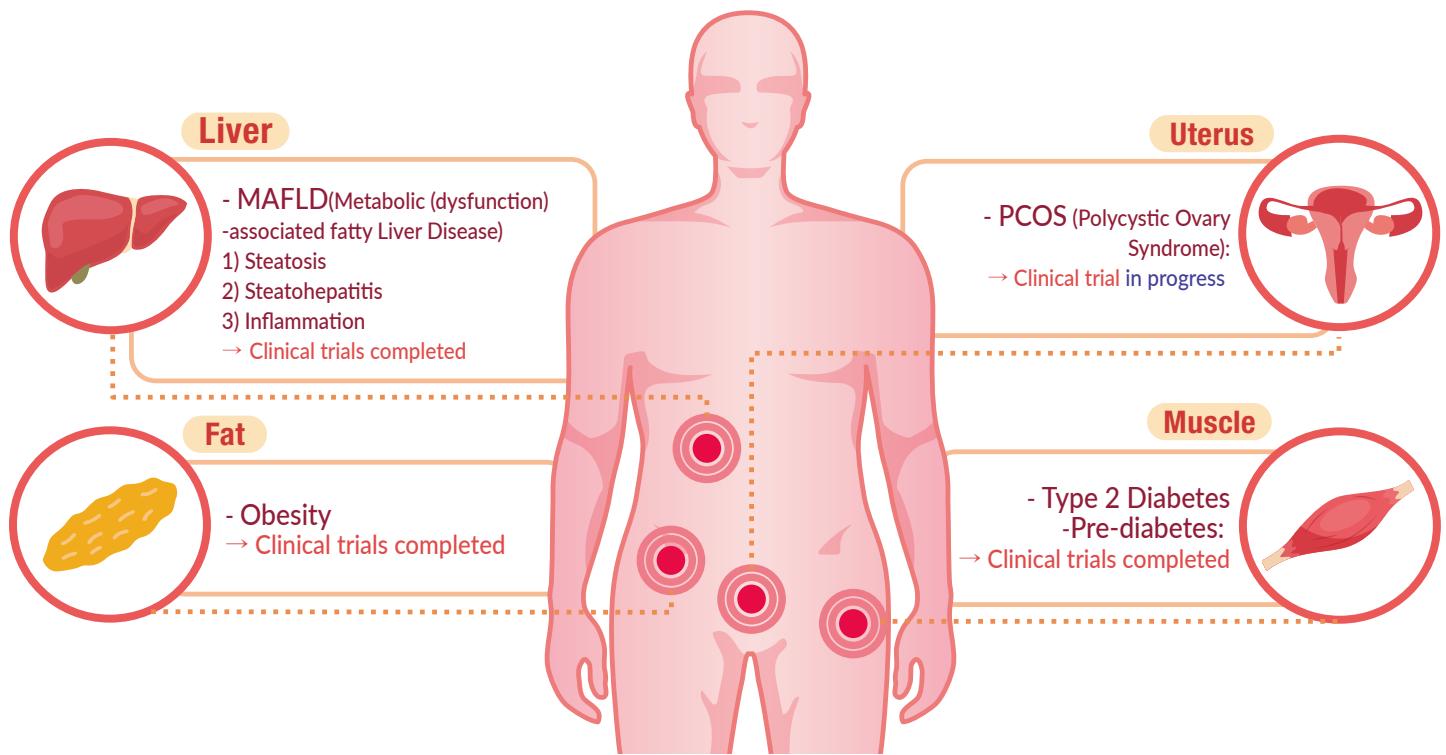
## Instant Result

after 30min

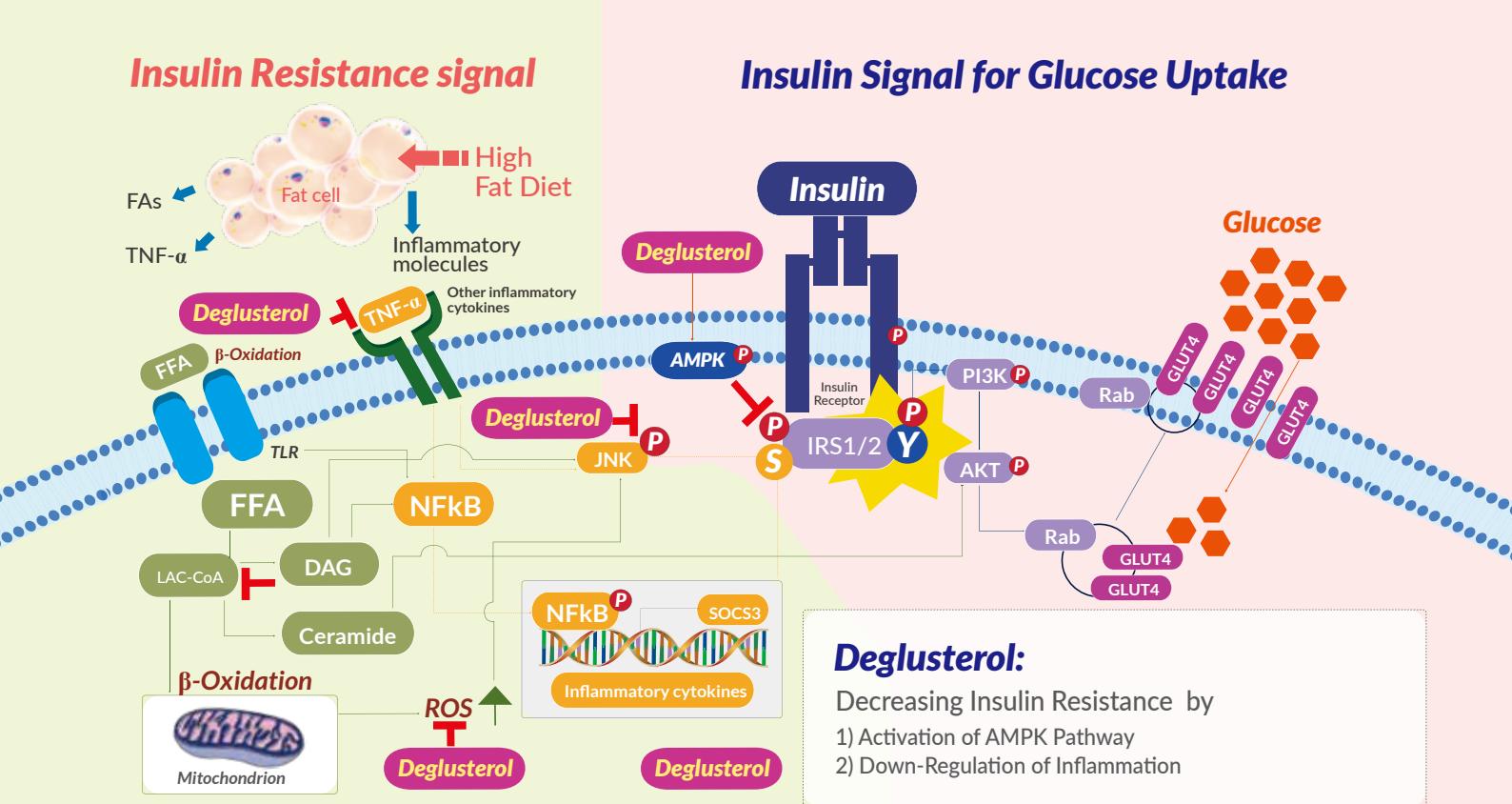


# proGsterol : The Key Solution for Metabolic Syndrome

## - Insulin resistance related diseases in human



## MOA of Deglusterol for Improving Insulin Resistance

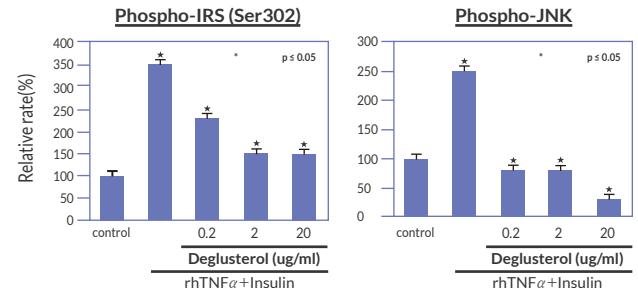


# IN VITRO Study: The Effects of Deglusterol on Improving Insulin Resistance

## 1. The effect of Deglusterol on Insulin Sensitivity and Resistant

### 1) Inhibition of Insulin Resistant signal

Cell: Differentiated 3T3-L1 (preadipocyte)

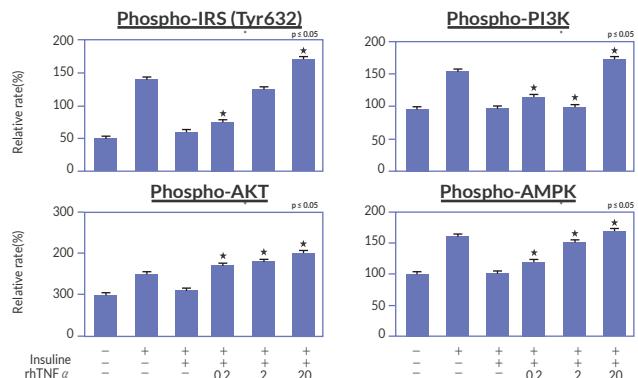
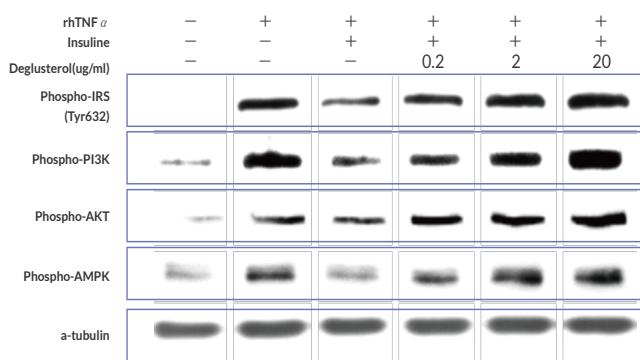


