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NR

Nutrition Research

High Impact Papers * - Published

- **The effect of cheese consumption on blood lipids; a systematic review and meta-analysis of randomized controlled trials.** Janette de Goede, Johanna M. Geleijnse, Eric L. Ding, Sabita S. Soedamah-Muthu. *Nutrition Reviews*. 2015;73(5):259-75.

PR

Product Research

High Impact Papers – Submitted

- **Consumer analysis of the sensory impact of light exposure and age on fluid milk.** Carey N, Martin N, Murphy S, Kent D, Bang JH, Stubbs T, Wiedmann M, Dando R. Consumer analysis of the sensory impact of light exposure and age on fluid milk. *Journal of Dairy Science*

S

Sustainability

High Impact Papers – Accepted

- **A goal programming model for minimizing diet costs and methane emissions.** L. E. Moraes, J. G. Fadel, A. R. Castillo, D. P. Casper, J. M. Tricarico, E. Kebreab. 2015 *Journal of Dairy Science* 98:0000-0000. <http://dx.doi.org/10.3168/jds.2014-9138>

RA

Regulatory Affairs

Updates:

- **Federal Drug Administration Ruling Expected on GRAS status of Partially Hydrogenated Oils**

Pipeline Statistics

January – June 2015

Nutrition

Papers:	8
Abstracts:	12

Product

Papers:	22
Abstracts:	18

Sustainability

Papers:	1
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Total Published: 61

* **The High Impact Papers** in this Research Pipeline Quarterly were selected to present new or novel findings that enhance what we know about a particular area of dairy related research, or reflect new large scale studies that support previous evidence that was once only considered emerging.

de Goede J, Geleijnse JM, Ding EL, Soedamah-Muthu SS. *Nutr Rev.* 2015;73(5):259-75.

Headline: Cheese consumption may not negatively affect blood cholesterol levels.

Abstract

Context: Cheese may affect lipids and lipoproteins differently than other high-fat dairy foods. **Objective:** The present systematic review and meta-analysis was performed to evaluate randomized controlled trials that examined the effect of cheese consumption compared with another food product on blood lipids and lipoproteins. **Data Sources:** A systematic literature search of the MEDLINE, Embase, Scopus, CAB, Abstracts, the Cochrane Controlled Trials Register, and the clinicaltrials.gov website was performed. **Study Selection:** A total of 12 randomized controlled trials (RCTs) were identified that examined the effect of cheese consumption on blood lipids and lipoproteins in healthy adults. **Data Extraction:** A meta-analysis of 5 RCTs that compared the effects of hard cheese and butter, both of which had a similar ratio of polyunsaturated fatty acids to saturated fatty acids (P/S ratio), was performed. **Data Synthesis:** Compared with butter intake, cheese intake (weighted mean difference: 145.0 g/d) reduced low-density lipoprotein cholesterol (LDL-C) by 6.5% (-0.22mmol/l; 95%CI: -0.29 to -0.14) and high-density lipoprotein cholesterol (HDL-C) by 3.9% (-0.05mmol/l; 95%CI: -0.09 to -0.02) but had no effect on triglycerides. Compared with intake of tofu or fat-modified cheese, cheese intake increased total cholesterol or LDL-C, as was expected on the basis of the P/S ratio of the diets. There was insufficient data to compare intake of cheese with intake of other foods. **Conclusions:** Despite the similar P/S ratios of hard cheese and butter, consumption of hard cheese lowers LDL-C and HDL-C when compared with consumption of butter. Whether these findings can be attributed to calcium, specific types of saturated fatty acids, or the food matrix of cheese warrants further research.

Contribution to the State of Science

Lowering the intake of saturated fat and sodium has been recommended because they have been associated with increasing LDL-cholesterol (LDL-C) and blood pressure (BP), respectively. Elevated LDL-C and high BP are considered independent risk factors for cardiovascular disease (CVD). Cheese is one of the main contributors of saturated fat and sodium in the diet of Western countries and thus, it might be thought that cheese intake increases the risk of CVD. However, several human clinical trials have reported that cheese intake affects blood lipid differently compared to other dairy products despite the same fat content ([Tholstrup et al. 2004, J Am Coll Nutr 23:169-176](#); [Biong et al. 2004, Br J Nutr 92:791-797](#); [Nestel et al. 2005, Eur J Clin Nutr 59:1059-1063](#); [Hjerpsted et al. 2011, Am J Clin Nutr 94:1479-84](#)). Additionally, observational studies have found that cheese intake is associated with reduced risk of CVD ([Warenso et al., Am J Clin Nutr 2010;92:194-202](#); [Qin et al. Asia Pac J Clin Nutr 2015;24\(1\):90-100](#)). Therefore, the aim of this study was to conduct a systematic review and meta-analysis of randomized controlled trials (RCTs) on the relationship between cheese and blood lipids and lipoproteins. The main findings of the study indicate that when cheese is compared with non-dairy foods with different polyunsaturated-saturated fat ratios (P/S ratio) -e.g. tofu or fat-modified cheese- cheese tends to increase total cholesterol (TC) and LDL-C. In contrast, when cheese is compared to butter with similar P/S ratio, cheese consistently lowers TC, LDL-C and HDL-C. In summary, the effect of cheese on blood lipids will depend on the product with which that cheese is compared.

