DAIRY PRODUCTS NUTRITION & HEALTH - MAJOR STUDIES

BEST of 2014

Special Dairy Fat

Editorial

The saturated-fat hunt is over, it's time to rehabilitate dairy fat!

For over 30 years, nutritional recommendations have focused on Saturated Fatty Acids (SFA), implicating them in cardiovascular disease (CVD) and sometimes even the "obesity epidemic".

The implied corollary to nutritional recommendations was of course: "Dairy products contain SFAs, so we should eat less of them, or eat lower-fat versions".

Science, however, moves on… The most recent research seems to show that SFAs are not THE major problem in cardiovascular risk and that low-fat foods perhaps do not have the expected effects on obesity.

Dairy fat (DF) may even have a special status. In fact, various studies suggest that dairy fat intake is associated more closely with a reduction in cardiovascular risk.

Focusing on nutrients, by taking them out of their food matrix, can lead to nutritional errors and even induce perverse effects…

These ideas have begun to gain traction among researchers and to reach nutritionists and cardiologists. While waiting for other health professionals and regulators to be convinced, here is the essence of the 2013/14 literature on this topic.

Yvette Soustre & Constance Boyer
PhD Science

Every year sees **positive scientific studies** published on the nutrition and health benefits of dairy products. In order to track them and make them easily usable by **dairy professionals** at various levels (regulatory, lobbying, communication, R&D, etc.), the scientific and technical division of CNIEL has created the "*Best of*". This publication compiles summaries (written for you) of (positive) articles on a given topic. The language has been **simplified** as much as possible in order to be accessible to as many people as possible and to highlight the essentials of the subject.

BEST of

A theme-based publication of the Scientific and Technical Affairs Division of CNIEL aimed at professionals in the dairy industry.

For this issue

Editors: Constance Boyer, Juliane L'Hermet, Yvette Soustre
Editorial Office: Anne Girard
Researcher: Vanessa Bodot
Proofreading of the English version: Laurence Rycken (FIL/IDF)

French bulk copies available on request from: **nutritionsante@maisondulait.fr**
Cniel - 42 rue de Châteaudun - F 75314 PARIS CEDEX 09 - Tel: +33(1) 49 70 72 24

Editor-in-Chief: Yvette Soustre - Design: Thierry Beaufils

"Cardiovascular disease: saturated fat is not THE major problem."

- 9 major observational studies, 12 clinical trials and 4 animal model studies.
- Neutral or even beneficial effects of SFA on blood lipid levels.

Saturated fat consumption may not be the main cause of increased blood lipid levels.

Dias CB, Garg R, Wood LG, *et al.*
Nutraceuticals research group, university of Newcastle, Australia.
Med Hypotheses. 2014; 82(2): 187-95.

"The conflicting evidence on the association between SFA and blood lipids suggests that SFA may not be the main culprit in raising blood lipids…"

Historically, research has focused on the role of SFA in the development of cardiovascular disease, misleadingly obscuring the involvement of numerous other factors. Authors are now analyzing the animal, clinical and epidemiological data in the literature to reevaluate the impact of saturated fatty acids and polyunsaturated n-3 on lipid profile. This reevaluation of years of research, enlightened by the latest knowledge, is leading authors to confirm that SFAs are not the sole culprits, and perhaps not even responsible at all, for altered lipid profile.

Results:

- Observational and intervention studies in humans have produced conflicting results on the impact of SFA on lipid profile. But most of them have obscured the effect of n-3 polyunsaturated fatty acids (PUFA) and/or have not differentiated the effects of n-3 from n-6.
- SFAs are not the main actors in increased blood cholesterol levels. An n-3 PUFA deficiency may have deleterious effects on lipid levels.
- No animal studies have investigated the combined effect of n-3 PUFA and saturated fat intake. However, those studies do show that the effect of SFA on cholesterol levels varies according to the diet administered.
- Some studies on humans and animals have investigated the effect of SFA combined with PUFA supplements. A beneficial synergy has been seen between SFA and n-3 PUFA if n-6 PUFA intake is lower than SFA intake.

Conclusion:
Although some studies have observed a positive relationship between SFA and hyperlipidemia, most of them show that SFA has no adverse effects. It could even have a beneficial effect on lipid levels if the entire diet is taken into account, particularly the n-3/n-6/SFA balance.

Dairy fat promotes the bioavailability of omega-3

In rats fed a fatty diet supplemented with myristic acid (a saturated fatty acid that dairy fat is particularly high in), EPA levels in the animals' liver and plasma increased significantly, compared with a diet without myristic acid. An increase in the quantity of myristic acid ingested is associated with an increase in DHA levels in the animals' blood and brains. These data were confirmed in a study performed with a dairy based diet (commercial butter). The rats fed a butter diet benefitted from a significant rise in alpha-linoleic acid and its (n-3) PUFA derivatives in many tissues (blood, liver, adipose tissue).
The authors suggest various mechanisms to explain this beneficial effect of dairy fat on the bioavailability of omega-3. For example, the presence of medium chain saturated fatty acids – specific to dairy fat and easily degraded to provide energy – preserving long chain precursors and derivatives. Increased activity, due to myristic acid, of the enzymes involved in the synthesis of PUFA derivatives is another hypothesis.

** The main omega-3 are alpha-linoleic acid and the long chain derivatives EPA and DHA. Fish and marine animals are the main food sources of long chain omega-3. Derivatives can also be synthetized by the body by the endogenous transformation of their precursor: alpha-linoleic acid.*

Short chain saturated fatty acids decrease circulating cholesterol and increase tissue PUFA content in the rat.
Legrand P, et al. Lipids. 2010; 45(11): 975-8.