#### Effect of Deglusterol in insulin resistance signal

phosphorylation levels of insulin resistance-related signaling molecules were induced by rhTNF  $\alpha$  and insulin co-treatment and those were decreased by Deglusterol treatment

### 2) Increase in Insulin Sensitivity signal

Cell: Differentiated 3T3-L1 (preadipocyte)



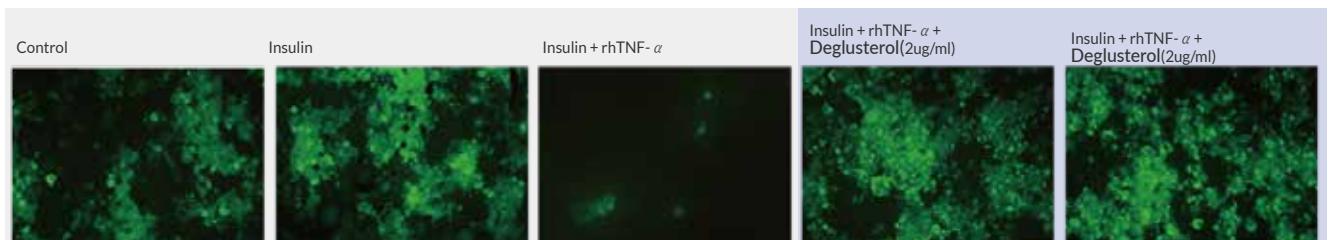
#### Effect of Deglusterol in insulin sensitivity signal

TNF  $\alpha$  induced down-regulation of Insulin sensitivity molecules, phospho-IRS(Tyr632), phospho-PI3K, phospho-AKT and phospho-AMPK were restored and increased by Deglusterol treatment in a dose dependent matter

## 2. The effect of Deglusterol on Glucose uptake

### 1) Glucose uptake in pre-adipocyte

Cell: Differentiated 3T3-L1 (preadipocyte)



### 2) Glucose uptake in Myoblast

Cell: C2C12 Myoblast



#### Effect of Deglusterol in Glucose uptake into Adipocyte and Myoblast

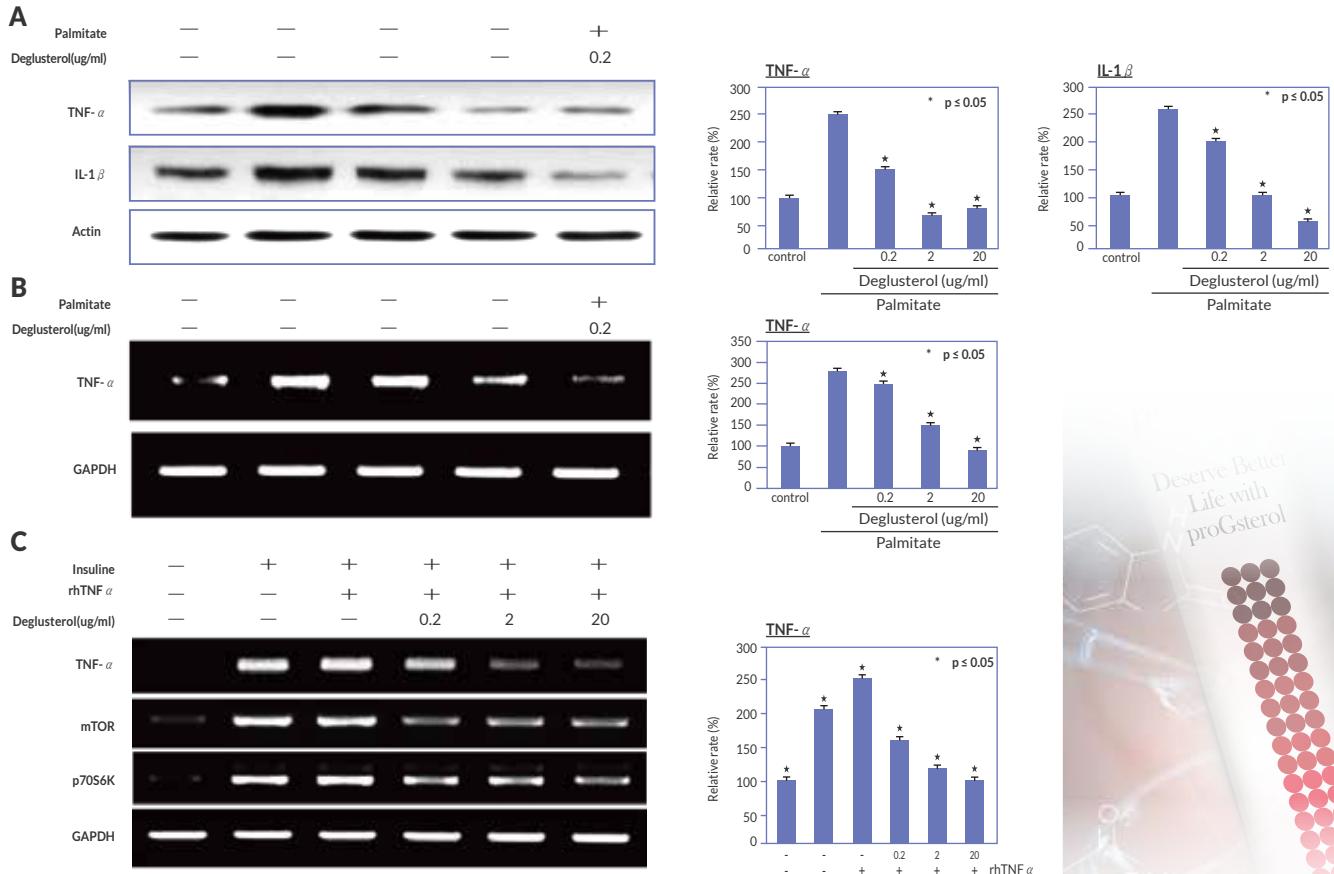
Decreased glucose uptake by TNF  $\alpha$  was restored by Deglusterol treatment in pre-adipocyte and Myoblast.

# IN VITRO Study: The Effects of Deglusterol on Improving Insulin Resistance

## 3. The effect of Deglusterol on FFA-induced inflammation

### 1) Inhibition of Palmitate-induced inflammatory cytokine expression

Cell: INS-1 (Pancreatic beta cells)



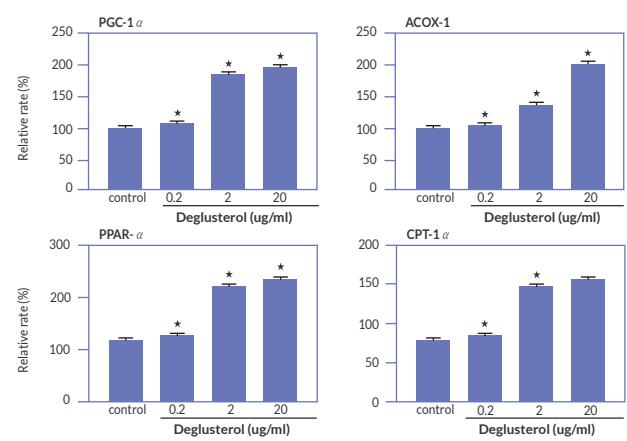
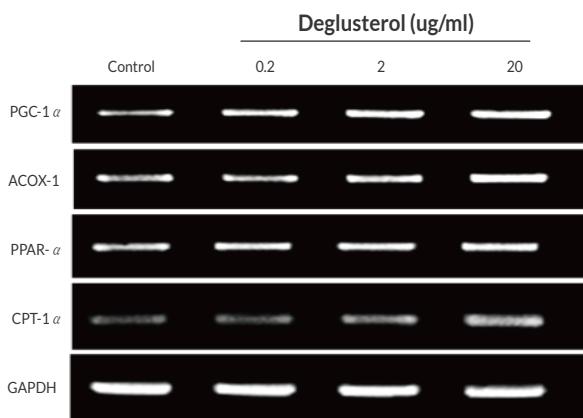
#### Effect of Deglusterol in FFA(Palmitate)-induced inflammatory cytokine expression

FFA(Palmitate-induced TNF  $\alpha$  and IL-1 $\beta$  and its signaling melesules(mTOR, p70S6K) expression were decreased by Deglusterol treatment

## 4. The effect of Deglusterol on FFA beta oxidation

### 1) FFA Beta oxidation related gene expression

Cell: INS-1 (Pancreatic beta cells)



#### Effect of Deglusterol in Palmitate-induced lipogenesis signal

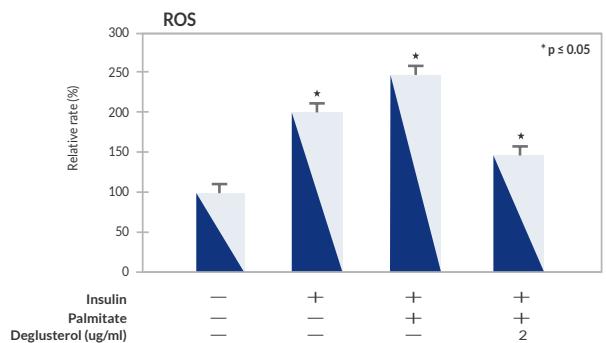
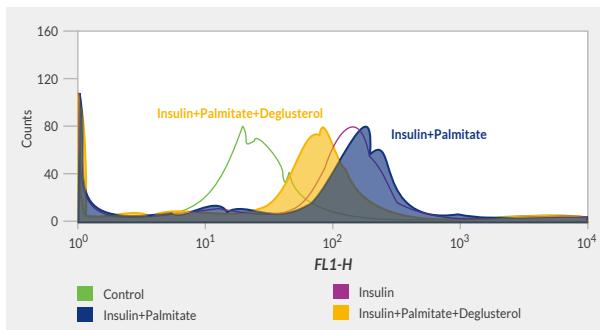
Expression levels of free fatty acid beta-oxidation related molecules like PCG-1  $\alpha$ , ACOX-1, PPAR-  $\alpha$ , and CPT-1  $\alpha$  were increased by Deglusterol treatment

