

# How to enrich dairy products with polyphenols and increase health benefits

Duration : 2011 –2016

## Highlights

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- This project is part of an initiative to identify the nutritional synergies and protective effects of dairy products on nutrients in other food groups.
- In regards to objective 1, this study is the first of its kind to demonstrate that the presence of calcium has a large influence on the interaction between EGCG/ protein  $\beta$  Ig and EGCG/ protein alpha s1 casein. In the case of beta-Ig, the presence of EGCG is required in order to have an increased particle size in accordance with increased calcium concentrations.
- In objective 2, the study demonstrated that milk has the strongest fixation ability for polyphenols from green tea with a rate that is slightly higher than 80%, while the average fixation rate of yogurt is 75% for polyphenols. However, cheese matrices have a greater protective effect on polyphenols during digestion.
- According to these results, calcium supplementation is important for milk that is enriched with strong concentrations of extracts rich in polyphenols. In addition, it appears that polyphenols influence the digestion of dairy products by decreasing the rates of liberation of peptides and fatty acids.
- The results confirm for the very first time that dairy matrices have a protective effect on the antioxidant activity of polyphenolic compounds during digestion. However, polyphenols in cranberries are more sensitive to the gastro-intestinal environment than polyphenols in green tea.
- Concerning objective 3, the results support that  $\beta$ -Ig has beneficial effects on glycemic control but suggest that the consumption of EGCG and calcium do not increase this effect.

\*EGCG: epigallocatechin-3-gallate

## Objectives

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In order to study the nutritional synergy between milk components and polyphenols contained in tea and cranberry juice, this study focuses on three main objectives:

- To characterize the interactions between milk components and isolated phenolic compounds in tea and cranberry juice;
- To measure, during digestion, the effect of milk components and three dairy matrices (milk, yogurt, cheese) on degradation kinetics and antioxidant activity of phenolic compounds;
- To measure, post digestion, the effect of the presence of milk components on the physiological activity of polyphenols.

## Results and potential benefits

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Research on these three components has primarily helped to advance knowledge in the dairy sector since many of the results have been demonstrated for the very first time. In addition, the knowledge and results obtained from this project will contribute to the development of new polyphenol-enriched dairy products while demonstrating the beneficial effect of the addition of polyphenols on health or during digestion. With the knowledge acquired during this project on the interactions between polyphenols/calcium/dairy proteins (alpha 1 casein and  $\beta$  Ig), new dairy ingredients may be developed (protein aggregates rich in ECG and calcium). Depending on the interests of dairy processors, these results may be used as part of a knowledge transfer project conducted in-plant. The results concerning the effect of polyphenols from grapes (commercial extracts) on rennet-induced coagulation could also be validated in-plant beforehand. In addition, results demonstrate that it is possible to preserve the antioxidant activity of

polyphenols according to the type of dairy matrix and the manner in which they are incorporated. Lastly, consumers benefit from knowing this information about the liberation of polyphenols during the digestion of milk matrices, as well as about the protection and liberation of polyphenols, as the research demonstrates the real impacts and benefits of milk components (beneficial effect on postprandial glycemia). The potential benefits of the research results are: 1) Increased revenues due to an increased demand for dairy products: Reinforcement of the “healthy” image of milk. In addition to its high nutritional density, milk provides “protection” to nutrients from other food groups (nutritional synergies); 2) Increased product quality: Effect of milk proteins and calcium on the protection and liberation of polyphenols during gastrointestinal digestion; and 3) The ability to better respond to consumers’ concerns.

## Contact persons

### Project managers :

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## Professionals trained

### Martine Lussier: Master's degree (incomplete)

Expertise acquired:

- Methods of analyzing polyphenol-protein interactions
- Methods of analyzing antioxidant properties (DPPH, ORAC)
- Fractioning techniques and characterization of proteins found in dairy products
- Dosage techniques
- Operation of a static digestion simulator

### Valérie Carnovale: PhD (completed)

Expertise acquired:

- Methods of analyzing polyphenol/calcium/milk protein interactions
- Effects of dairy products and their interactions on physiological responses
- Physical chemistry of proteins
- Physiology and digestion of dairy products

## For further information

• Lussier, M.; Britten, M.; Couillard, C.; Bazinet, L. Interaction entre les polyphénols d'un extrait de thé vert et les matrices laitières: impact sur les activités anti-radicalaire et anti-oxydante. Poster presented during the first research day at the Faculty of Agriculture and Agri-Food Sciences, "Mieux nourrir le monde." Quebec City (Qc), November 28, 2012.

• Lussier, M.; Britten, M.; Couillard, C.; Bazinet, L. Interaction entre les polyphénols d'un extrait de thé vert et les différentes forme de matrices laitières. Poster presented during the STELA Symposium "Innovation for the Future of the Dairy Sector" and the FIL-IDF "Dairy Outlook Seminar," Montreal (Qc), May 13–16, 2013.

• Carnovale, V.; Britten, M.; Couillard, C.; Bazinet, L. Étude et impacts des interactions entre l'épigallocatechine gallate, la bêta-lactoglobuline et le calcium dans la phase minérale du lait. Poster presented during the Novalait Technological Forum "Carrefour des compétences, savoirs et savoir-faire laitiers," Drummondville (Qc), May 28, 2014.

• Lussier, M.; Britten, M.; Couillard, C.; Bazinet, L. Interaction entre les polyphénols d'un extrait de thé vert et les matrices laitières. Poster presented during the Novalait Technological Forum "Carrefour des compétences, savoirs et savoir-faire laitiers," Drummondville (Qc), May 28, 2014.

• Carnovale, V.; Britten, M.; Couillard, C.; Bazinet, L. Effet de complexes épigallocatechine-3-gallate et la  $\beta$ -Lactoglobuline formé dans un ultrafiltrat de lait simulé avec et sans calcium sur la réponse métabolique chez la souris. Poster presented during the 2015 STELA Symposium "Challenges and Opportunities for the Dairy Sector." Poster No. 27. Quebec City (Qc), June 1–2, 2015.

• Carnovale, V.; Labaeye, C.; Britten, M.; Couillard, C.; Bazinet, L. Impact du calcium sur les interactions entre épigallocatechine-3-gallate et la  $\beta$ -Lactoglobuline. Poster presented during the 2015 STELA Symposium "Challenges and Opportunities for the Dairy Sector." Poster No. 28. Quebec City (Qc), June 1–2,

## Financial contributions

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-Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec

-Novalait

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