"Reduce saturated and increase polyunsaturated fats to decrease coronary risk? Is that really the solution?"

- 49 prospective studies and 27 randomized controlled clinical trials.
- Neither polyunsaturated fatty acids nor saturated fatty acids are correlated with coronary risk.
- An inverse relationship between the blood level of C17 (marker of dairy fat intake) and coronary disease is suggested.

Association of dietary, circulating, and supplement fatty acids with coronary risk: a systematic review and meta-analysis.

Chowdhury R, Warnakula S, Kunutsor S, *et al.*
Department of Public health and Primary Care, University of Cambridge, UK.
Ann Intern Med. 2014; 160(6): 398-406.

"We found a possible inverse association between circulating C17:0 and coronary disease, suggesting that odd-chain saturated fats which reflect milk or dairy consumption may have less deleterious effects in risk for CHD."

Nutritional guidelines encourage reducing the consumption of saturated fatty acids (SFA) and increase consumption of polyunsaturated fatty acids (PUFA). The purpose of this meta-analysis is to clarify the relationship between the intake of fatty acids (saturated, polyunsaturated and monounsaturated) and coronary risk, using data from prospective studies and clinical trials. In light of the results obtained, the authors question current guidelines.

In total, 49 prospective studies were included in the analyses. Dietary fatty acid intake were reported using diet records or diet questionnaires (32 studies) and/or by measuring plasma levels of fatty acids (17 studies).

Results:

Only the analysis of studies based on circulating fatty acids composition revealed that certain n-3 PUFA (DHA, EPA and arachidonic acid, the principal long chain PUFA) are inversely correlated to coronary risk. Nevertheless, randomized controlled clinical trials that tested the effect of PUFA dietary supplements do not confirm these results.

Furthermore, regardless of the methods used to estimate fatty acid intake, no association has been demonstrated between total SFA intake and coronary risk. If we examine the various types of saturated fatty acids, this meta-analysis suggests a possible inverse association between blood concentrations of C17:0 (margaric acid) and coronary risk: an increase in plasma levels of C17:0 is associated with a reduction in coronary risk. This fatty acid, of exclusively exogenous origin, is mainly present in dairy fat and is recognized as being a marker of dairy consumption.

Conclusion:

The authors conclude that reducing SFA intake, and particularly dairy SFA, does not systematically reduce coronary risk. Current nutritional guidelines may require reappraisal.

Spotlight on C17:0

Margaric acid (or heptadecanoic acid) is a saturated fatty acid that cannot by synthesized by the body. It is present mainly in dairy fat, and is a very specific marker of dairy fat consumption. A considerable number of studies have confirmed a positive correlation between dairy consumption and C17:0 levels in plasma. Fatty acids biomarkers may provide more accurate assessment of consumption as it is difficult to avoid misclassification in self-reported dietary questionnaires. Although more invasive, measuring C17:0 in adipose tissue reflects the long-term intake of dairy products.

Biomarker of dairy intake and the risk of heart disease.
Aslibekyan S, et al. Nutr Metab Cardiovasc Dis. 2012; 22(12): 1039-45.

Biomarker of milk and the risk of myocardial infarction in men and women: a prospective, matched case-control study.
Warensjo E, et al. Am J Clin Nutr. 2010; 92(1): 194-202.

"Reducing the intake of food high in saturated fat does not reduce mortality risk"

- Meta-analysis of 26 prospective studies that include up to 41 years of follow-up.
- Intake of milk, cheese and/or butter does not increase mortality risk, including cardiovascular mortality.

Food sources of saturated fat and the association with mortality: a meta-analysis.

O'Sullivan TA, Hafekost K, Mitrou F, Lawrence D.
Telethon institute for Child health research, West Perth, Australia.
Am J Public Health. 2013; 103(9): e31-42.

"Our review, which summarizes the currently available evidence, is unable to support a strong recommendation regarding restricting intake of foods high in saturated fat for the prevention of mortality."

The debate persists over saturated fatty acids and their role in the development of cardiovascular disease. The results of numerous recently published studies moderate or even contradict those of previous decades. This meta-analysis including data from 26 prospective studies shows that the effect of saturated fatty acids on mortality varies depending on the food matrix. What needs to be considered is food sources of fat and indeed the diet as a whole, and not just fatty acids in isolation, to evaluate their impact on health.

The 26 studies in this meta-analysis cover the intake of saturated fatty acid and all-cause, cardiovascular or cancer mortality.

Saturated fatty acids are found in various food sources, which were analyzed in different subgroups: all dairy products, cheese, milk, butter, meat and deli/processed meat. Where results were reported for both full and low-fat products for a food group, only the data relating to the full-fat product was included in the analysis.

Results:

- Neither dairy products (cheese, milk) nor butter are associated with increased mortality risk (all-cause, cardiovascular or from cancer).
- High intakes of dairy, milk or cheese are not associated with cardiovascular mortality.
- In 9 of the 26 studies, data was available on the number of servings consumed. The authors therefore performed dose-response analyses by food-group to see whether the quantities consumed influenced mortality risk. They showed an inverse relationship between the weekly quantity of milk consumed and mortality, all-cause or cardiovascular. In contrast, there was no dose effect between the number of servings of cheese consumed and mortality.

Note: The data also suggest that high consumption of meat and processed meat is associated with a slight increase in mortality risk from all-cause and from cancer (increase also in cardiovascular mortality risk for processed meats).

Conclusion:

Even though a methodological bias persists (mainly due to the poor quality of dietary data collected), these results do not support the dietary guidelines to reduce the intake of dairy-based saturated fatty acids. Future research should focus on developing efficient tools to reliably measure the intake of saturated fatty acids by food source.

In France...