## IN VITRO Study: The Effects of Deglusterol on Improving Insulin Resistance

### 4. The effect of Deglusterol on FFA beta oxidation

#### 2) Inhibition of Palmitate-induced ROS expression

Cell: INS-1 (Pancreatic beta cells)

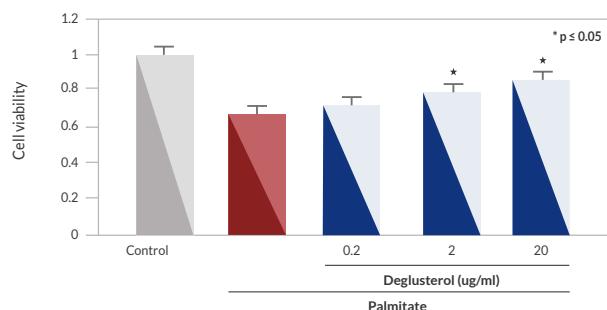


#### Effect of Deglusterol in FFA(Palmitate)-induced ROS expression

Expression level of Palmitate-induced ROS was decreased by Deglusterol treatment

#### 3) Inhibition of Palmitate-induced ROS expression

Cell: INS-1 (Pancreatic beta cells)



#### Effect of Deglusterol in FFA(Palmitate)-induced Pancreatic beta cell death

Palmitate-induced pancreatic beta cell apoptosis was prevented by Deglusterol treatment in a dose-dependent manner

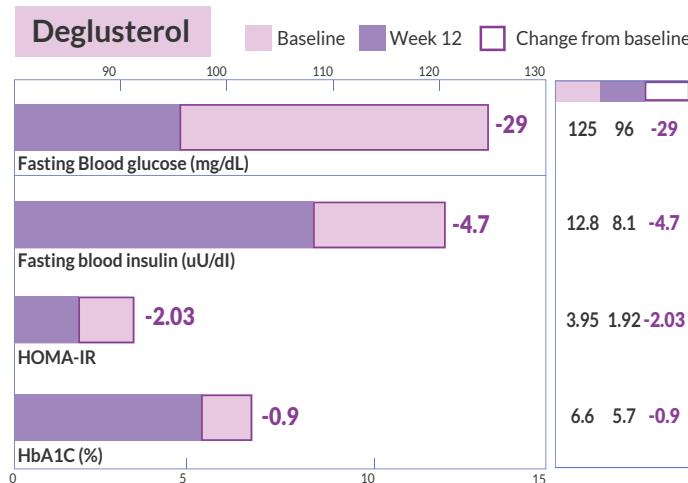
## Human Clinical Study: 1. Type II Diabetes Mellitus

### (Study1 - Deglusterol effect : 12Weeks)

A Randomized, Double-Blind, Placebo-Controlled clinical trial for evaluation of the efficacy and safety of Deglusterol (ProGsterol) versus Placebo in Patients with Type II Diabetes Millitus

Subject number: Deglusterol; 75, Placebo; 75.

Subject: Metabolic syndrome according to NCEP-ATPIII/ Confirmation of NASH in Ultra Sonography.



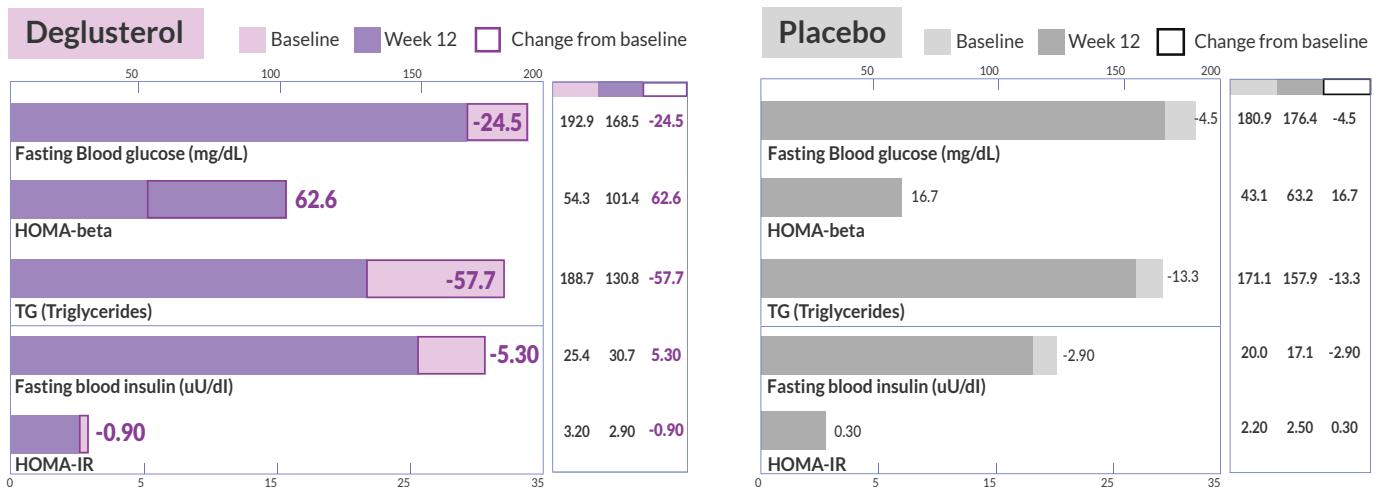
## Human Clinical Study: 2. Type II Diabetes Mellitus

### (Study2 - Comparison with Metformin : 12weeks, In progress)

A Randomized, Double-Blinded, Placebo-Controlled, Parallel Study to Assess the Effects of Deglusterol on Fasting Glucose and other Cardiometabolic risk factors in patients with type 2 Diabetes mellitus

Subject number: Deglusterol (Deglusterol+Metformin); 35, Placebo (Metformin); 35.

Subject: diagnosed with type 2 diabetes mellitus with HbA1c 6.5% - 11%



## Human Clinical Study: 3. Type II Diabetes Mellitus

### (Study3 - Comparison with Metformin/Gliptin combination therapy : 12weeks, In progress)

A Randomized, Double-Blinded, Placebo-Controlled, Parallel Study to Assess the Effects of Deglusterol on Fasting Glucose and other Cardiometabolic risk factors in type 2 Diabetes mellitus patients who are on Metformin + Gliptin combination therapy

Subject number: Deglusterol (Deglusterol+Metformin+Gliptin); 40, Placebo (Metformin+Gliptin); 40. (Gliptin: Sitagliptin, Liraglitin, Vildagliptin, etc)  
Subject: diagnosed with type 2 diabetes mellitus with HbA1c 6.5% - 11%

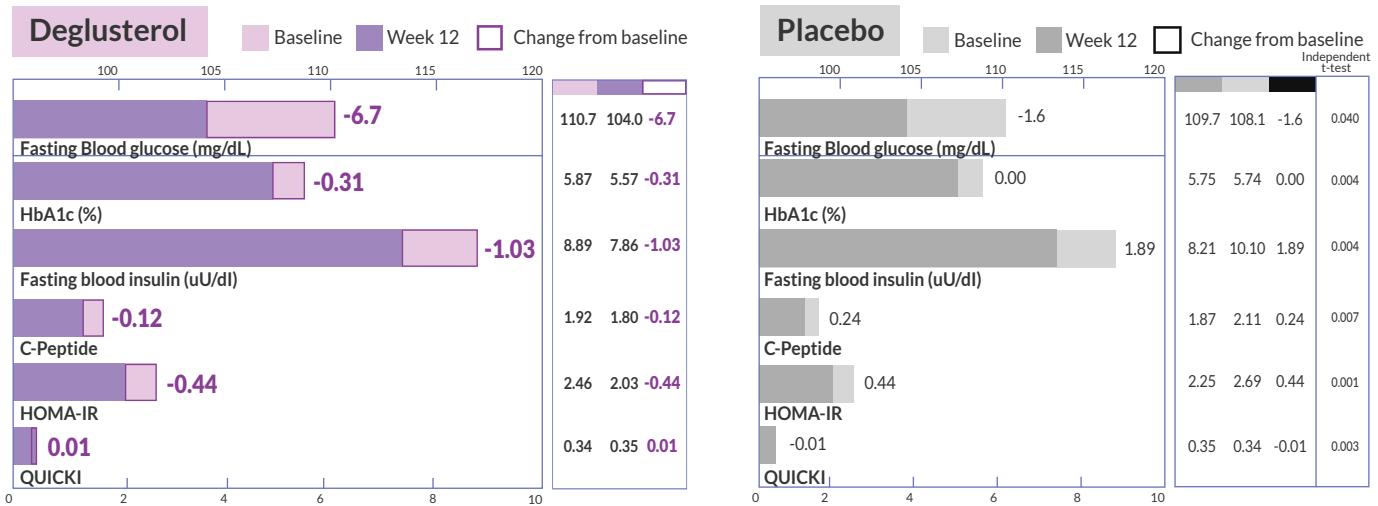


## Human Clinical Study: 4. Pre-Diabetes (Study1 : 12weeks)

A 12weeks, multi-center, randomized, double-blind, paralleled, placebo-controlled Human study to evaluate the efficacy and safety of Deglusterol on Fasting blood glucose level.

