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SKIM MILK FORTIFIED WITH BUTTERMILK AFFECTS THE PLASMA PHOSPHOLIPID AND FATTY ACID COMPOSITION IN HEALTHY SUBJECTS

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Background and Objectives:

Buttermilk is attracting renewed scientific interest not only for its nutritional and technological value, but for the biological activities and their potential human health benefits. It is a rich source of phospho- and sphingolipids that have been linked to the age-related disease (cognitive ability, dementia), the inflammatory responses and chemotherapeutic activity on some types of cancer.

The aim of this work was to study the phospholipid bioavailability after human intake of a skim milk fortified with buttermilk.

Methods:

Twelve healthy subjects were randomly assigned to receive 400 mL intake of skim milk fortified with buttermilk. Serial blood samples were collected at 0,1, 2, 3, 4 and 5 hours after ingestion of the dairy product. Lipids from plasma were extracted and thoroughly monitorized by GC-MS and HPLC-ELSD techniques.

Results:

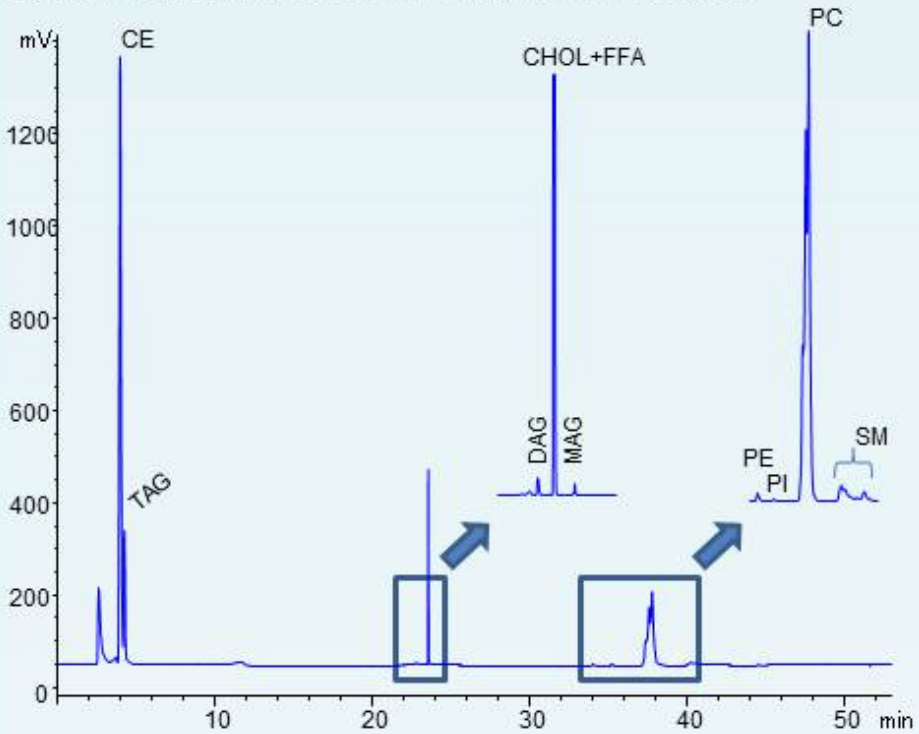
The intake of skim milk formula supplemented with

Table 1. Lipid classes composition (%) in human plasma over time by HPLC-ELSD.

Lipid classes	t0	t1	t2	t3	t4	t5	p

buttermilk induced changes in the human plasma lipid classes composition. TAG, DAG, MAG and PE showed significant differences over the time, reaching the maximum concentration between 1h (t1) and 3h (t3) after the ingestion (Table 1). Afterwards the values reduced until the initial amount (Fig. 2). However, significant variations in major FAMEs during the studied period were not found (Table 2).

Figure 1. Human plasma total lipids analysis by HPLC-ELSD.

