

Fatty Acids and Protein Composition of milk produced under different feeding regime-“We eat what we feed”

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Introduction

Milk production nowadays is based on a variety of different philosophies. Currently, a consumer can only distinguish between conventional and organic milk. All other differences in the production are not transparent and the impact of the feeding regime on the composition of the milk are mainly unknown. Therefore, milk, which was produced under different feeding conditions has been analyzed for their fatty acid and protein profile.

Methods

In order to define the fatty acid and protein composition, the milk samples were characterized by various analytical methods. Total nitrogen and fat were analyzed by using the methods of Kjeldahl and Roesse-Gottlieb. Specific fatty acids were characterized by high-resolution GC-MS. The twenty most abundant milk proteins were quantified by selected reaction monitoring mass spectrometry [1] (Fig. 1).

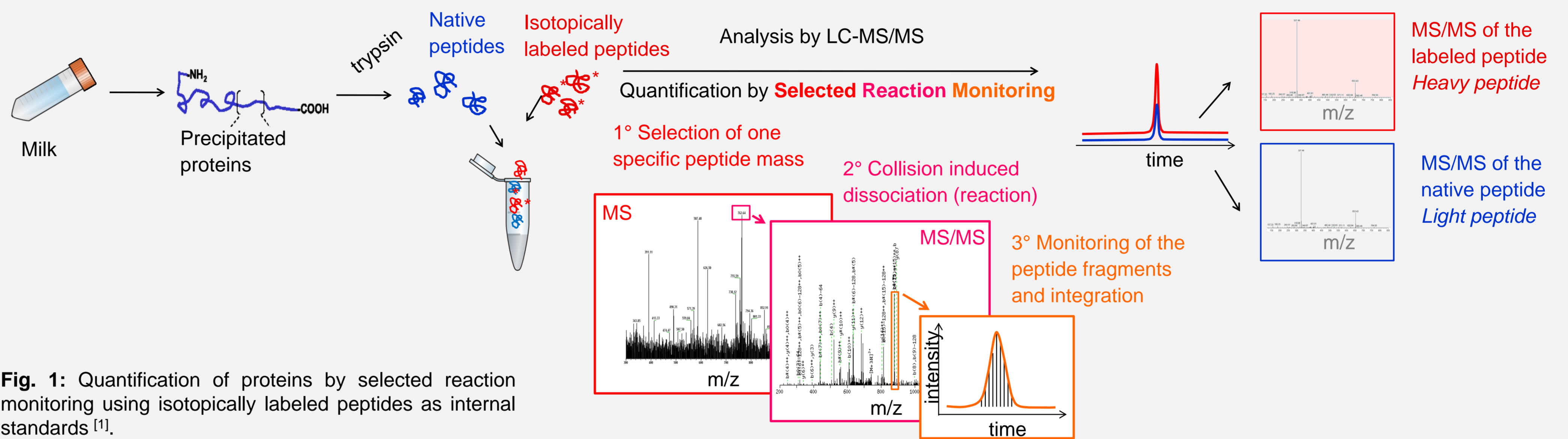


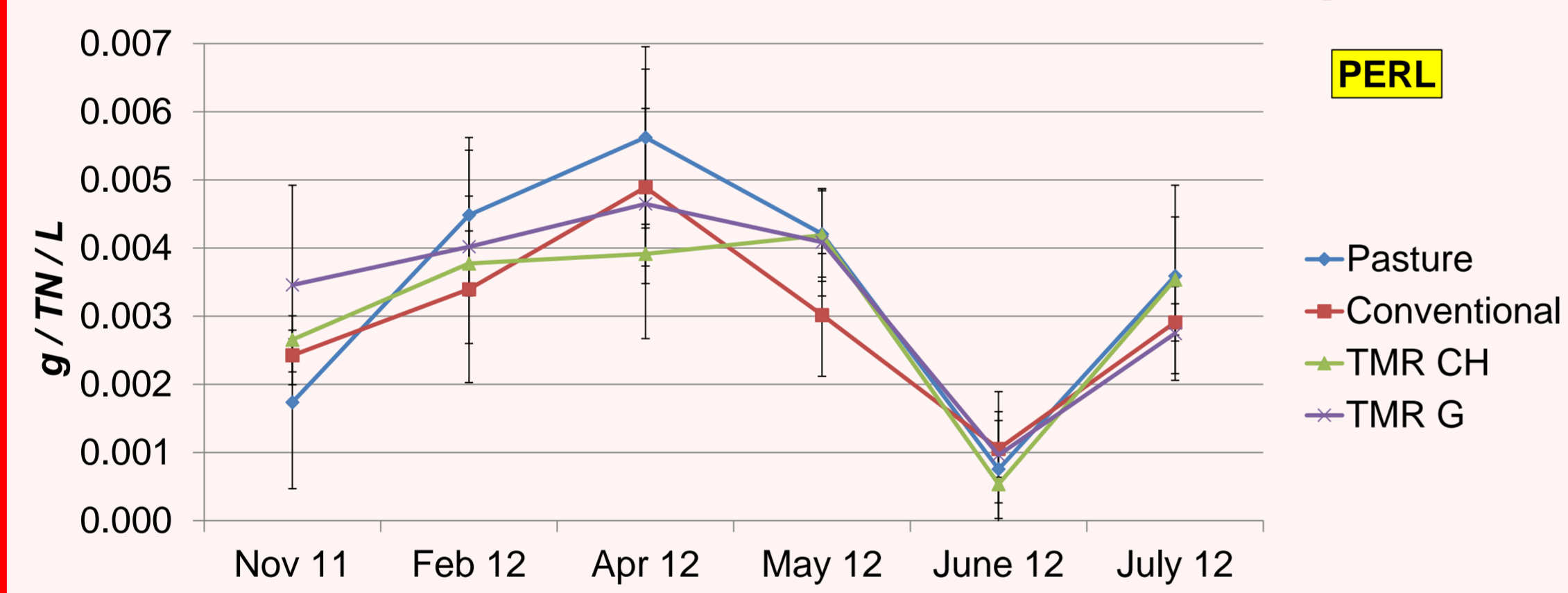