Subject number: Deglusterol; 27, Placebo; 29.

Subject: Adults with impaired glucose tolerance, fasting glucose or belonging to a high-risk group for diabetes

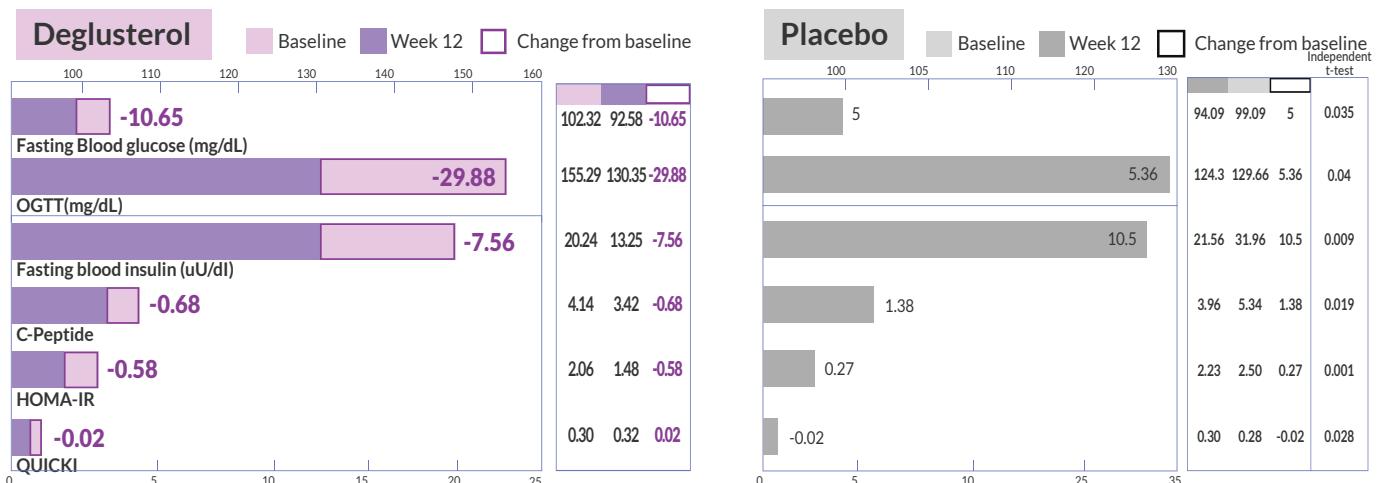


## Human Clinical Study: 5. Pre-Diabetes (Study2 : 4weeks)

A Randomized, Double-Blinded, Placebo-Controlled, Parallel Study to Assess the Effects of Deglusterol on Fasting Glucose and other cardiometabolic risk factors

Subject number: Deglusterol (Deglusterol+Metformin); 40, Placebo (Metformin); 40.

Subject: diagnosed with type 2 diabetes mellitus with HbA1c 6.5% - 11%

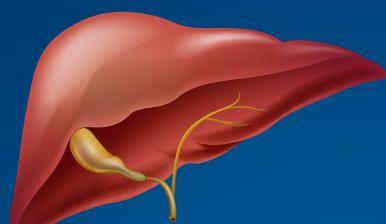


# Deglusterol Metabolic dysfunction-associated steatotic liver disease (MASLD), Non-Alcoholic fatty liver disease (NAFLD)

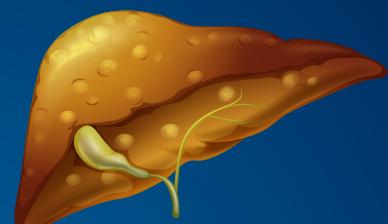


## NONALCOHOLIC FATTY LIVER DISEASE (NAFLD)

Nonalcoholic fatty liver disease (NAFLD) is a condition in which excess fat builds up in the liver, often related to obesity and insulin resistance which can lead to inflammation and scarring of the liver tissue



Healthy liver



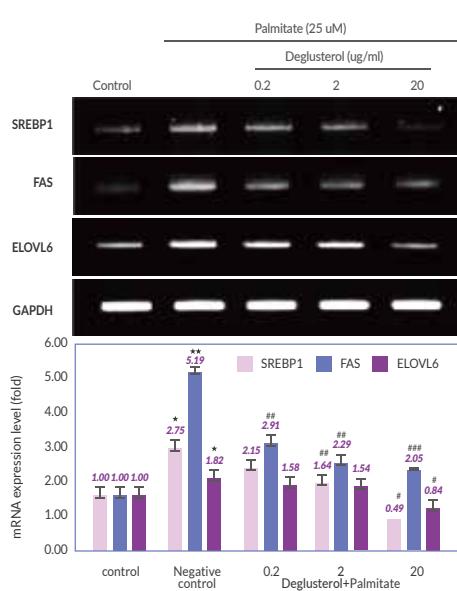
Fatty liver disease

## IN VITRO Study: The Effects of Deglusterol on FFA-induced NAFLD cellular model

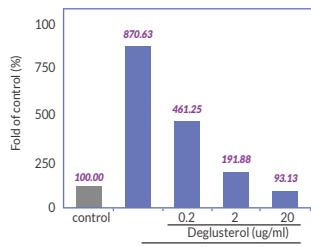
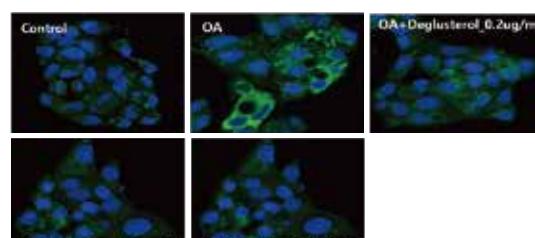
### 1. Effect of Deglusterol on Lipid metabolism disorders in palmitate-treated Hepatocyte

#### 1) Inhibition of Lipogenesis signal

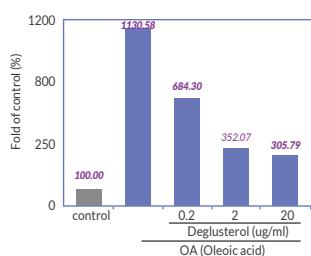
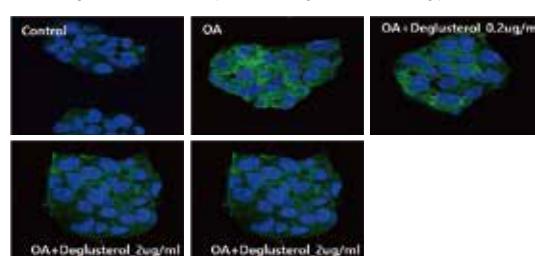
Cell: HepG2 (Hepatocellular cell)



#### SREBP1 Expression levels (immunocytochemistry)



#### FAS Expression levels (immunocytochemistry)



#### Inhibition of Lipogenesis signal in Hepatocyte

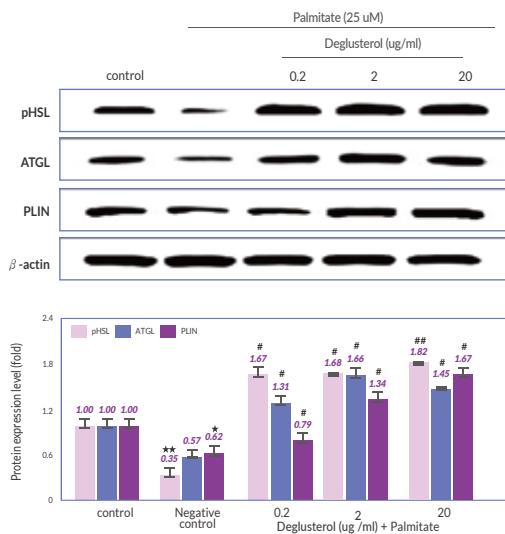
FFA (Palmitate)-induced lipogenesis related molecules (SREBP-1, FAS, and ELOVL6) expression were decreased by Deglusterol treatment

# IN VITRO Study: The Effects of Deglusterol on FFA-induced NAFLD cellular model

## 2) Increase in Lipolysis signal

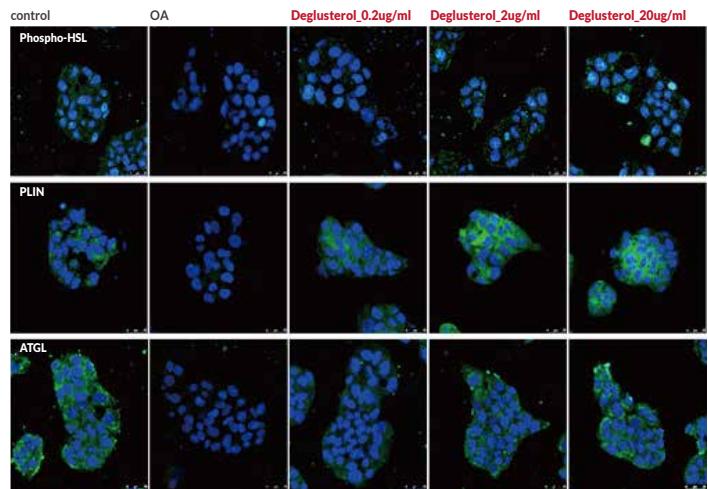
Cell: HepG2 (Hepatocellular cell)