The French study MONICA confirms that there is no evidence of a significant relationship between the proportion of dairy-based SFA in a diet, and the risk of death (all causes combined). After adjusting for confounding factors, the mortality risk (all causes combined) is significantly reduced (by about 55%) in high consumers of dairy. The MONICA study is a cross-sectional study of 897 people in France aged 45 to 65.

"Diabetes: Does the fatty acid content of dairy have a protective effect?"

- 2,617 American of 4 different ethnic origins (white, black, Hispanic and Chinese) monitored for 7 years.
- *Trans* palmitoleic acid (C16:1 n-7), present in dairy fat, could be one of the actors of the beneficial effects of dairy products on diabetes.

Trans palmitoleic acid, other dairy fat biomarkers, and incident diabetes: the Multi-Ethnic Study of Atherosclerosis (MESA).

Mozaffarian D., de Oliveira Otto MC, Lemaitre RN, *et al.*
Harvard School of Public Health, Boston, USA.
Am J Clin Nutr. 2013; 97(4): 854-61.

"Higher circulating trans-palmitoleate concentrations were associated with substantially lower incident diabetes."

Some studies suggest that dairy intake is associated with a lower risk of diabetes, but the mechanisms involved remain unknown. In the present study, the authors show that *trans*-palmitoleic acid (*trans* C16:1 n-7), present in dairy fat, could play a role in the observed metabolic benefits of dairy consumption. These data also reveal the relevance of *trans*-palmitoleic acid as a marker of dairy fat intake.

This study was carried out on 2,617 participants in the multi-ethnic American cohort "MESA" (Multi Ethnic Study of Atherosclerosis). Volunteers, with an average age of 61.7 at the start of the study, were monitored for 7 years. At each study examination (4) they filled in questionnaires on their dietary habits. Various metabolic parameters (lipid and lipoprotein profiles, insulin levels, blood sugar levels, etc.) were measured as well as the manifestation or not of diabetes. Plasma fatty acid levels were measured, in particular markers of dairy fat intake: myristic acid (C14:0), pentadecanoic acid (C15:0) and *trans*-palmitoleic acid (C16:1 n-7).

Results:

An inverse correlation exists between plasma levels of C16:1 n-7 and the onset of diabetes: the higher the plasma level of C16:1 n-7, the lower the risk of diabetes.

The risk is approximately 2 times lower for individuals with high levels of *trans*-palmitoleic acid. This relationship persists after adjusting for several confounding factors, and regardless of gender or ethnicity.

In accordance with previously published results, the authors show that high levels of C16:1 n-7 are also associated with an improvement in various metabolic parameters. They observe in particular a reduction in triglyceridemia, blood pressure and fasting insulin levels, along with, however, higher LDL-C.

Conclusion:

Trans-palmitoleic acid turns out to be a relevant marker for estimating relatively reliably the intake of full-fat dairy products. Given also the specific association between *trans*-palmitoleic acid and diabetes, it may be a robust marker of diabetes risk.

C15:0, another dairy fatty acid, has a beneficial effect on cardiovascular risk

These authors have also used the MESA cohort to study the impact of dairy fat intake on cardiovascular health. Result: Subjects with the highest blood levels of C15:0 have lower risk of cardiovascular disease and coronary events. It is hard to tell, however, whether this beneficial effect is the result of SFA acting directly and/or through various factors in combination with dairy intake (lower BMI, no smoking, healthy diet, etc.).

Biomarkers of dairy fatty acids and risk of cardiovascular disease in the Multi-ethnic Study of Atherosclerosis.
De Oliveira Otto MC, et al. J Am Heart Assoc. 2013; 2(4): e000092.

"Is dairy fat beneficial for reducing insulin resistance?"

- Cross-sectional study of 496 Japanese people aged 20 to 68.
- The consumption of full-fat dairy products is inversely associated with plasma insulin levels and insulin resistance.

Dairy consumption is associated with decreased insulin resistance among the Japanese.

S Akter, K Kurotani, A Nanri, NM. Pham, *et al.*
Department of Epidemiology and Prevention, National Center for Global Health and Medicine, Tokyo, Japan.
Nutr Res 2013; 33(4): 286-92.

"The present finding adds evidence to the hypothesis that moderate intake of whole dairy products play a protective role against insulin resistance."

Studies have shown that dairy intake may have a protective effect against type 2 diabetes and metabolic syndrome. It was therefore necessary to check whether it acts on the development of insulin resistance, a major constituent of these two pathologies. As some constituents of dairy fat, such as medium chain saturated fatty acids, bioactive lipids may reduce insulin resistance, this study was performed taking the products' fat content into account.

The study participants were 496 Japanese municipal employees aged 20 to 68. Their dietary habits in the previous month were evaluated using a food frequency questionnaire. Total dairy intake included whole dairy products (milk and yogurt) and low-fat dairy products. Blood samples were collected to assess fasting insulin and blood sugar and to determine the insulin resistance index (Homeostatic Model Assessment Insulin Resistance or HOMA-IR index).

Results:

► Total dairy intake among Japanese is low: 79 g/day on average. The participants consumed more full-fat dairy products than low-fat, regardless of gender. People eating more dairy had higher intakes of energy, fiber and calcium than those eating less dairy.

► Neither the total intake of dairy nor the total intake of low-fat dairy were significantly associated with the three markers of insulin resistance.

► In contrast, the intake of full-fat dairy was significantly and inversely associated with insulin levels and the insulin resistance (HOMA-IR) index, after adjusting for certain variables (including calcium). People consuming full-fat dairy products at least once a day had lower insulin levels and insulin resistance indices than the others. There was no association with blood sugar levels.

Conclusion:

The daily intake of full-fat dairy is significantly and inversely associated with two markers of insulin resistance in Japanese while no association is observed with low-fat dairy products.

