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To cite this version:
Christine Feillet Coudray, Gilles Fouret, Evanthia Tolika, Jérôme Lecomte, Manar Aoun, et al.. Effects of high fat diet intake and a mitochondrial antioxidant (MitoQ) on liver mitochondrial activity and cardiolipin content in rats. Cardiolipin as Key Lipid of Mitochondria in Health and Disease, Sep 2015, Florence, Italy. 1 p. hal-01837638

HAL Id: hal-01837638
https://hal.archives-ouvertes.fr/hal-01837638
Submitted on 5 Jun 2020

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Effects of high fat diet intake and a mitochondrial antioxidant (MitoQ) on liver mitochondrial activity and cardiolipin content in rats

C Feillet-Coudray¹, G Fouret¹, E Tolka², J Lecomte³, M Aoun⁴, MP Murphy⁵, C Ferrari⁶, E Dubreucq⁷, C Coudray⁸

¹INRA UMR 866 DIMEM, Montpellier, Fr; ²ISOF Bio Free Radicals, Bologna, Italy; ³CIRAD, UMR IATE, Montpellier, Fr; ⁴INSERM U1046, CNRS UMR9214, Université de Montpellier, Fr; ⁵MRC Mitochondrial Biology Unit/MRC Building, Cambridge UK; ⁶Montpellier SupAgro, UMR IATE, Montpellier, Fr.

cfeillet@supagro.inra.fr

A-Introduction
Excessive intake of dietary fat is one of the major causes of appearance and progression of metabolic syndrome features, such as liver steatosis. These features are associated with structural and functional alterations of mitochondria. Recent studies indicate that some of these alterations are related to the content and quality of cardiolipin (CL), a phospholipid that occurs mainly in the inner membrane of mitochondria and is involved in the organization and functioning of the mitochondrial respiratory chain complexes [1].

B-Protocol and methods

24 rats Sprague Dawley 0.106 - 0.82

1-Characterisation of rats
- Oral glucose tolerance test (OGTT) was completed 4 days before rat sacrifice.
- Plasma insulin was quantified with ELISA kits (Merck Millipore, Allemagne).
- Liver TG levels were quantified by enzymatic methods (TG PAP kit, Biomerieux, Fr).

C-Results

1-Characteristics of the rats

Body weight

OGTT

PL insulin

3-Fatty acid composition of mitochondrial PL

MitoQ increased 18.2n-6 (linoleic acid) percent in the mitochondrial phospholipids.

2-Liver mitochondrial cardiolipin content

MitoQ both increased CL content of liver mitochondria in the mitochondrial phospholipids and CL synthase gene expression by comparison to the HFD.

4-Liver mitochondrial characteristics

CL content is positively correlated with ATP synthase activity, mitochondrial membrane fluidity, membrane potential, respiration and negatively correlated with mitochondrial ROS production.

D-Conclusion
Our studies show that the high fat diets impair liver mitochondrial functions and modify membrane structure and characteristics. MitoQ ameliorates some metabolic syndrome features, and in particular increases mitochondrial cardiolipin content. Antioxidant-independent mechanisms of MitoQ may be involved in addition to its own antioxidant action.

Acknowledgments
The support and sponsorship of the COST Action CM1201 "Biomimetic Radical Chemistry" to Manar Aoun and Eva Tolka is gratefully acknowledged. The authors acknowledge the financial support of the French Lipid Nutrition Group and the National Institute for Agronomic Research.

References

Supporting information

- Additional tables and figures
- Methodological details for each experiment

Figure captions

1. A comparison of body weight and glucose tolerance test (OGTT) in rats fed either a control or high fat diet. MitoQ supplementation significantly ameliorated weight gain and glucose intolerance.

2. A comparison of liver histology in rats fed either a control or high fat diet. MitoQ supplementation significantly reduced liver TG content.

3. A comparison of mitochondrial cardiolipin content in rats fed either a control or high fat diet. MitoQ supplementation significantly increased CL content.

4. A comparison of liver mitochondrial respiratory chain activity in rats fed either a control or high fat diet. MitoQ supplementation significantly increased ATP synthase activity.

5. A comparison of liver mitochondrial membrane fluidity in rats fed either a control or high fat diet. MitoQ supplementation significantly increased membrane fluidity.

6. A comparison of liver mitochondrial membrane potential in rats fed either a control or high fat diet. MitoQ supplementation significantly increased membrane potential.

7. A comparison of liver mitochondrial respiration in rats fed either a control or high fat diet. MitoQ supplementation significantly increased respiration.

8. A comparison of liver mitochondrial ROS production in rats fed either a control or high fat diet. MitoQ supplementation significantly decreased ROS production.