### Translational level of HSL, ATGL and PLIN



### Secretion level of HSL, ATGL and PLIN

#### Immuno cyto chemistry



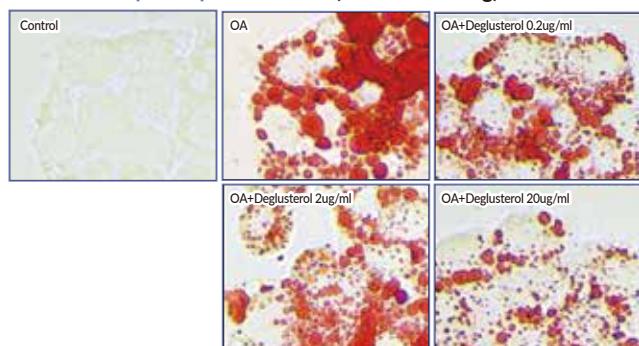
#### Increase in Lipolysis signal in Hepatocyte

FFA (Palmitate)-reduced lipolysis related molecules (phosphor-HSL, ATGL, PLIN) expression were increased by Deglusterol treatment

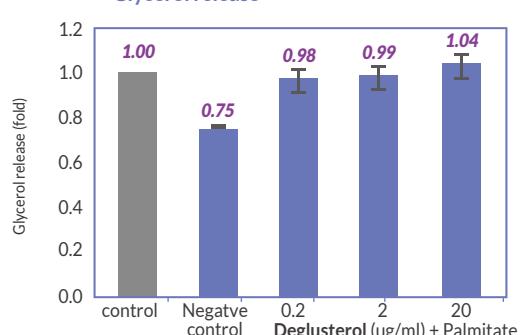
## 3) Inhibition of lipid accumulation

Cell: HepG2 (Hepatocellular cell)

### Inhibition of Lipid droplet formation (Oil red O staining)



### Glycerol release

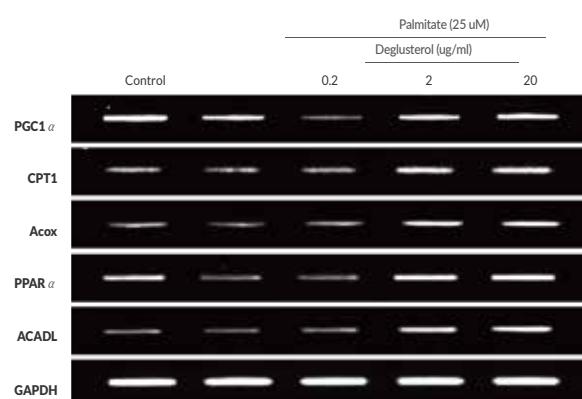


#### Glycerol Release

FFA (palmitate)-reduced Glycerol release were increased by Deglusterol treatment

## 4) FFA beta oxidation related genes expression

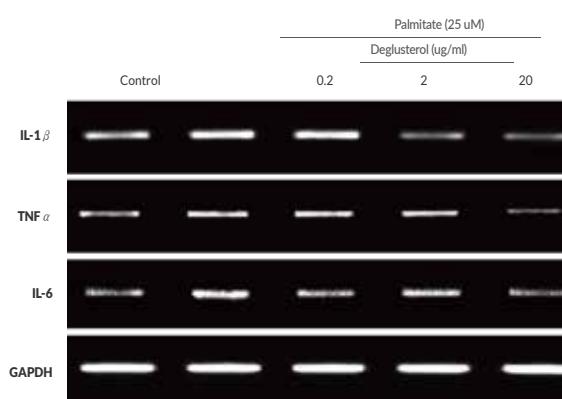
Cell: HepG2 (Hepatocellular cell)



#### FFA beta oxidation-related genes expression in Hepatocyte

FFA (Palmitate)-reduced FFA Beta oxidation-related gene expression were dramatically increased by Deglusterol treatment

## 5) Inhibition of Palmitate-induced inflammatory cytokine expression



#### Inhibition of FFA-induced pro-inflammatory cytokines expression

FFA (Palmitate)-induced pro-inflammatory genes expression were reduced by Deglusterol treatment

## IN VITRO Study: The Effects of Deglusterol on DIO(Diet-induced Obese) NAFLD Animal model (2weeks Treatment / 2weeks Recovery, HFD 45%)

### 1) Liver Tissue after Medication and Recovery

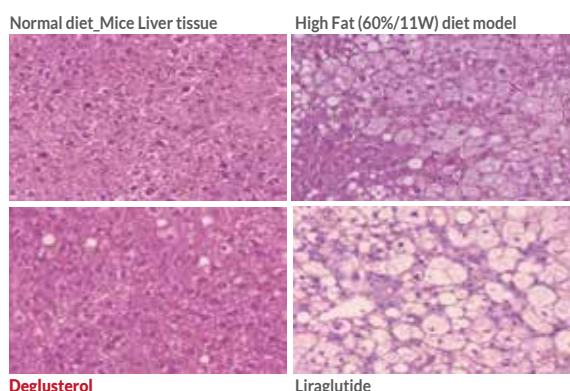
After 2weeks of Medication



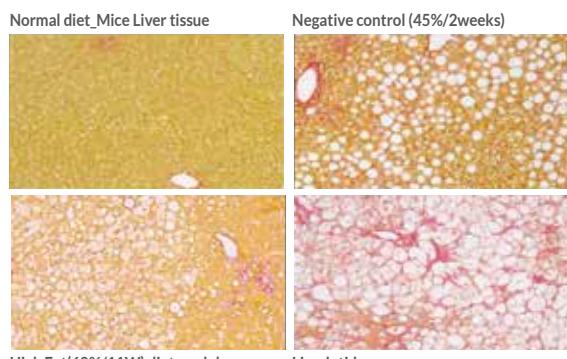
After 2weeks of Recovery



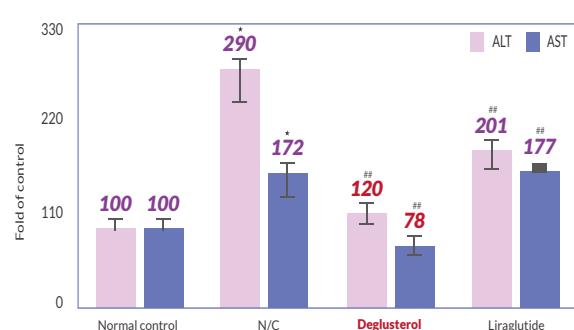
### 3) Hepatic Steatosis (H&E staining)



### 4) Hepatic fibrosis (Sirius Red staining)

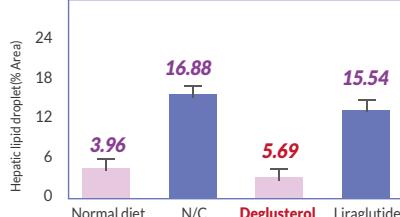


### 5) ALT&AST Level

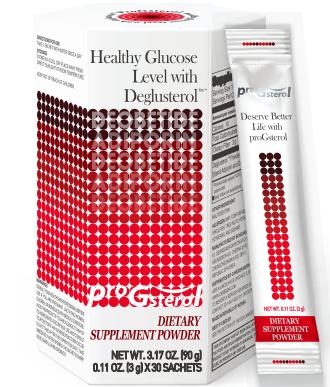
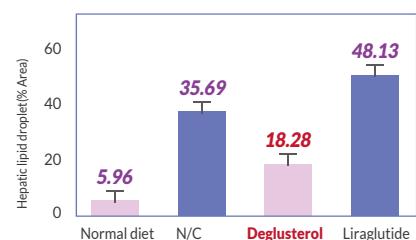


### 2) steatohepatitis in liver tissue

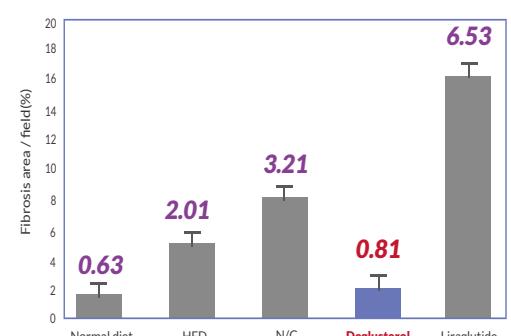
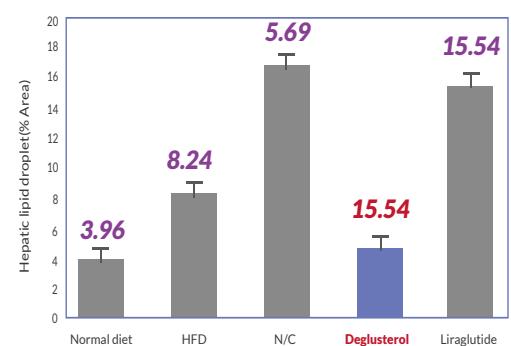
After 2weeks of Medication