Note: The intake of cheese, butter and cream was not measured in this study, as the Japanese eat very little of these products.

Mechanistic hypotheses

Many hypotheses have been advanced to explain the potentially protective effect of dairy products on type 2 diabetes: Their beneficial role in weight management; their role as markers of a healthier diet and/or lifestyle (people eating dairy have more-balanced meals, engage in physical exercise, drink fewer fizzy drinks, etc); the role of some constituents such as proteins (lactoserum), minerals (calcium, magnesium, phosphorus); water-soluble vitamins (B12 and riboflavin), etc... Regarding full-fat dairy products, the main hypotheses relate to the low glycemic index of dairy products, the role of the liposoluble vitamins (A, D and K2) they contain, as well as the effect of bioactive fatty acids (medium chain fatty acids, CLA, trans-palmitoleic acid). Thus, in humans, a study of more than 3,700 people showed that a high plasma level of palmitoleic acid is linked to an improvement in the lipid profile (reduction in triglyceride content, increase in HDL, etc.) and markers of inflammation, reduced insulin resistance, and lower risk of diabetes.

Best of 2012 dairy products, diabetes prevention and weight management

"The beneficial effects of dairy fat on men's waist sizes"

- 1,400 Swedish men aged 40 to 60 with 12 years' follow-up.
- The use of butter on bread, full-fat milk and regular intake of cream are associated with a lower risk of abdominal obesity.

High dairy fat intake related to less central obesity: A male cohort study with 12 years' follow-up.

S Holmberg and A Thelin.
Research and Development Center, Kronoberg County Council, Växjö, Sweden.
Scand J Prim Health Care 2013; 31(2): 89-94.

"A high intake of dairy fat was associated with a lower risk of central obesity and a low dairy fat intake was associated with a higher risk of central obesity."

Abdominal obesity predisposes to insulin resistance and is one of the constituents of metabolic syndrome, a risk factor for cardiovascular disease and type 2 diabetes. Non-low-fat dairy products are often excluded from dietary guidelines due to their high lipid content (mainly saturated), thought to have an adverse effect on cardiovascular risk. However, several studies show either an inverse or no association between dairy intake and various metabolic risk factors.

The purpose of this work was to study the impact of dairy fat intake on the risk of developing abdominal obesity.

There were 1,782 men screened at the first visit, 1,589 at the second, and 1,405 at both. At each study examination, the participants reported what they ate. High dairy fat intake was defined as consuming butter on bread, full-fat milk, as well as cream daily or several times a week. Low dairy fat intake was defined as never consuming butter, consuming low-fat or skim milk, and never or rarely cream. Other combinations of dairy fat intake were classified as medium. Body measurements (height, weight, waist and hips circumference) were also done. Central obesity was defined as a waist-to-hip ratio ≥ 1.

Results:

► At the beginning of the study, the majority of participants were overweight or obese (6.5% were even excluded because they already had abdominal obesity). 20% had low dairy fat intakes and 24% had high intakes.

► 12 years later, 20% of those who had indicated low dairy fat intake at the first interview had developed abdominal obesity. In contrast, barely 9% of those who had reported high dairy fat intake had seen their waist size increase.

► Compared with average intake of dairy fat, low intake was associated with higher risk of abdominal obesity (+53%), while high intake was associated with lower risk (-48%), even after adjusting for possible confounding variables (intake of fruit and vegetables, alcohol, smoking, age, profession, physical activity, and education).

Conclusion:

Dairy fat intake is inversely associated with the risk of abdominal obesity in Swedish middle-aged men from a rural environment.

Note: In 1990-1991 (when the study started), dietary questionnaires were not as comprehensive as those used today. Therefore, the intake of other dairy products such as cheese and yogurt was not reported.

Put in perspective

American researchers reviewed 16 epidemiological studies of the relationship between the intake of full-fat milk products and the risk of obesity and metabolic diseases (diabetes, cardiovascular disease).

► 11 of the 16 studies show that people who consume more dairy lipids and/or full-fat milk products are thinner or gain less weight than those who consume less!

► No study shows an adverse relationship between the intake of full-fat milk products and corpulence.

The relationship between high-fat dairy consumption and obesity, cardiovascular, and metabolic disease.
Kratz M, Baars T, Guyenet S.
European Journal of Nutrition 2013; 52(1): 1-24.

"'full-fat' dairy products do not promote adiposity or overweight in adolescents, on the contrary..."

- 2,455 English children aged 10 to 13 monitored.
- Those consuming the most non-low-fat dairy products at age 10 have a lower risk of being overweight at age 13.

Dairy Intakes at Age 10 Years Do Not Adversely Affect Risk of Excess Adiposity at 13 Years.

Sherman J. Bigornia, Michael P. LaValley, Lynn L. Moore, *et al.*
Department of Pediatrics, Boston University School of Medicine, Massachusetts, USA.
J Nutr 2014; 144(7): 1081-90.

"Children in the highest vs. the lowest quartile of full-fat dairy intakes (g/d) at age 10 y had a > 30% reduced risk of excess body fat mass and overweight at age 13 y. Moreover, higher intakes of full-fat dairy products were related to a lower gain in BMI during follow-up."

The relationship between dairy intake and childhood adiposity is unclear and little data exists. The purpose of this study was to determine the effects of dairy intake (total, low-fat and full-fat) at age 10, on the risk of excessive adiposity and overweight at age 13.

The study covered 2,455 English children. Their diet was recorded over three days, at age 10 and again at age 13. Dairy products included milk (natural or flavored), cheese, yogurt, ice cream, and milk-based desserts. They were classified by fat content. Low-fat dairy products were those based on low-fat or skim milk as well as low-fat cheese and yogurt. Body measurements (weight, height, total fat) and body mass index (BMI = weight/height^2) were also taken.

