

**Supplementary data :**

**Supplementary Table 1:** Diet composition (g/kg) on the basis of the AIN-93M diet formulation.

| Ingredient, g/kg de diet | Control diet | High Fat diet |
|--------------------------|--------------|---------------|
| Casein                   | 165          | 200           |
| Cornstarch               | 442.5        | 233.8         |
| Dextrinized cornstarch   | 144          | 80            |
| Sucrose                  | 100          | 53            |
| Soybean oil              | 50           | 25            |
| Lard                     | 0            | 300           |
| Cellulose                | 50           | 50            |
| Mineral mix (AIN-93M)    | 35           | 42            |
| Vitamin mix (AIN-93M)*   | 10           | 12            |
| L-Cystine                | 2            | 2.4           |
| Choline chloride \$      | 1.5          | 1.8           |
| TOTAL                    | 1000         | 1000          |

\*The diet vitamin E level was reduced in the five diets from 75 mg/kg to 25 mg/kg diet to decrease the antioxidant capacity of the high fat diets.

\$ We added choline chloride instead of choline bitartrate because we observed the formation of important stones in the bladder of rats in previous studies using choline bitartrate.

**Supplementary Table 2:** Spirulina composition.

| <b>Mean nutritional composition</b> | <b>for 100 g</b> |
|-------------------------------------|------------------|
| Proteins                            | 65 g             |
| -whose phycocyanin (protein)        | 20 g             |
| Carbohydrates                       | 20 g             |
| Lipids                              | 6 g              |
| Energy                              | 375 Kcal         |
| <b>Vitamins</b>                     |                  |
| Beta caroten                        | 161 mg           |
| Vitamin A                           | 1.5 mg           |
| Thiamin (vit B1)                    | 5 mg             |
| Riboflavin (vit V2)                 | 4 mg             |
| Niacin (vit B3)                     | 13 mg            |
| Ca pantothenate (vit B5)            | 2 mg             |
| Pyridoxin (vit B6)                  | 0.7 mg           |
| Biotin (vit B8)                     | 10 µg            |
| Folate (vit B9)                     | 50 µg            |
| Cyanocobalamin (vit b12)            | 200 µg           |
| Tocopherol (vit E)                  | 20 mg            |
| <b>Minerals</b>                     |                  |
| Sodium                              | 450 mg           |
| Potassium                           | 1100 mg          |
| Calcium                             | 770 mg           |
| Phosphorus                          | 780 mg           |
| Magnesium                           | 250 mg           |
| Iron                                | 120 mg           |
| Zinc                                | 3 mg             |
| Manganese                           | 3 mg             |
| <b>Amino acids</b>                  |                  |
| Alanine                             | 5.0 g            |
| Arginine                            | 4.1 g            |
| Aspartic acid                       | 5.7 g            |
| Glutamic acid                       | 8.5 g            |
| Cystine                             | 0.6 g            |
| Glycine                             | 3.0 g            |
| Histidine                           | 0.9 g            |
| Isolucine                           | 3.6 g            |
| Leucine                             | 5.7 g            |
| Lysine                              | 2.3 g            |
| Methionine                          | 1.3 g            |
| Phenylalanine                       | 2.7 g            |
| Proline                             | 1.9 g            |
| Serine                              | 3.3 g            |
| Threonine                           | 3.0 g            |
| Tryptophan                          | 0.9 g            |
| Tyrosine                            | 2.8 g            |
| valine                              | 4.2 g            |