Importance to Industry

For Thought Leaders/Health Professionals: Despite the fat content, cheese consumption does not negatively affect blood lipid levels.



Subject Matter Expert Comment – Moises Torres-Gonzales, Ph.D.

It is normally thought that consuming foods with high saturated fat content, such as cheese, increase the risk of CVD, because saturated fat elevates blood lipids levels. However, scientific studies have demonstrated that cheese intake is associated with reduced risk of CVD. By focusing on the effects of cheese on blood lipids levels, this study shows that in general, cheese does not have a negative impact on the levels of TC, LDL-C and HDL-C. It is important to mention that cheese is not only saturated fat but also a source of unsaturated fat, calcium and other substances that may exert beneficial effects against CVD.

Status: Published

Communication Ready: YES

DGA Relevant: NO

Key Words: Cheese, butter, saturated fat, total cholesterol, LDL-cholesterol, HDL-Cholesterol and CVD risk.

Type of Research: meta-analysis

Funding Source: Global Dairy Platform, National Dairy Council, Dairy Australia

Consumer analysis of the sensory impact of light exposure and age on fluid milk.

Carey N, Martin N, Murphy S, Kent D, Bang JH, Stubbs T, Wiedmann M, Dando R.; J. Dairy Sc.

Headline: Protecting fluid milk from exposure to light is critical to consumer acceptance.

Status: Submitted

Publication ETA: TBD

Communication Ready: NO-
Publication Pending

Key Words: fluid milk, sensory, consumer evaluation, hedonic, light, LED, Northeast Dairy Foods Research Center, Dairy Management Inc., National Dairy Council, sensory evaluation

Type of Research: Consumer research study

Funding Source: National Dairy Council

Abstract

Multiple samples of fluid milk were evaluated to identify factors which negatively affect the perceived sensory quality of milk, and to quantify their relative impact on the consumer's experience. We assayed the effects of fat content, light exposure, age, and microbiological content across 24 samples of fluid milk. Previous research in this area has not involved broad general-population consumer testing paired with detailed descriptive analysis, to produce hedonic mapping of product liking. Most notably, light exposure resulted in a broad negative reaction and large overall liking penalties from consumers. The study also revealed that 2 underlying segments exist within the consumer market for both reduced fat and skim milk, with divergent drivers of liking. An overall implication of the study is that a component of paramount importance in ensuring the success of the dairy industry would be to protect fluid milk from all sources of light exposure, from process plant to consumer.

Contribution to the State of Science

This is the first major study to measure the impact of LED lighting on quality and consumer liking. As the industry is rapidly moving from florescent to LED lighting it is critically important to understand the impact.

Importance to Industry

Industry:

- This could impact future packaging material decisions, future dairy case manufacturing design, and industry practices during distribution and storage.
- Additional studies are underway to compare LED to Florescent lighting and quantify the protection provided by different packaging materials.

Farmers:

- May need to minimize light exposure on farm (this should already be minimal)
- Addressing these issues is important to protecting fluid milk volumes



Subject Matter Expert Comment – Tim Stubbs, Ph.D.

Protecting the sensory properties of milk is a critical, controllable, factor in consumer/commercial success. The most important finding of this study was the quantification of the negative consumer impact of typical dairy-case light exposure. This result has led to the initiation of additional research designed to be actionable by processors and collaboration with resin producers and case manufacturers.

Status: Accepted

Publication ETA: July/August 2015

Communication Ready: **NO-Publication Pending**

Key Words: Environmental impact, methane, optimization, goal programming

Type of Research: Mathematical modeling study

Funding Source: Cow of the Future® program from the Innovation Center for U.S. Dairy®

A goal programming model for minimizing diet costs and methane emissions

L. E. Moraes, J. G. Fadel, A. R. Castillo, D. P. Casper, J. M. Tricarico, E. Kebreab. 2015. A goal programming model for minimizing diet costs and methane emissions. *Journal of Dairy Science* 98:0000-0000. <http://dx.doi.org/10.3168/jds.2014-9138>

Headline: Economic-environmental trade-off analysis allows identification of dairy cattle diets that generate reduced amounts of methane without compromising milk production.

Abstract

Enteric methane emission is a major greenhouse gas from livestock production systems worldwide. Dietary manipulation may be an effective emission-reduction tool; however, the associated costs may preclude its use as a mitigation strategy. Several studies have identified dietary manipulation strategies for the mitigation of emissions, but studies examining the costs of reducing methane by manipulating diets are scarce. Furthermore, the trade-off between increase in dietary costs and reduction in methane emissions has only been determined for a limited number of production scenarios. The objective of this study was to develop an optimization framework for the joint minimization of dietary costs and methane emissions based on the identification of a set of feasible solutions for various levels of trade-off between emissions and costs. Such a set of solutions was created by the specification of a systematic grid of goal programming weights, enabling the decision maker to choose the solution that achieves the desired trade-off level. Moreover, the model enables the calculation of emission-mitigation costs imputing a trading value for methane emissions. Emission imputed costs can be used in emission-unit trading schemes, such as cap-and-trade policy designs. An application of the model using data from lactating cows from dairies in the California Central Valley is presented to illustrate the use of model-generated results in the identification of optimal diets when reducing emissions. The optimization framework is flexible and can be adapted to jointly minimize diet costs and other potential environmental impacts (e.g., nitrogen excretion). It is also flexible so that dietary costs, feed nutrient composition, and animal nutrient requirements can be altered to accommodate various production systems.