Results:

- Nearly 21% of the children were overweight at age 10 and nearly 20% at age 13.
- Children consuming the most dairy (563 ± 155 g/day) at age 10 were less overweight at age 13.
- Children consuming the most full-fat dairy products (348 ± 176 g/day) at age 10 were also less overweight and had a lower body mass index at age 13 (30% less risk).
- Also, the BMI of children consuming the most dairy at age 10 increased less between age 10 and 13. The identical relationship was observed with whole dairy products (but not with low-fat products).

Conclusion:

Dairy intake during pre-adolescence is not associated with an excessive accumulation of fat or with overweight in adolescence. Intake of non-low-fat dairy is associated with a lower risk of fat mass accumulation and overweight at age 13, as well as with a lower gain in BMI between ages 10 and 13.

Low-fat or not low-fat: What to recommend to young teens?

The recommendation to consume low-fat dairy is based on the opinion that it may contribute to reducing calorie intake as well as fat intake. Prof. Willett (Harvard University) has shown that although lipid intake was lower in children drinking low-fat milk, calorie intake was not reduced as much. Actually, the lower lipid intake is likely to be offset by a higher intake of calorific foods, especially high-sugar foods. The recommendation to replace full-fat dairy with low-fat dairy as part of weight-management could therefore prove to be counterproductive.

Three Daily Servings of Reduced-Fat Milk, An Evidence-Based Recommendation ?
David S. Ludwig, Walter CWillett.
Jama Pediatrics, 2013; 167(9): 788-9.

"Diet: Is the effect of low-fat dairy gender-dependent?"

- 86 overweight or obese Australian adults put on a regimen with low-fat dairy.
- A gender-based behavioral difference observed, with important nutritional consequences.

Dietary Consequences of Recommending Reduced-Fat Dairy Products in the Weight-Loss Context: A Secondary Analysis with Practical Implications for Registered Dietitians.

D Nolan-Clark ; E Mathers ; Y Probst ; *et al.*
Landmark Nutrition Pty Ltd, Wollongong, Australia.
J Acad Nutr Diet 2013; 113(3): 452-8.

"Men tended to decrease their overall intake of dairy foods when advised to choose low-fat variants, and women replaced whole dairy products with reduced-fat alternatives with no net reduction in energy from this food group."

Nutritionists frequently recommend low-fat dairy products to overweight people, to reduce their calorie intake while maintaining calcium intake. To evaluate the nutritional impact and feasibility of such recommendations, this study compared the quantity and type of dairy products consumed by overweight adults before and after a 3-month regimen that included low-fat dairy products. The objective was partly also to evaluate if the recommendations were followed regarding the number of servings of dairy (2 or 3 a day in Australia).

The study included 86 overweight or obese adults (average age 45.2 ± 8.8), who reported the quantity and type of food consumed before and during the 3-month regimen.

Results:

Nutritional intake:

Significant reduction in total calorie, lipid and carbohydrate intake. With a reduction in the contribution of dairy products to lipid and calorie intake but with an increase in their contribution to carbohydrate intake.

Men significantly reduce their daily intake of dairy as well as the calories from them.

Women do not change the quantity of dairy products consumed, but they do consume less dairy fat. The calorie intake from dairy does not fall significantly, because the contribution of these products to their carbohydrate intake increases significantly.

Type of dairy products consumed:

- Consumption of cheese, whole milk and ice cream falls.
- Consumption of yogurt and low-fat milk increases.

Number of servings consumed per day: the percentage of participants that followed the recommendations declined from 30% to 20%.

Conclusion:

Recommending low-fat dairy products as part of a weight-loss regimen diet reduces the lipid intake from those products. However, this study shows gender-based differences in reactions, with potentially important nutritional consequences. Thus, instead of opting for low-fat dairy products, men reduce their total intake of dairy and therefore of the associated nutritional intake (notably calcium). Women replace full-fat dairy with low-fat dairy but without significantly reducing the calorie intake from dairy. The calories from dairy lipids are replaced by calories from carbohydrates, probably mainly by consuming dairy products with higher sugar content.

Lipids, carbohydrates and calcium: a precarious balance

The reduction in total dairy intake observed in men could be problematic as part of a weight-loss regimen. In fact, one study showed that an intake of 1,000 mg of dairy calcium per day (recommended daily calcium intake for adults in Australia) increased fecal calorie excretion by about 80 kcal/day, which could have a significant impact on long-term weight loss.*

Moreover, it has been shown that substituting saturated lipids with carbohydrates, as seen here in women, could increase the risk of cardiovascular disease.**

These are consequences not to be ignored when recommending low-fat dairy as part of a weight-loss plan.

* *Jacobsen R, Lorenzen JK, Toubro S, Krog-Mikkelsen I, Astrup A.* ***Effect of short-term high dietary calcium intake on 24-h energy expenditure, fat oxidation, and fecal fat excretion.*** *Int J Obes Relat Metab Disord. 2005; 29(3): 292-301.*

** *Jakobsen MU, O'Reilly EJ, Heitmann BL, et al.* ***Major types of dietary fat and risk of coronary heart disease : A pooled analysis of 11 cohort studies.*** *Am J Clin Nutr. 2009; 89(5): 1425-1432.*

"Low-fat or full-fat? Fermented or non fermented...?"

- 12 overweight and/or obese adults, 12 weeks of intervention.
  3 regimens: 1 using low-fat dairy;
  2 using full-fat dairy (fermented and non fermented).
- Compared with regimens using full-fat dairy products, those using low-fat dairy did not improve the metabolic profile.