Fig. 1: Quantification of proteins by selected reaction monitoring using isotopically labeled peptides as internal standards [1].

Results

Earlier studies on the fatty acid composition showed an increase in Omega 3, CLA, branched chain fatty acids and a decrease in LDL-raising saturated fatty acids in milk that was produced by pasture feeding [2][3][4]. Those results could be confirmed in this study.

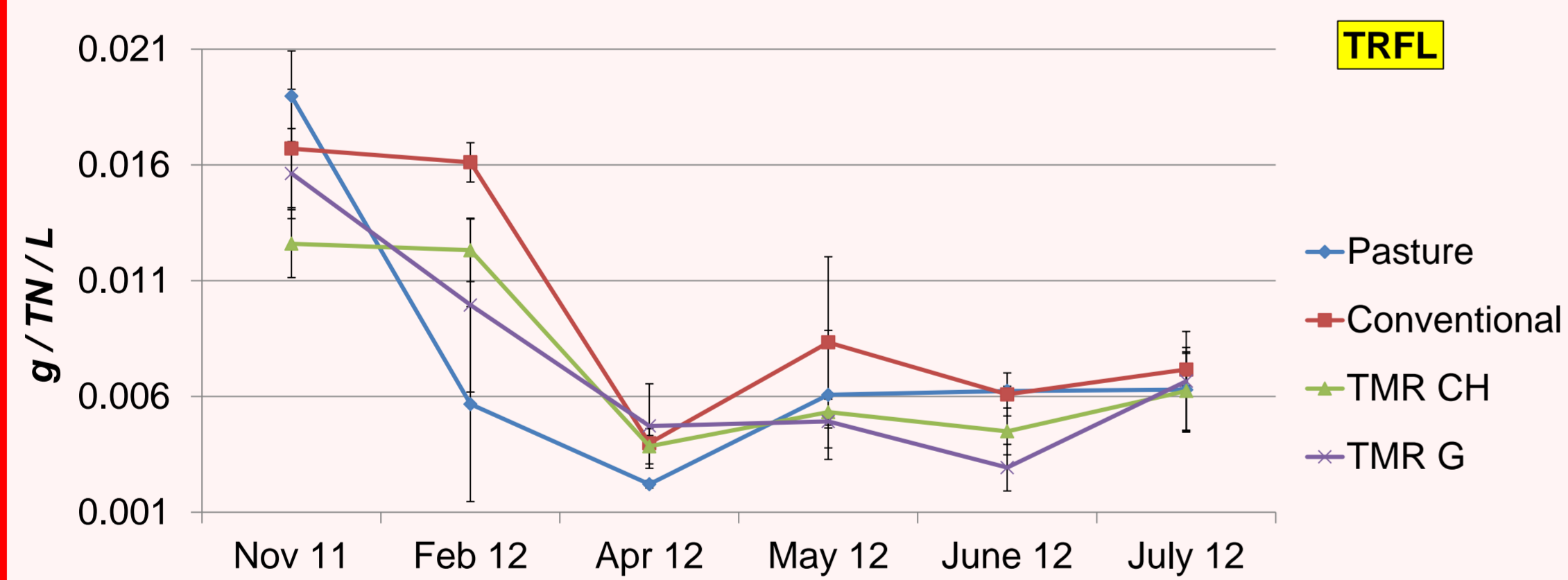
However, the impact of the feeding on the protein composition could not be demonstrated so far, due to a lack of specific quantification methods for the different milk proteins. Milk contains a few quantitatively dominant proteins and over 100 different minor proteins. They can be regrouped into caseins, whey proteins, and proteins associated with the milk fat globule membrane (MFGM). So far, a method for the absolute quantification of individual proteins with a high concentration range was lacking. Consequently, a mass spectrometry-based method (selected reaction monitoring) was developed, which allows the simultaneous quantification of twenty major dairy proteins in different milk varieties [1] (Fig.1).