**Supplementary Table 3:** List and source of primary and secondary antibodies of liver investigated proteins.

| Name                                 | Source           | Product reference | Animal host | Dilution |
|--------------------------------------|------------------|-------------------|-------------|----------|
| <b>Primary antibodies</b>            |                  |                   |             |          |
| ACC                                  | Cell Signaling 1 | 3676              | rabbit      | 1/1000   |
| p-ACC                                | Cell Signaling 1 | 3661              | rabbit      | 1/1000   |
| ACLS1                                | Cell Signaling 1 | 9189              | rabbit      | 1/2000   |
| FAS                                  | Cell Signaling 1 | 3180              | rabbit      | 1/1000   |
| FAT/CD36                             | Abcam 3          | ab64014           | rabbit      | 1/200    |
| FATP5                                | ClinSciences 4   | PAB660Ra01        | rabbit      | 1/1000   |
| IL-6                                 | Abcam 3          | ab25107           | rabbit      | 1/1000   |
| L-CPT-1                              | Abcam 3          | ab128568          | mouse       | 1/400    |
| MCP-1                                | Abcam 3          | ab7997            | rabbit      | 1/1000   |
| NF-kB p65                            | Cell Signaling 1 | 3034              | rabbit      | 1/1000   |
| Nrf2                                 | Abcam 3          | ab137550          | rabbit      | 1/3000   |
| PGC-1 $\alpha$                       | Abcam 3          | ab54481           | rabbit      | 1/1000   |
| TNF- $\alpha$                        | Abcam 3          | ab66579           | rabbit      | 1/1000   |
| $\beta$ -Actin                       | Santa Cruz 2     | sc-81178          | rabbit      | 1/1000   |
| <b>Secondary antibodies</b>          |                  |                   |             |          |
| Anti-mouse IgG, HRP-linked Antibody  | Cell Signaling   | 7076              | 7076        | 1/2000   |
| Anti-rabbit IgG, HRP-linked Antibody | Cell Signaling   | 7074              | 7074        | 1/2000   |

1 Cell signaling Technology, Boston, Massachusetts, USA.

2 Santa Cruz Biotechnology, Dallas, Texas, USA.

3 Abcam, Cambridge, UK.

4 ClinSciences, Nanterre, France.

ACC: acetyl-CoA carboxylase; ACLS1: acyl CoA synthetase 1; FAS: fatty acid synthase; FAT/CD36: fatty acid transporter/cluster of differentiation 36; Il-6: interleukine 6; L-CPT1: liver-carnitine palmitoyl transferase 1; Mcp-1 (Ccl2) monocyte chemoattractant protein 1; NF-kappaB/RELA (p65): REL-associated protein A; Nrf2/Nfe2l2: Nuclear factor (erythroid-derived 2)-like 2; PGC-1 $\alpha$ : peroxisome-proliferator-activated-receptors- $\gamma$  cofactor-1 $\alpha$ ; TNF-a: tumor necrosis factor- $\alpha$ .

**Supplementary Table 4:** Recapitulative effects of spirulina and Si-enriched spirulina compared to HF diet

| Parameter                          | Spirulina vs HF | Si-spirulina vs HF | Si-spirulina vs spirulina |
|------------------------------------|-----------------|--------------------|---------------------------|
| <b><i>Rat characteristics:</i></b> |                 |                    |                           |
| Rat food consumption               | NS              | NS                 | NS                        |
| Rat energy consumption             | NS              | NS                 | NS                        |
| Final rat body weight              | NS              | NS                 | NS                        |
| Body weight gain                   | NS              | NS                 | NS                        |
| Rat liver weight                   | NS              | NS                 | NS                        |
| Rat adipose tissue weight          | NS              | NS                 | NS                        |
| <b><i>Blood parameters:</i></b>    |                 |                    |                           |
| OGTT at 6 weeks                    | NS              | NS                 | NS                        |
| OGTT at 11 weeks                   | increase        | increase           | NS                        |
| Plasma glucose level               | NS              | NS                 | NS                        |
| Serum insulin level                | NS              | NS                 | NS                        |
| HOMA-IR index                      | NS              | NS                 | NS                        |
| HOMA-beta index                    | NS              | NS                 | NS                        |
| Serum leptin level                 | NS              | NS                 | NS                        |
| Serum adiponectin level            | NS              | NS                 | NS                        |
| Serum TAG level                    | NS              | NS                 | NS                        |
| Serum FFA level                    | NS              | NS                 | NS                        |
| Serum total cholesterol level      | NS              | NS                 | NS                        |
| Serum paraoxonase activity         | NS              | NS                 | NS                        |
| Serum ALAT activity                | NS              | NS                 | NS                        |
| Serum CRP level                    | NS              | NS                 | NS                        |
| Serum TNF-a level                  | NS              | NS                 | NS                        |
| Serum IL-6 level                   | NS              | NS                 | NS                        |
| Serum MCP-1 level                  | NS              | NS                 | NS                        |
| Plasma TBARS, $\mu\text{M}$        | decrease        | decrease           | NS                        |
| Plasma FRAP                        | NS              | NS                 | NS                        |
| Plasma AGEs                        | NS              | NS                 | NS                        |
| Plasma SH Groups level             | NS              | NS                 | NS                        |
| Plasma SOD activity                | NS              | NS                 | NS                        |
| RBC Catalase activity              | NS              | NS                 | NS                        |
| Plasma GPx activity                | NS              | NS                 | NS                        |
| Blood GSH level                    | NS              | NS                 | NS                        |
| Blood GssG level                   | NS              | NS                 | NS                        |
| Blood GssG/GSH ratio               | NS              | NS                 | NS                        |
| <b><i>Liver parameters:</i></b>    |                 |                    |                           |
| Liver TAG level                    | NS              | NS                 | NS                        |
| Liver FFA level                    | NS              | NS                 | NS                        |
| Liver cholestreol level            | NS              | NS                 | NS                        |
| Liver steatosis score              | NS              | NS                 | NS                        |
| Liver citrate syntahse activity    | NS              | NS                 | NS                        |
| Liver complex I activity           | NS              | NS                 | NS                        |
| Liver complex II activity          | NS              | NS                 | NS                        |
| Liver complexes II+III activity    | NS              | NS                 | increase                  |
| Liver complex IV activity          | NS              | NS                 | NS                        |
| Liver $\beta$ -HAD activity        | decrease        | NS                 | NS                        |