Effects of low-fat or full-fat fermented and non-fermented dairy foods on selected cardiovascular biomarkers in overweight adults.

Nestel P, Mellet N, Pally S *et al.*
Baker heart and diabete institute, Melbourne, Australia.
Br J Nutr. 2013; 110(12): 2242-9.

"Low-fat dairy products did not lead to a more favourable biomarker profile associated with CVD risk compared with the full-fat dairy products..."

Is it preferable to consume low-fat dairy products to reduce the risk of cardiovascular disease? The literature remains contradictory on this subject. This clinical trial investigated the effect of three different regimens based on full-fat dairy products or low-fat dairy products (fermented or non fermented), on multiple cardiovascular risk factors such as markers of inflammation, oxidative stress and lipid profile. When compared with full-fat dairy products, the consumption of low-fat dairy does not significantly improve the metabolic profile. The authors also suggest a beneficial effect of fermented products, although that remains to be confirmed. This cross-sectional randomized study involved 12 overweight or obese subjects (men and women), for a total 12 week period. The reduced-fat regimens contained 15% fat, and the full-fat dairy regimens contained 30% to 35% fat. The products consumed were: skim milk and 1% yogurt for the low-fat diet; cheddar and full-fat yogurt for the fermented full-fat diet; butter, cream and ice cream for the non fermented full-fat diet. A number of pro-atherogenic markers associated with inflammation and oxidative stress were also measured (MCP-1, MIP-1α, CRP, IL-1β, IL-6, TNFα, ICAM-1, VCAM-1).

Results:

► The consumption of low-fat dairy is not associated with a reduction in plasma concentrations of pro-atherogenic markers. The authors conclude that there are no evident benefits in consuming low-fat products in place of full-fat products.

► Non fermented full-fat dairy products differ from their fermented versions by a slight but significant increase in interleukin-6, a well-recognized plasma marker of inflammation. This suggests a potential beneficial effect of fermented full-fat dairy products.

Conclusion:

This study suggests that both low- and full-fat dairy products do not alter the metabolic profile. Fermented products could have a specific beneficial effect on some proinflammatory markers. These data, however, needs to be confirmed in a long term study.

How to explain the neutral or beneficial effects of dairy products on cardiovascular disease?

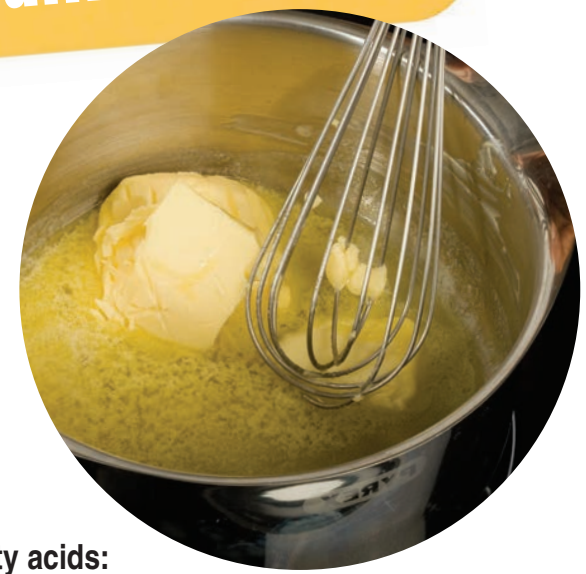
It has been hypothesized that the high content of calcium in dairy products may limit the absorption of saturated fats (in the intestine, saturated fat tend to form complexes with calcium constituting insoluble soaps that are excreted in the feces).
A randomized controlled crossover study was carried out on 15 healthy men living in Denmark (average age 27) to evaluate the effect on lipid levels of three isocaloric diets with different calcium content: dairy-free diet (500 mg of Ca^{2+}) vs a cheese diet (1700 mg Ca^{2+}) vs a skim milk diet (1700 mg Ca^{2+}). Results: All three diets induced an increase in total cholesterol and LDL-C. However, the dairy diets significantly limited the increase in blood lipids. Fecal fat excretion was also higher with the dairy diets and correlated with LDL-C plasma levels. There was no observed difference between milk and cheese. The formation of calcium soaps requires the simultaneous presence of fat and calcium in the duodenum. The interaction between these two constituents may be limited if they do not enter the duodenum at the same time.

Effect of dairy calcium from cheese and milk on fecal fat excretion, blood lipids, and appetite in young men.
Soerensen A, et al. Am J Clin Nutr. 2014; 99(5): 984-91

Milk minerals modify the effect of fat intake on serum lipid profile: results from an animal and a human short-term study.
Lorenzen J, et al. Br J Nutr. 2014; 111(8): 1412-20.

"Technologically produced *trans* fatty acids and dairy *trans* fatty acids: What's the difference?"

- 6 meta-analyses or systematic reviews and 16 intervention or observational studies.
- *Trans* fatty acids (TFA) and conjugated linoleic acids (CLA) from dairy have different effects than technologically or synthetically produced variants.



Current issues surrounding the definition of trans-fatty acids: implications for health, industry and food labels.

Wang Y and Proctor SD.
Center for health research innovation, University of Alberta, Canada.
Br J Nutr. 2013; 110(8): 1369-83.

"Recent clinical and preclinical data continue to demonstrate a positive correlation between the consumption of industrial trans fats and CVD risk measures, whereas this is not the case with a moderate intake of TFA from ruminant sources."

The effects of TFA on health vary depending on their origin: industrial or dairy. After years of debate, the scientific literature has now reached a degree of consensus on the topic. Nonetheless, this distinction does not yet appear in the definition of TFA in the Codex Alimentarius, the guide for nutritional and legislative regulations.