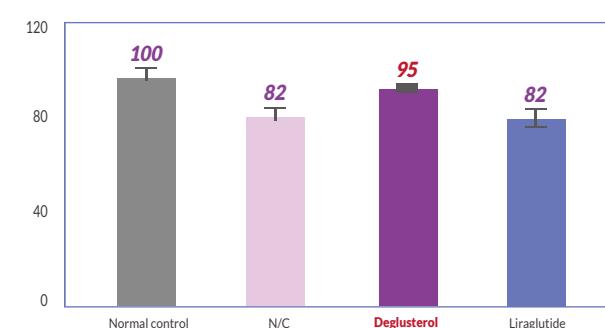
After 2weeks of Recovery



**Testing is Believing!**



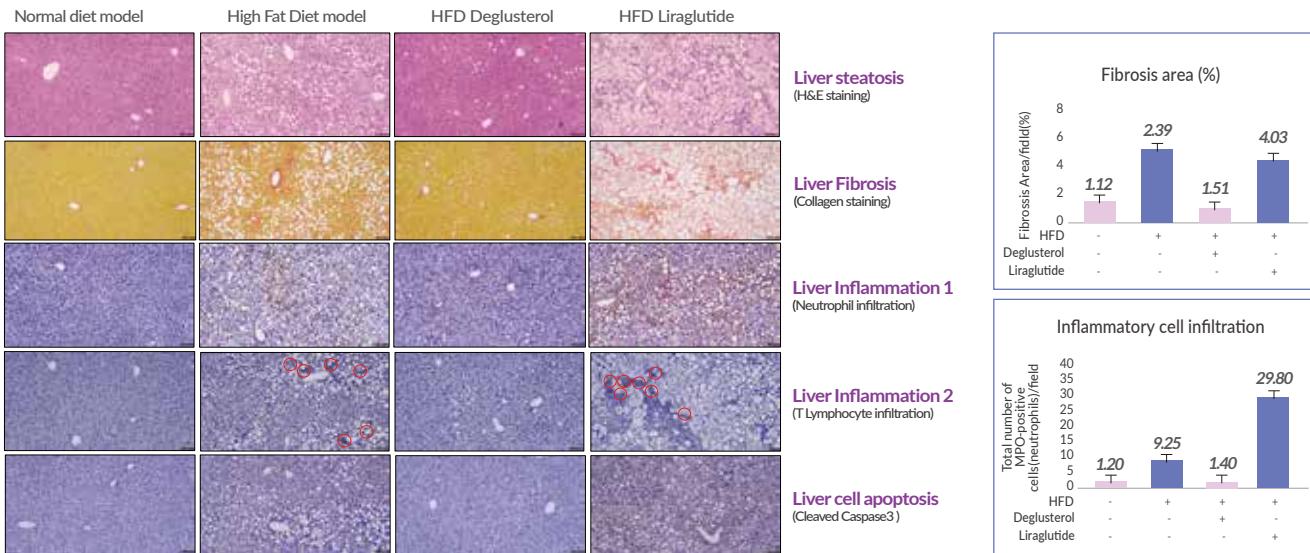
### 6) Adiponectin Level



**proGsterol**

## IN VITRO Study: The Effects of Deglusterol on DIO(Diet-induced Obese) NAFLD Animal model (2weeks Treatment / 2weeks Recovery, HFD 45%)

### 7) Liver steatosis, Ballooning degeneration, fibrosis, inflammation



## Human Clinical Study: 3. NASH and NAFLD (MASLD; Metabolic dysfunction-associated Steatotic Liver Disease)

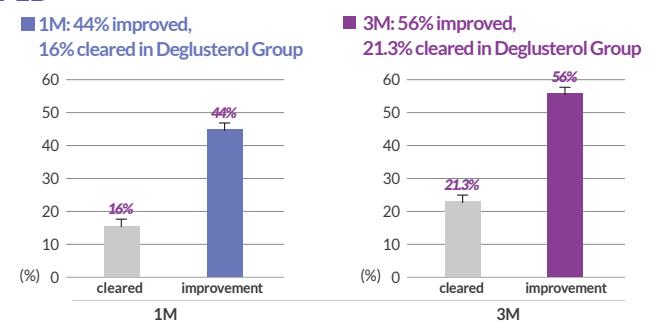
A Randomized, Double-Blind, Placebo-Controlled clinical trial for evaluation of the efficacy and safety of Deglusterol (ProGsterol) versus in Patients with Metabolic syndrome and NAFLD (Non Alcoholic Fatty Liver Disease)

Subject number: Deglusterol; 75, Placebo; 75.

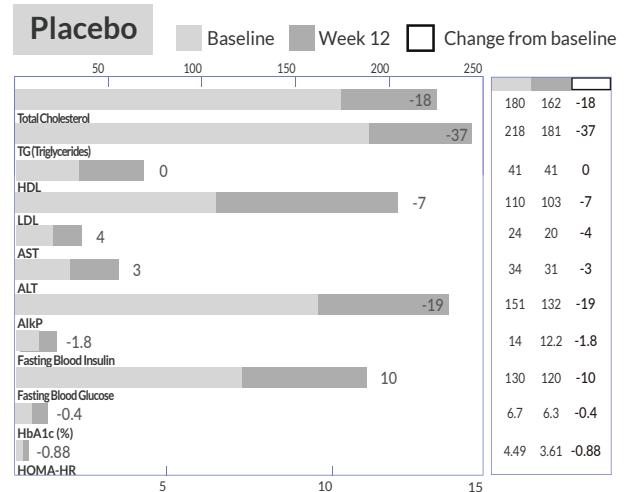
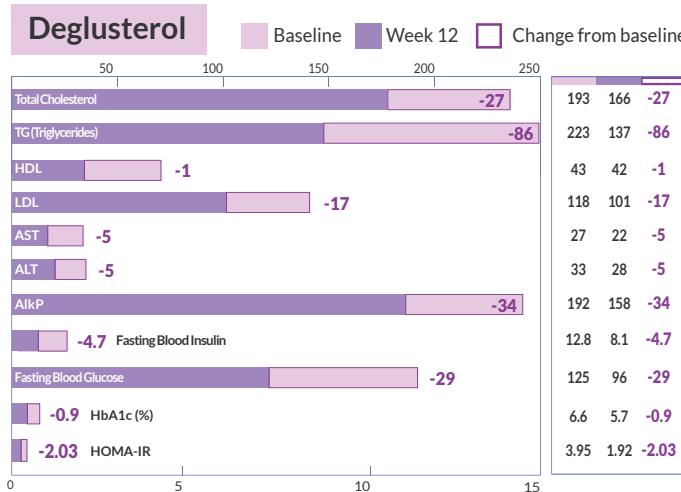
Subject: Metabolic syndrome according to NCEP-ATPIII/ Confirmation of NASH in Ultra Sonography.

### 1) Changes in Clinical status and disease Severity of NAFLD

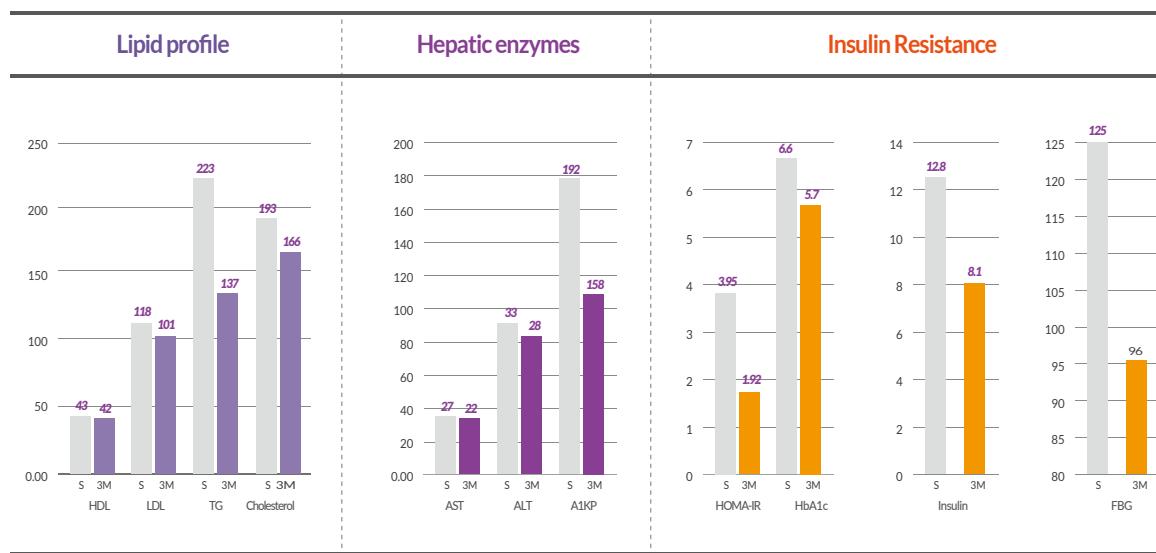
Fatty Liver Grade	Deglusterol			Placebo		
	Screening	1 Month	3 Months	Screening	1 Month	3 Months
Cleared	0	12	16	0	6	8
Grade1	24	27	28	25	30	32
Grade2	37	27	23	38	29	26
Grade3	14	9	8	12	10	9