Analysis of specific proteins shows minor differences between pasture milk and other milk samples



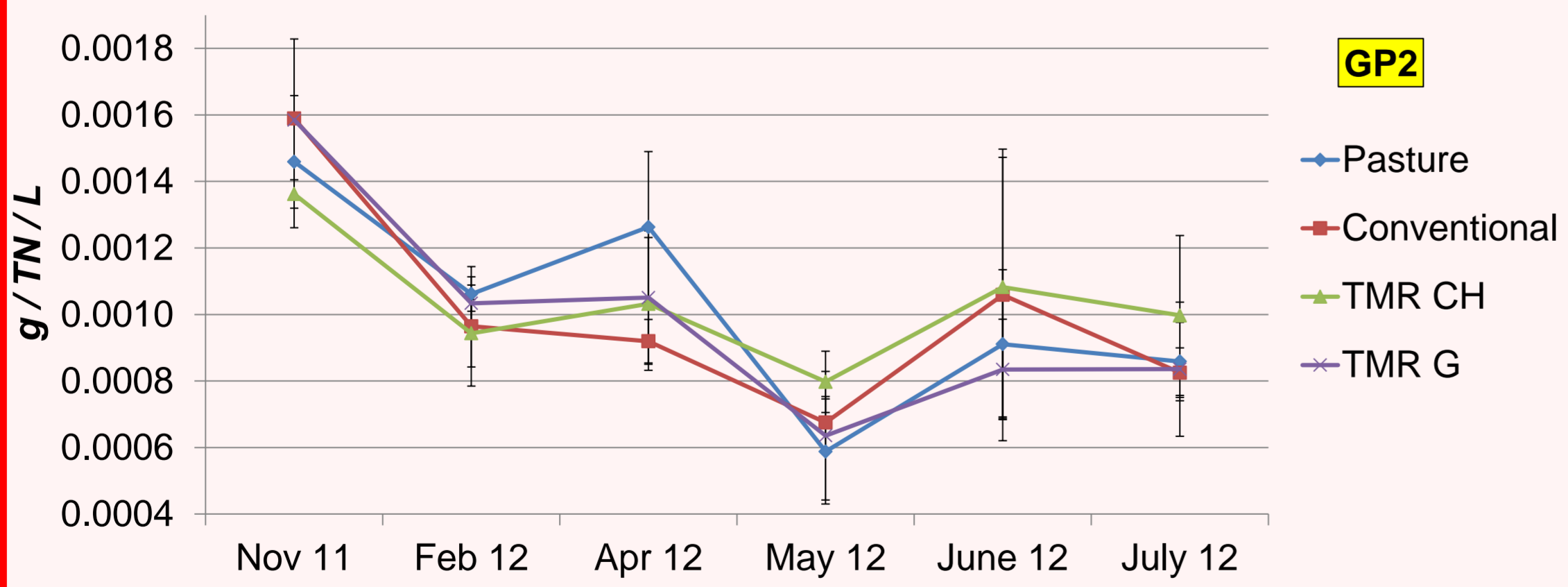
*W.M.A. Mullan et al., 2003; S.366, "Chemie und Physik der Milch", A. Töpel, ISBN 3-89947-131-8