In the present paper, the authors review the recent scientific literature with a specific focus on CLA – conjugated linoleic acid – a special form of TFA. CLAs can be produced synthetically (consumed in the form of dietary supplements) or naturally (present in dairy fat). In the light of published animal studies and clinical trials, the authors conclude that natural dairy CLAs have very different biological properties than synthetic CLAs.

Results:

- Recent epidemiological and intervention studies confirm previously published data that show that - at current levels of intake - natural dairy TFAs have no deleterious effect on cardiovascular risk factors.
- The main differences between CLA supplements and natural dairy CLA is in the distribution of isomers (compounds with the same chemical formula but different arrangements of atoms), the quantities consumed, their position on triglycerides and therefore their bioavailability.
- Synthetic CLAs are mainly a mix of cis-9, *trans*-11 and *trans*-10, cis-12 variants. Dairy fat contains mainly cis-9, *trans*-11 (rumenic acid).
- In *vitro* experiments, in *vivo* studies (in animals) and some human trials suggest that these isomers all have different effects.
- Synthetic CLA has little or no effect on markers of cardiovascular risk or fat reduction. Rumenic acid from dairy fat could have beneficial effects on obesity, cancer and cardiovascular risk.

Conclusion:

The distinction in terms of impact on health, between the different types of TFA (natural dairy versus industrially-produced), as well as CLA (natural dairy versus synthetic), should probably be incorporated in the official Codex definition of TFA.

"At least three dairy products a day: A healthy choice!"

- 180 adults of which 70% women; living in Auckland, New Zealand; aged 38 to 55.
- Either increasing or reducing dairy intake for one month has no impact on the main cardiovascular risk factors.

A randomized trial evaluating the effects of change in dairy food consumption on cardio-metabolic risk factors.

Benatar JR, Jones E, White H *et al.*
Cardiovascular Research Unit, Auckland City Hospital, New Zealand.
Eur J Prev Cardiol. 2013 doi: 10.1177/2047487313493567.

"These observations suggest that dairy food can be included as part of a normal healthy diet without increasing cardio-metabolic risk."

To reduce the intake of saturated fatty acids, nutritional recommendations advise lower consumption of products high in saturated fats. While more and more studies show there is no link between saturated fatty acid and cardiovascular disease, some epidemiological studies even suggest a beneficial effect of dairy products. The authors aimed to verify whether increasing or reducing dairy intake impacts cardio-metabolic risk factors. No change on metabolic profile was observed after one month of the regimen.

The study (parallel randomized trial) included 180 healthy volunteers with an average age of 47. Three groups of 60 subjects changed (or not) their intake of dairy products. Some had to increase their dairy intake by 2 or 3 servings* per day, with whole milk and cheese. Other had to eliminate all possible sources of dairy products. The last group did not change their usual dietary habits.

** 1 serving being equivalent to 250 ml of 3% milk, 250 ml of yogurt, or about 43 g of cheese.*

Metabolic parameters (lipid and lipoprotein profiles, anthropometric measurements, blood sugar and insulin levels) were assessed at baseline and at the end of the 1-month intervention period.

Results:
Compliance to the diet was confirmed by analyzing the food questionnaires and by measuring plasma markers of dairy fat intake (C15 and C17 saturated fatty acids). After one month of the diet, dairy intake was significantly changed: a daily increase of 12.5 g of dairy fat (+3 servings/day) versus a reduction of 10.5 g/day of dairy fat (-2.5 servings/day) for subjects who had, respectively, to increase or reduce their intake. Such changes in dairy fat intake had no direct impact on clinical and metabolic parameters. Blood pressure, plasma levels of cholesterol (LDL, HDL) and triglyceride, insulin resistance (HOMA test) and associated parameters (blood sugar, insulin levels) were unchanged. Only a slight increase in waist circumference was observed, with no weight gain.

Conclusion:
The results of this study confirm that dairy products have their place in a well balanced diet, including at least three servings a day, with no risk of affecting cardio-metabolic factors. It would be of great interest to confirm these results over the longer term and within different groups of population.

On a larger scale...

As a continuation of this work, still for the purpose of investigating the effect of increased dairy consumption on cardiovascular risk factors, the same authors conducted a meta-analysis using randomized clinical trials available in the literature.
The final analysis included 20 studies, covering a 1,677 people in total. The individuals had changed their dairy consumption by +/-3.6 servings/day depending on the group, for 26 weeks on average.
Results: Increasing dairy intake (full-fat or low-fat) had no or very little effect on the main cardiovascular risk factors (LDL and HDL cholesterol, blood pressure, CRP inflammation marker, HOMA insulin sensitivity test). However, the authors observed a slight weight gain, probably due to the increase in the total calorie intake.

Effects of high and low fat dairy food on cardio metabolic risk factors : a meta-analysis of randomized studies.
Benatar J, et al PLoS One. 2013; 8(10): e76480.

Milk fat... what else?

Dairy fat should also be (re)considered in infant feeding

The milk fat globules in breast milk differ from those in infant formula in that they are larger and surrounded by a phospholipid membrane. Recent animal data suggest that this characteristic may limit the development of metabolic syndrome. Furthermore, the triglycerides in breast milk preferentially enclose palmitic acid at sn-2 (internal) position, in contrast to vegetable oils used in infant formula. This position seems to promote the absorption of fatty acids in the intestine as well as their bioavailability in tissues.

Accordingly, the use of dairy fat seems even more interesting in that it encloses medium-chain fatty acids thereby facilitating the biosynthesis of certain fatty acids highly important for infant nutrition (DHA).

Place des lipides dans l'alimentation du nourrisson [Role of lipids in infant feeding].
Guesnet P, Ailhaud G, Delplanque B, *et al.*
Cah Nutr Diet 2013; 48(4): 175-83.