### 2) Changes in Biochemical Parameters



## Human Clinical Study: 3. NASH and NAFLD (MASLD; Metabolic dysfunction-associated Steatotic Liver Disease)

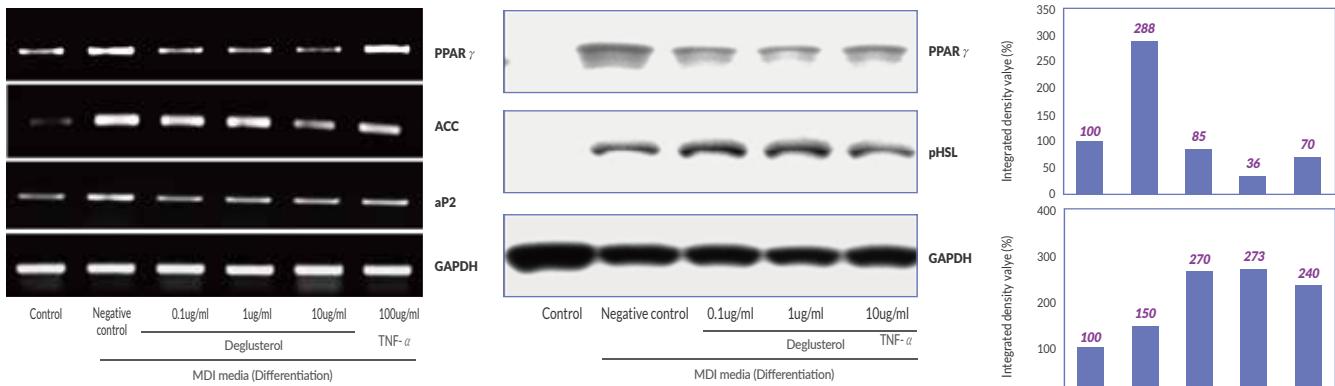


## IN VITRO Study: The Effects of Deglusterol on Anti-obesity

### 1. Inhibition of Lipogenesis by Deglusterol

#### 1) Expression of Lipid Metabolism-related Target Genes and proteins

Cell line: 3T3-L1 pre-adipocyte cell line

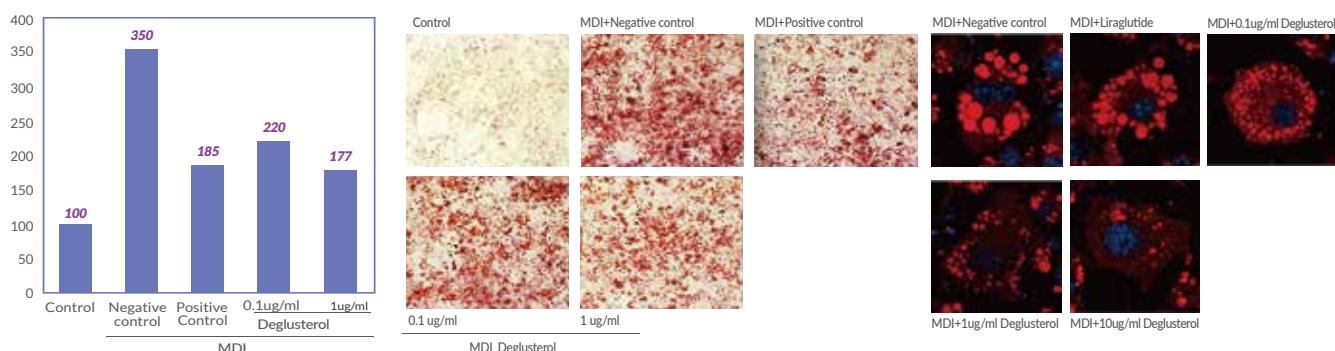


#### Expression of Lipid metabolism-related target genes and protein

MID (Adipocyte differentiation Conditioned Media)-induced Lipogenesis related genes (PPAR $\gamma$ , ACC, and aP2) expression were reduced by Deglusterol treatment

#### 2) Inhibition of Lipid Accumulation

Cell line: 3T3-L1 pre-adipocyte cell line



#### Inhibition of Lipid Accumulation in adipocyte

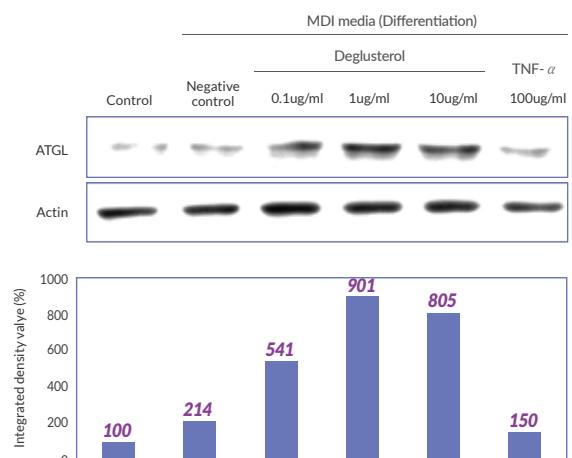
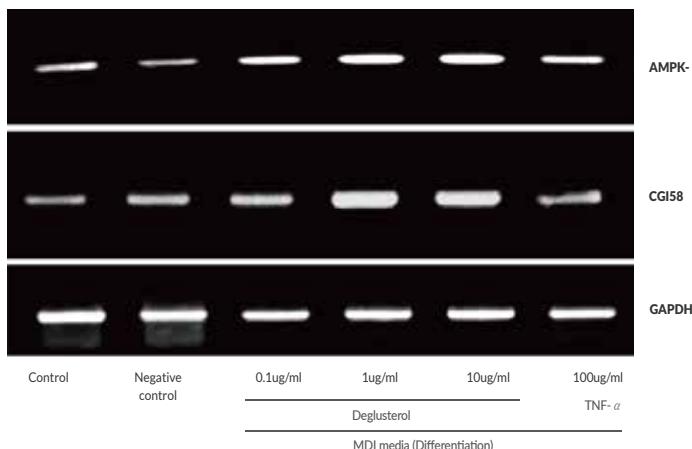
MID (Adipocyte differentiation Conditioned Media)-reduced lipid accumulation was reduced by Deglusterol treatment

# IN VITRO Study: The Effects of Deglusterol on Anti-obesity

## 2. Increase in Lipolysis by Deglusterol

### 1) Expression of Lipolysis-related Target Genes and proteins

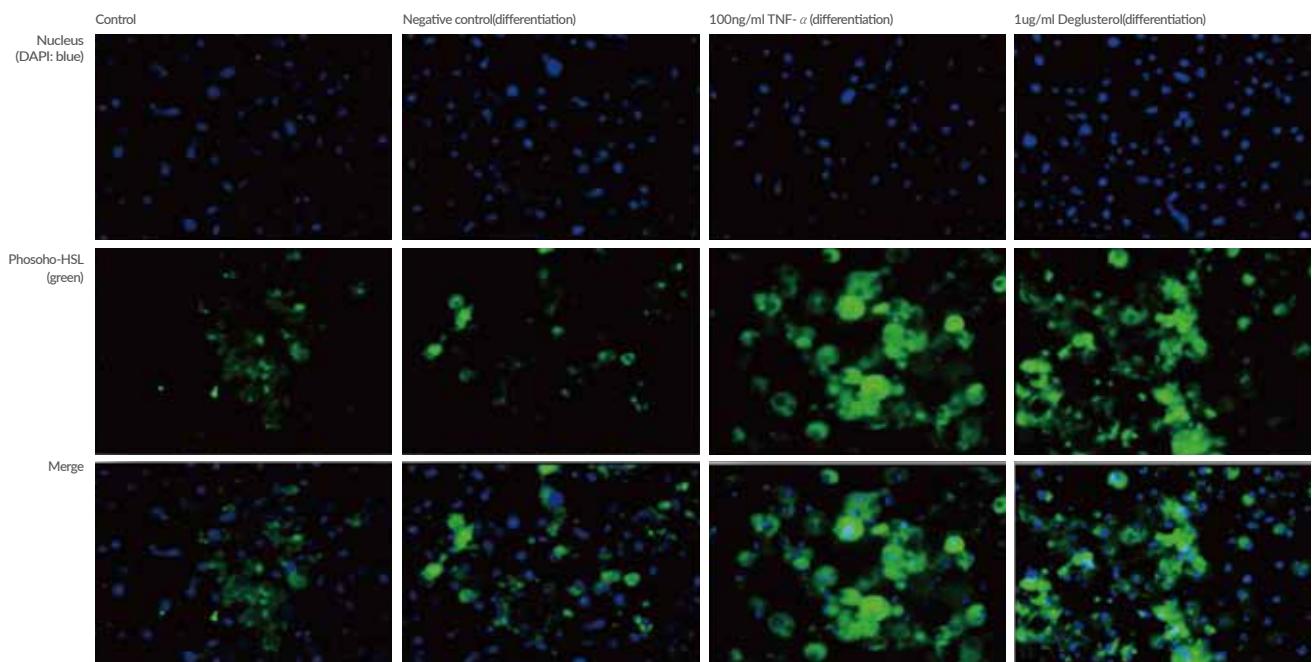
Cell line: 3T3-L1 pre-adipocyte cell line



#### Increase in lipolysis-related genes

MDI (Adipocyte differentiation Conditioned Media)-reduced lipolysis related molecules, AMPK-A1, CGI58, and ATGL, were increased by Deglusterol treatment

### 2) Induction of Lipolysis in pre-Adipocyte Cell Line



#### Increase phosphor-HSL activity

Phosphorylation of HSL as a lipolysis key protein was dramatically increased by Deglusterol treatment

Control Glucose Level  
with Deglusterol

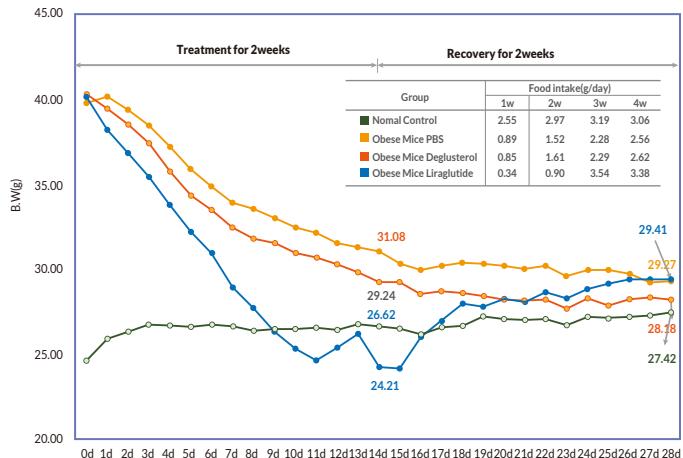


# IN VIVO Study: The Effects of Deglusterol on Obese Animal model

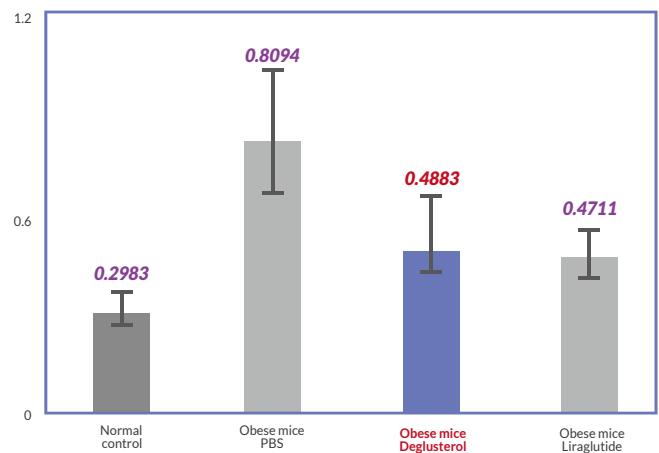
- 60% High Fat diet for 10weeks – Medication for 2W(5% diet) – Recovery for 2W (5% diet)