Whey protein PERL
Lactoperoxidase (PERL)-part of the innate immune system, functions as a natural antibacterial agent*



*reviewed in L. Adlerova et al., 2008; L. Sánchez et al., 1992

Whey protein TRFL
Lactoferrin, (TRFL)-antibacterial, antiviral, antiparasitic, anticancer, anti-allergic and radio-protecting properties*



*reviewed in Hirno et al., 1998

MFGM-associated protein GP2
Glycoprotein 2 (GP2)-Inhibition of Helicobacter pylori haem-agglutination*

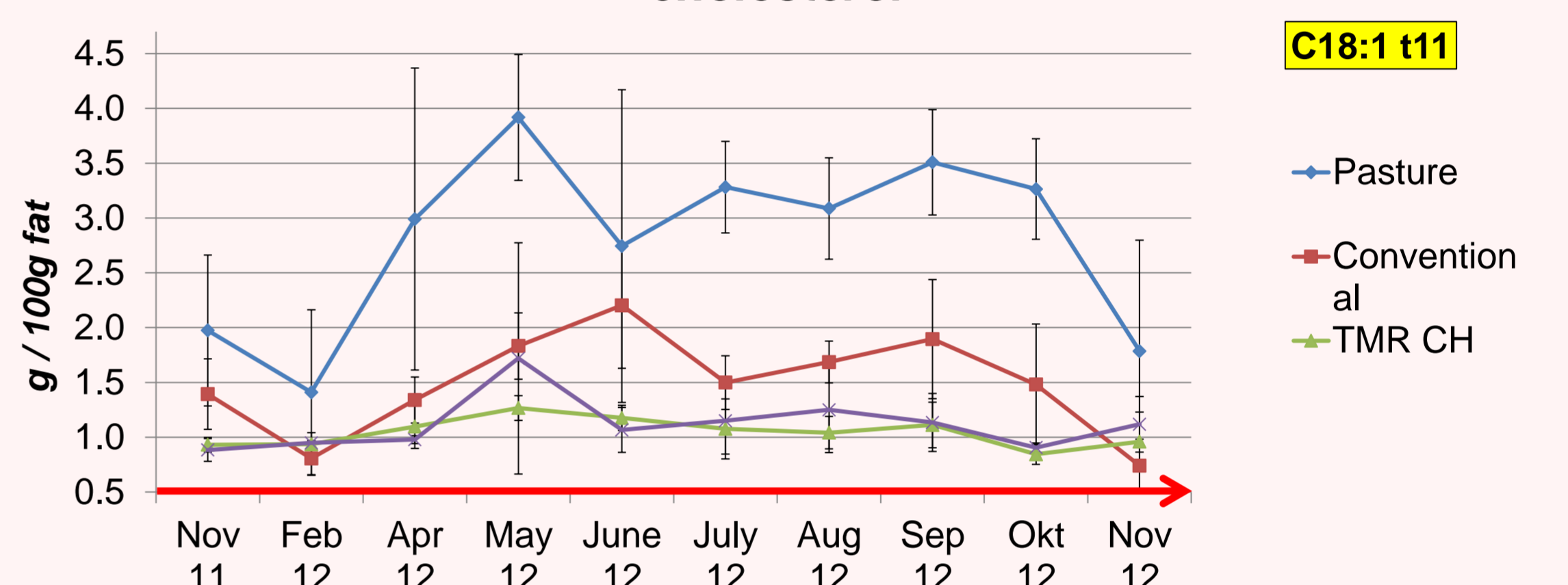
Outlook

Confirm the advantage of pasture milk by quantification of fatty acids, twenty major proteins and metabolites in milk, produced under distinct feeding regimes over a period of one year.