Possible benefits for people obese

Recent work has shown that *trans* palmitoleic acid (C16:1 n-7), an exogenous source of fatty acid, could have a role in the beneficial effect of dairy products on diabetes. In this cross-sectional study, the authors show that dairy fat intake, evaluated by measuring specific markers – including *trans* palmitoleic acid – is associated with an improvement in insulin sensitivity in the obese.

32 obese subjects (average age 51) were recruited: 17 with fatty liver disease, and 15 healthy control subjects. The healthy subjects consumed more dairy products (all types combined) and butter than those with fatty livers. Measurements of plasma markers of dairy fat intake (C16:1 n-7; C15:0; C17:0) confirmed that data.

Results: After adjusting for several confounding factors, a powerful inverse relationship was observed between the various markers of dairy fat intake and all the insulin sensitivity measurement parameters. Thus, higher intake of dairy products is associated with an improvement in hepatic and systemic insulin sensitivity, lower fasting blood sugar, better glucose tolerance and a reduction in liver fat content. These results, particularly the cause-and-effect relationship, should be verified by randomized controlled clinical trials.

Dairy fat intake is associated with glucose tolerance, hepatic and systemic insulin sensitivity and liver fat but not b-cell function in humans.
Kratz M, Marcovina S, nelson JE, *et al.*
Fred Hutchinson cancer research, Division of Public Health Sciences. Seattle, USA
Am J Clin Nut 2014; 99(6): 1385-96.

An improvement in insulin sensitivity in people with metabolic syndrome

Some studies suggest that dairy intake may reduce the risk of type 2 diabetes. It has also been observed that plasma concentrations of specific dairy fatty acids (C16:1 n-7; C15:0; C17:0) are inversely associated with type 2 diabetes risk and/or insulin resistance. The purpose of this work is to investigate the possible associations of certain fatty acids and classes of specific lipids with insulin sensitivity and insulin resistance parameters, in people suffering of metabolic syndrome.

The study included 86 overweight or obese adults (average age 55 ± 6) with metabolic syndrome, who recorded their food consumption for 4 days. Insulin sensitivity and insulin resistance variables were measured as well as plasma levels of phospholipids, sphingolipids and fatty acids.

Results: The number of servings of full-fat dairy products consumed was significantly and positively associated with plasma levels of C16:1 n-7; C15:0; C17:0 and phospholipids. The concentrations of certain classes of phospholipids and C17 were positively associated with insulin sensitivity and negatively with insulin resistance. The intake of full-fat dairy products may therefore prove beneficial in the case of metabolic syndrome.

Specific plasma lipid classes and phospholipid fatty acids indicative of dairy food consumption associate with insulin sensitivity.
PJ Nestel, NS traznicky, NA Mellett, *et al.*
Baker IDI Heart and Diabetes Institute, Melbourne, Australia.
Am J Clin Nutr 2013; doi: 10.3945/ajcn.113.071712.

Other articles of interest...

Potentially beneficial effects on blood pressure and cholesterol levels.

Conway V, Couture P, Richard C, *et al. Impact of buttermilk consumption on plasma lipids and surrogate markers of cholesterol homeostasis in men and women.* Dis 2013; 23(12): 1255-62.

Conway V, Couture P, Gauthier S, *et al. Effect of buttermilk consumption on blood pressure in moderately hypercholesterolemic men and women.* Nutrition 2014; 30(1): 116–9.

Conway V, Gauthier SF, Pouliot Y. *Buttermilk: Much more than a source of milk phospholipids.* Animal Frontiers 2014; 4(2): 44-51.

► Buttermilk is particularly high in fat globule membranes. Its consumption may have beneficial effects on blood pressure and plasma cholesterol levels.

A particular macrostructure.

Martini M, Salari F, Altomonte I - *The macrostructure of milk lipids: the fat globules - Crit Rev Food Sci Nutr 2014; in press.*

► The structure of milk fat globules implies specific technological characteristics of dairy products as well as their impact on health, especially in the digestion of dairy fat.

Interactions with genes.

Smith CE, Tucker KL, Arnett DK, *et al. A2 Polymorphism Interacts with Intakes of Dairy Foods to Influence Body Weight in Two U.S. Populations.* Nutr 2013; 143(12): 1865-71.

► The impact of the fat content of dairy products on weight may depend on each individual's genetic heritage. Some may respond favorably to low-fat dairy intake, others may not...

A healthier lifestyle.

Crichton GE and Alkerwi Aa. *Dairy food intake is positively associated with cardiovascular health: findings from ORISCAV-LUX study.* Nutrition Research 2014*; in press.*

► The higher consumers of full-fat dairy products (milk, cheese, yogurt) also have a healthier lifestyle: they tend to be non-smokers, follow nutritional recommendations, are not overweight, have a better cardiovascular health score, etc...

The end of low-fat products?

Walker TB and Parker MJ. *Lessons from the war on dietary fat- Journal of the American College of Nutrition.* 2014*; in press.*

► Hunting down saturated fat has in no way limited the increase in obesity in the American population. Reducing lipid intake is not an effective method in terms of public health for lowering obesity rates.

and to learn more...

Available on request.

The BEST of 2012 & 2013

- Dairy products and decreased cardiovascular risk
- Dairy products, diabetes prevention and weight management*
- Cheese special*
- Yogurt special*
- Milk special*

Questions On:

QS 12. Dairy lipids
QS 13. Cholesterol and atherosclerosis
QS 14. Butter and cream
QS 19. Prevention of metabolic syndrome
QS 27.b Trans and CLA
QS 37. Dairy fat, technology and health
QS 46. Weight management
QS 47. Diabetes
QS 53. Saturated fatty acids

nutritionsante@maisondulait.fr

* *Available in English.*

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