Contribution to the State of the Science

Various studies identify dietary manipulation as technical options for mitigating enteric methane from dairy cattle (Hristov et al. 2013; <http://dx.doi.org/10.2527/jas2013-6583>) but the economic-environmental trade-offs of such manipulations are poorly understood. This study developed an optimization framework for the joint minimization of dietary costs and methane emissions from lactating dairy cows. It sequentially applies an equation to predict methane emissions, two linear programming models to minimize dietary costs and methane emissions, and a weighted goal programming model to identify a set of feasible solutions representing various levels of trade-off between diet costs and methane emissions. Application of the model using data from dairies in the California Central Valley produced a set of 12 distinct solutions with methane ranging from 17.9 to 21.6 MJ/ cow x day and diet costs ranging from \$5.95 to \$7.31 per cow x day. Calculated methane mitigation costs expressed per ton of CO₂-equivalents ranged from \$127 to \$23,119.

Importance to Industry

For industry: The framework allows for economic-environmental trade-off analysis to identify dairy cattle diets that mitigate methane while delivering the required nutrients for desired levels of milk production. **For industry and thought-leaders:** The framework can also be used to quantify the costs associated with various nutritional methane mitigation options available to dairy producers. It also provides opportunities impute trading values for methane emissions and evaluate economic incentives for mitigation. **For farmers:** The framework allows dairy farmers the opportunity to select the most desired solution according to current feed prices and policy regulations.



Subject Matter Expert Comment - Juan Tricarico, Ph.D.

Dairy cattle diet manipulation is proposed by many as a significant and desirable strategy to reduce enteric methane emissions. However, dairy farmers do not possess tools to readily and simultaneously evaluate environmental and economic trade-offs associated with these nutritional mitigation strategies. This study provides the mathematical framework and optimization model to explore the environmental and economic trade-offs of dairy cattle diet optimization and quantify them in terms of economic costs

By Kristin Harris, Ph.D.



The FDA recently announced that the final rule on the GRAS determination regarding partially hydrogenated oils (PHOs) will be published on or before June 15th. The proposed rule ([Tentative Determination Regarding Partially Hydrogenated Oils: Request for Comments and for Scientific Data and Information](#)) was published on February 8, 2013. The proposed rule addresses PHOs because they are the primary dietary source of industrial produced *trans* fat. According to the proposed rule, "the current scientific evidence identifies significant health risks caused by the consumption of *trans* fat" and therefore, FDA announced its tentative determination that PHOs are no longer GRAS for use in food. Should the GRAS status of PHOs be revoked in the final rule, any use of PHOs in food would then require FDA approval through the food additive petition process.

A substance is Generally Recognized As Safe (GRAS) if it is generally recognized, among experts qualified by scientific training and experience to evaluate its safety, as having been adequately shown through scientific procedures to be safe under the conditions of intended use. Alternatively, a substance may be considered GRAS if safety has been shown through experience based on common use in food prior to 1958. Partially hydrogenated oils have been in widespread commercial use since the 1940's. The FDA notes in the proposed rule that the GRAS status of a particular substance in food is time dependent and the status may change based on the evolution of scientific opinion regarding the consequences of consumption.

The evidence for the significant health risks of PHOs includes a 2005 recommendation by the IOM to limit *trans* fat consumption as much as possible while consuming a nutritionally adequate diet as well as data from the CDC predicting prevention of a significant number of coronary events and deaths with elimination of PHOs from the food supply.

The proposed rule specifically excludes inherent *trans* fats in the fat components of dairy products. "This document is limited to PHOs and does not address the *trans*-fat component of meat and dairy products from ruminant animals." Therefore the anticipated impact of the final rule (should the GRAS status of PHOs be revoked) to dairy foods is expected to be minimal. A small portion of dairy products may be marginally impacted (e.g. ice cream with inclusions that contain PHOs). However, food manufacturers and ingredient suppliers have been actively working to remove PHOs from most foods and ingredients, which should further minimize any impact.

The food industry expects the FDA to revoke the GRAS status of PHOs in the final rule. However, questions still remain regarding the definition of a PHO as the degree of hydrogenation and *trans* fatty acid content of PHO's can vary widely. In addition, even "fully" hydrogenated oils contain a small degree of *trans* fatty acids due to incomplete hydrogenation. Public comments to FDA have challenged the science behind the detrimental health effects of *trans* fats. However, those arguments are unlikely to prevail given the authoritative statements from IOM, DGA and others to the contrary. FDA did not indicate a compliance date for PHO removal in the proposed rule but did request comment on the idea of a multi-year compliance period.

Contact

Questions?

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