Analysis of specific Fatty Acids shows a significant physiological advantage of pasture milk

Branched chain fatty acids

Trans-vaccenic acid, C18:1 t11 - Cancer inhibition, lowering of HDL cholesterol*

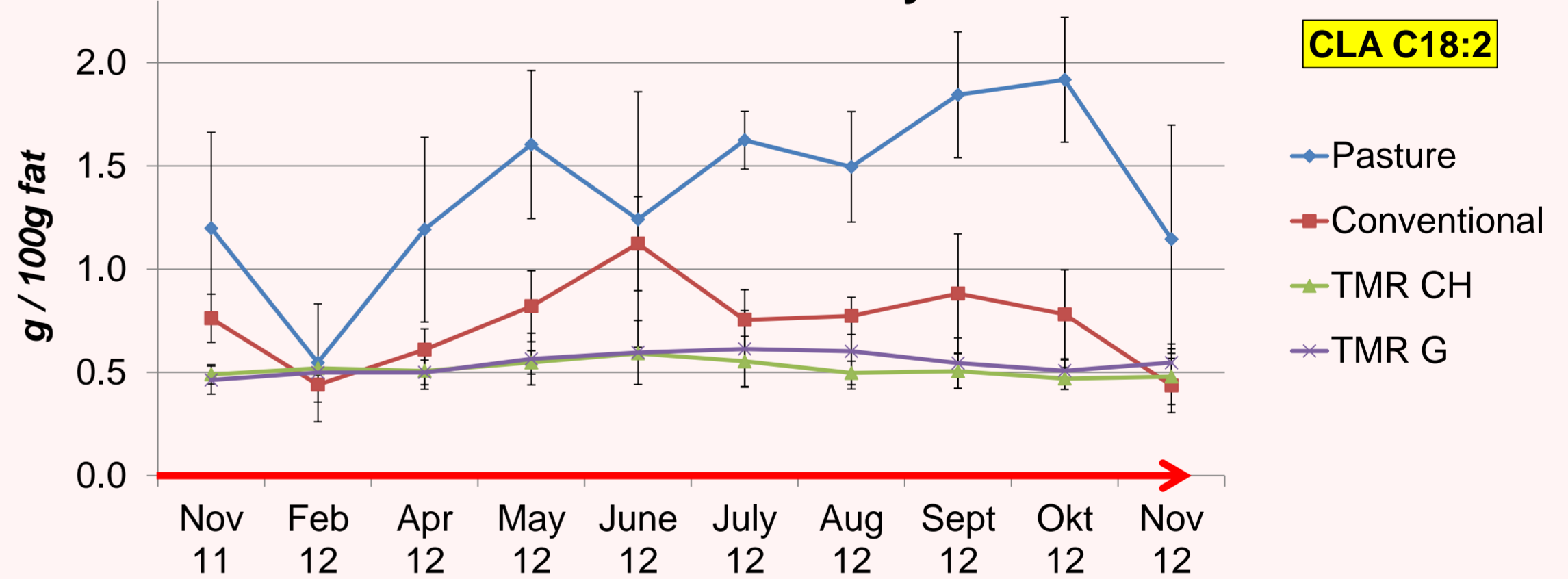


	0.101	0.095	0.021	0.003	0.422	0.000	0.001	0.001	0.000	0.049	Pasture - Conv
	0.010	0.173	0.011	0.001	0.039	0.000	0.000	0.000	0.000	0.105	Pasture - TMR G
	0.008	0.181	0.008	0.002	0.030	0.000	0.000	0.000	0.000	0.176	Pasture - TMR CH

*Chillard et al., 2006

CLA

Conjugated linoleic acid (CLA) C18:2- anti-cancer properties, additional effects on body fat reduction*