|                              |          |          |    |
|------------------------------|----------|----------|----|
| Liver Aconitase activity     | NS       | NS       | NS |
| Liver NADPH oxidase activity | decrease | decrease | NS |
| Liver TBARS level            | NS       | NS       | NS |
| Liver SH Groups level        | NS       | NS       | NS |
| Liver GSH level              | NS       | NS       | NS |
| Liver GssG level             | NS       | NS       | NS |
| Liver GssG/GSH ratio         | NS       | NS       | NS |
| Liver SOD activity           | NS       | NS       | NS |
| Liver catalase activity      | NS       | NS       | NS |
| Liver GPx activity           | NS       | NS       | NS |
| Liver GRx activity           | NS       | NS       | NS |
| Liver GTx activity           | NS       | NS       | NS |
| Liver aconitase activity     | NS       | NS       | NS |
| Liver TNF-a protein, WB      | NS       | NS       | NS |
| Liver IL-6 protein, WB       | NS       | N        | NS |
| Liver NF-kB protein, WB      | NS       | NS       | NS |
| Liver Nrf2 protein, WB       | NS       | NS       | NS |
| Liver p22 protein, WB        | NS       | NS       | NS |
| Liver p47 protein, WB        | NS       | NS       | NS |
| Liver FAT/CD36 protein, WB   | NS       | NS       | NS |
| Liver FATP5 protein, WB      | NS       | NS       | NS |
| Liver ACLS1 protein, WB      | NS       | decrease | NS |
| Liver PGC1a protein, WB      | NS       | NS       | NS |
| Liver FAS, protein, WB       | NS       | NS       | NS |
| Liver L-CPT-1, protein, WB   | NS       | NS       | NS |
| Liver ACC, protein, WB       | NS       | NS       | NS |
| Liver p-ACC, protein, WB     | NS       | NS       | NS |

Out of the 70 measured parameters, 5 to 6 parameters were significantly modified by spirulina and/or Si-enriched spirulina supplementations compared to the HF diet. Only 2 parameters were increased with Si-spirulina vs spirulina alone (hepatic complexes II+III activity and p-AMPK WB).

ACC: acetyl-CoA carboxylase; ACLS1: acyl CoA synthetase 1; AGEs: advanced glycoxidation end products;  $\beta$ -HAD:  $\beta$ -hydroxyacyl-CoA dehydrogenase; FAS: fatty acid synthase; FAT/CD36: fatty acid transporter/cluster of differentiation 36; GSH: glutathione; GPx: glutathione peroxidase; GRx: glutathione reductase; GSSG: oxidized glutathione; GTx: glutathione transferase; HOMA-IR: Homeostasis Model Assessment-Insulin Resistance; Il-6: interleukine 6; L-CPT1: liver-carnitine palmitoyl transferase 1; Mcp-1 (Ccl2) monocyte chemoattractant protein 1; NEFA/FFA: non-esterified fatty acids; Nrf2/Nfe2l2: Nuclear factor (erythroid-derived 2)-like 2; PGC-1 $\alpha$ : peroxisome-proliferator-activated-receptors- $\gamma$  cofactor-1 $\alpha$ ; NF-kappaB/RELA (p65): REL-associated protein A; ROS: reactive oxygene species; SOD: superoxide dismutase; TAG: triacylglycerides; TBARS: thiobarbituric acid reactive substances; TNF- $\alpha$ : tumor necrosis factor- $\alpha$ .