## 1. The effect of Deglusterol on Insulin Sensitivity and Resistant

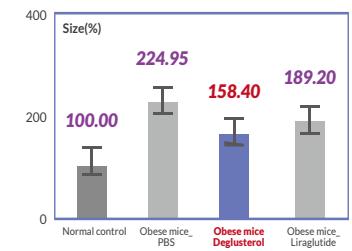
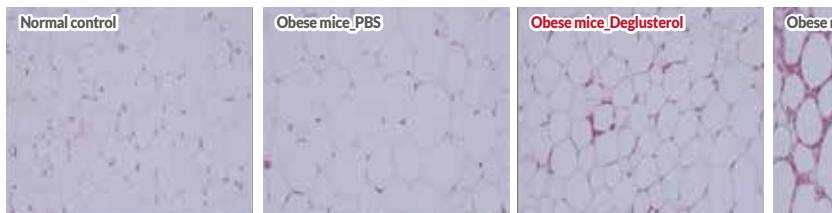
### 1) Changes in Body weight (g)



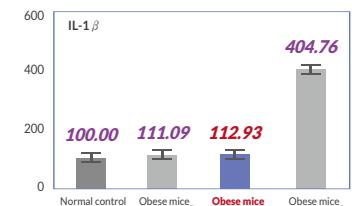
### 2) Changes in Body weight (g)



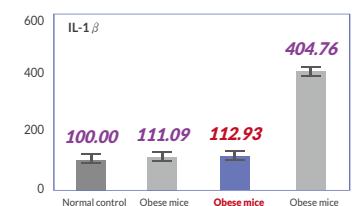
### 3) Fat Tissue Tissue \_ Size and number of Adipocyte (H&E staining)



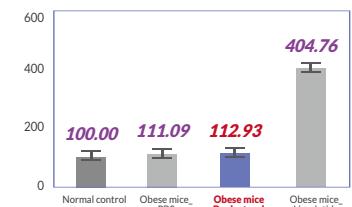
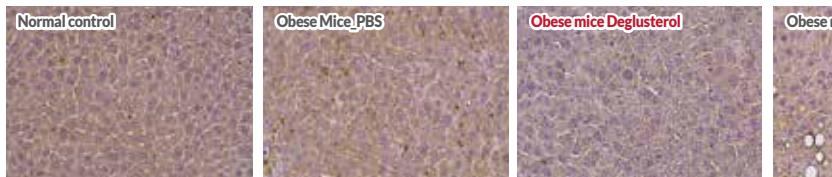
### 4) Inflammation in Adipose Tissue (IL-1 $\beta$ expression)



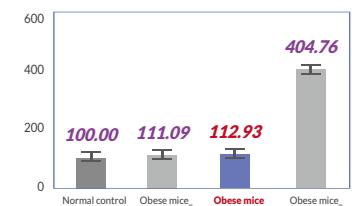
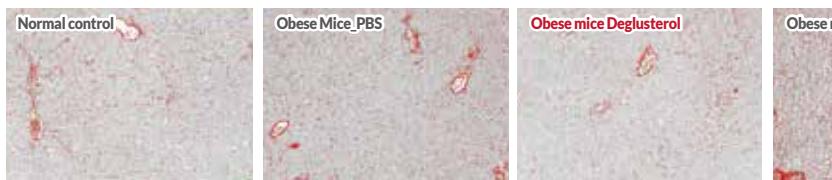
### 5) Liver Tissue\_steatosis



### 6) Inflammation in Liver Tissue (MPO-Positive cell\_Neutrophil infiltration)



### 7) Liver Fibrosis (Collagen expression)



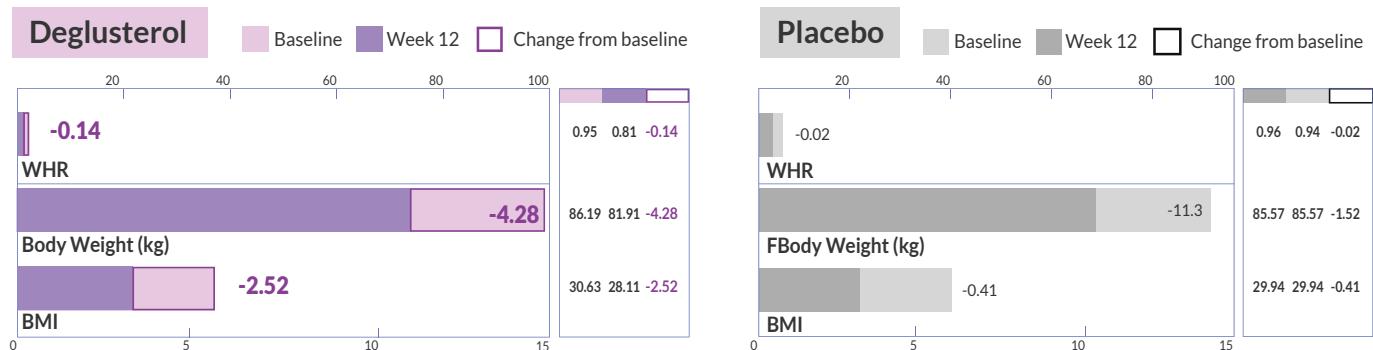
# Human Clinical Study: Obesity

A Randomized, Double-Blind, Placebo-Controlled clinical trial for evaluation of the efficacy and safety of Deglusterol (ProGsterol) versus in Patients with Metabolic syndrome and NAFLD (Non Alcoholic Fatty Liver Disease)

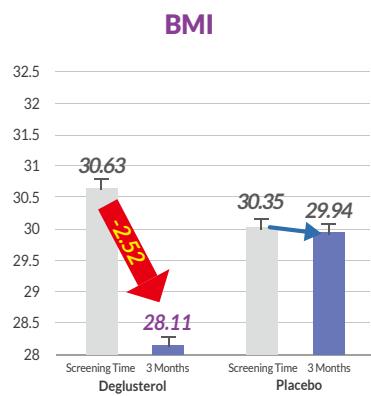
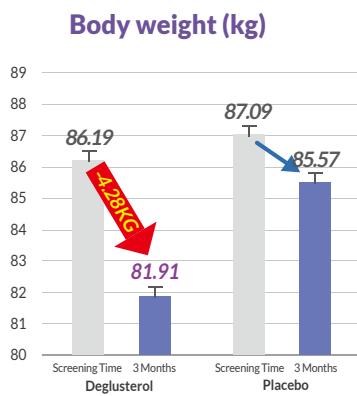
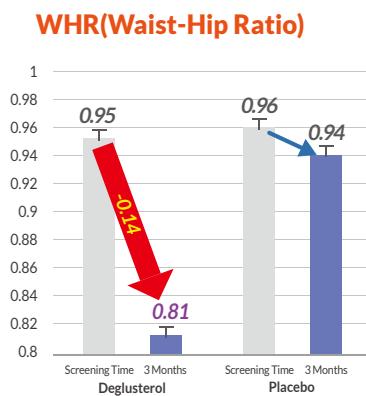
Subject number: Deglusterol; 75, Placebo; 75.

Subject: Metabolic syndrome according to NCEP-ATPIII/ Confirmation of NASH in Ultra Sonography.

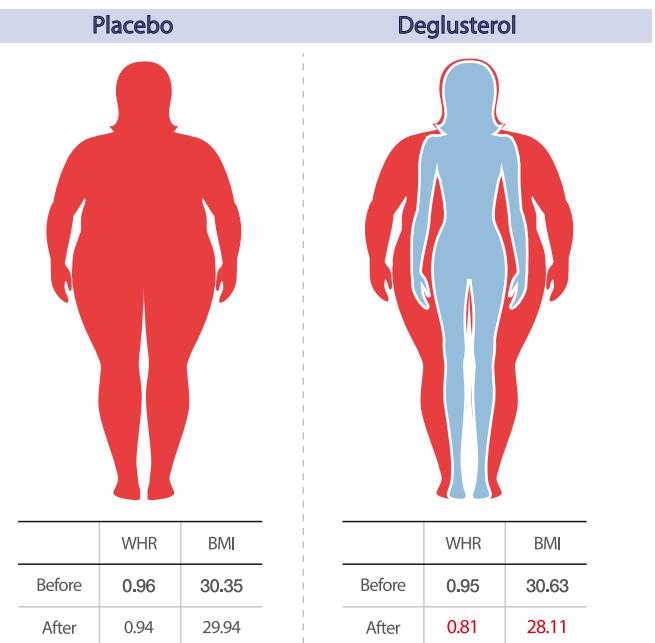
## 1) Changes in WHR, Body Weight and BMI



**WHR -0.14, Body weight -4.28kg, BMI -2.52 in Deglusterol Group**



**Testing is Believing!**



**proGsterol**

# proGsterol

Head Office 23, Yeoksam-ro 98-gil, Gangnam-gu, Seoul, 06188 South Korea  
E-mail : sales@caregen.com  
Creative village 16-27, LS-ro 91beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, 14119 South Korea  
R&D Center 46-38, LS-ro 91beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, 14119 South Korea  
Peptide Manufacturing Plant 37 Jeongoksandan 4-gil, Seosin-myeon, Hwaseong-si, Gyeonggi-do, 18554 South Korea  
[www.caregen.com](http://www.caregen.com)

Copyright © 2024 All right reserved by Caregen Co.,Ltd.