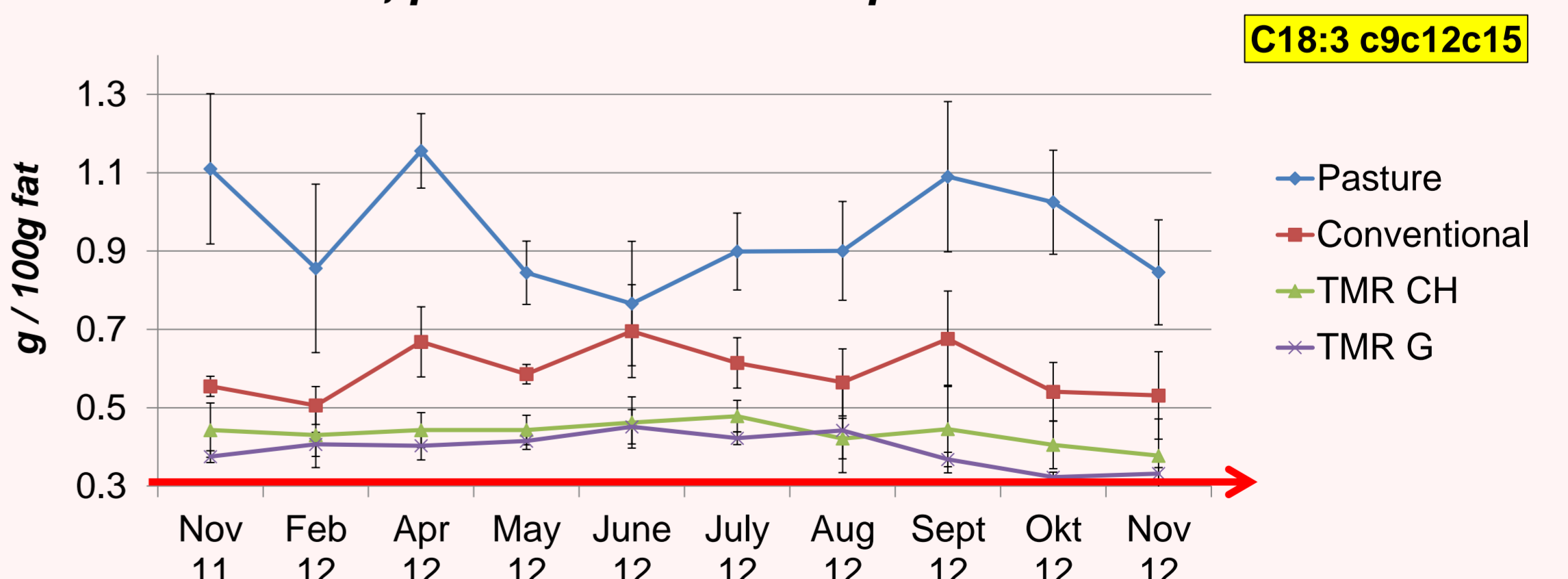


	0.059	0.419	0.016	0.002	0.683	0.000	0.001	0.001	0.000	0.018	Pasture - Conv
	0.007	0.832	0.007	0.000	0.047	0.000	0.000	0.000	0.000	0.024	Pasture - TMR G
	0.006	0.712	0.007	0.000	0.048	0.000	0.000	0.000	0.000	0.036	Pasture - TMR CH

*D.L. Amarù et al., 2009; L.D. Whingham et al., 2007

Omega3

α-linolenic acid, C18:3 c9c12c15 - lower risk of cardiovascular diseases, positive effect on depression and stress*



	0.000	0.006	0.000	0.000	0.464	0.001	0.002	0.004	0.000	0.005	Pasture - Conv
	0.000	0.002	0.000	0.000	0.009	0.000	0.000	0.000	0.000	0.000	Pasture - TMR G
	0.000	0.002	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.000	Pasture - TMR CH

*P. M. Kris-Etherton et al., 2002; W.E. Connor et al., 2002; M. Lukas et al., 2002

[1] Mathis D., Schwander F., Kopf-Bolanz K., Egger C., Portmann R., Absolute Quantification of 20 Major Proteins in Dairy Products by LC-MS/MS, 2013

[2] Bisig W., Collomb M., Bütikofer U., Sieber R., Bregy M. und Etter L. (2008). Saisonale Fettsäurezusammensetzung von Schweizer Bergmilch. Agrarforschung 15(1), 38-43.

[3] Collomb M., Bisig W., Bütikofer U., Sieber R., Bregy M., Etter L. (2008). Fatty Acid composition of mountain milk from Switzerland. Comparison of organic and integrated farming systems. International Dairy Journal 18, 976-982.

[4] Wyss U., Mauer J., Frey H., Reinhard T., Bernet A. (2011). Systemvergleich Milchproduktion Hohenrain. Aspekte zur Milchqualität und Saisonalität der Milchlieferungen. Agrarforschung Schweiz 2 (9): 412-417.