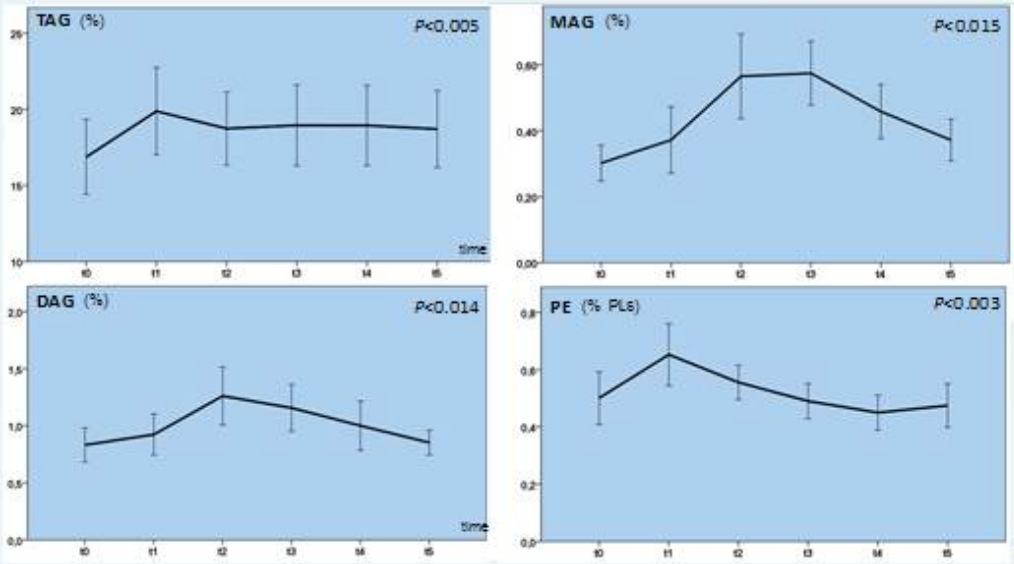


CE:cholesterol esters; TAG:triaylglycerides; DAG: diacylglicerydes; MAG: monoacylglicerydes; CH:cholesterol; FFA:free fatty acids, PE: phosphatidyl-ethanolamine; PI:phosphatidylinositol; PC:phosphatidylcholine; SM: sphingomyelin.

g/100g fat	CE	52.03	49.69	50.59	50.79	50.00	50.86	>0.05
	TAG	16.63	19.94	18.73	18.94	18.93	18.69	0.01
	DAG	0.83	0.92	1.26	1.15	1.00	0.85	0.01
	CHOL+FFA	4.91	4.73	4.80	4.66	4.92	4.91	>0.05
	MAG	0.31	0.39	0.59	0.61	0.47	0.38	0.01
	PLs	24.43	24.36	24.31	23.97	24.03	24.24	>0.05
g/100g PLs	PE	0.53	0.70	0.56	0.49	0.45	0.47	0.00
	PI	0.24	0.23	0.25	0.22	0.27	0.31	>0.05
	PC	92.99	93.00	93.19	93.32	93.37	93.33	>0.05
	SM	5.53	5.98	6.16	5.98	5.98	5.86	>0.05

CE: cholesterol esters; TG: triglycerides; DG: diglicerydes; MG: monoglicerydes; CH: cholesterol; FFA: free fatty acids, PLs: polar lipids; PE: phosphatidylethanolamine; PI: phosphatidylinositol; PC: phosphatidylcholine; SM: sphingomyelin.Significant difference $p < 0.05$

Figure 2. Evolution of the lipid classes in human plasma over the time with significant differences determined by HPLC-ELSD.

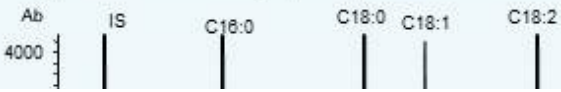


TAG: triglycerides; DAG: diglicerydes; MAG: monoglicerydes; PLs: polar lipids; PE: phosphatidylethanolamine; *p*: significant difference.

Table 2. Major human plasma FAMEs increment over the time by GC-MS

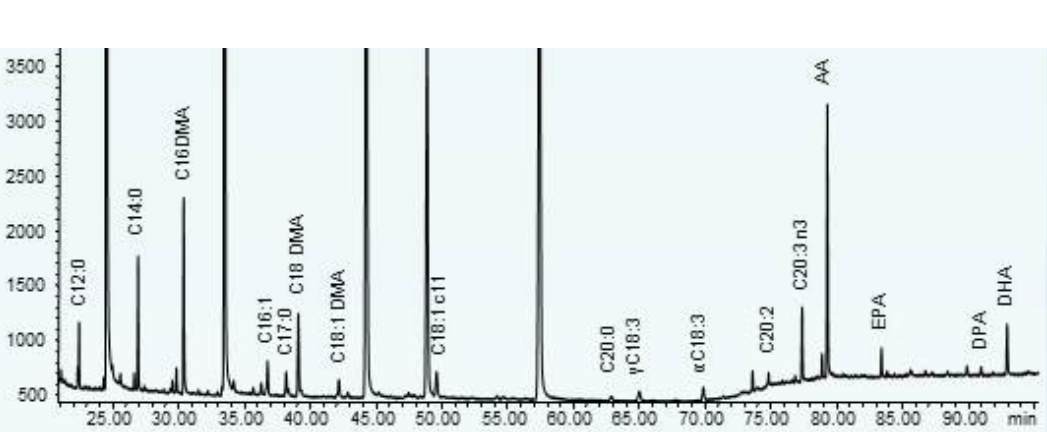
FAME (mg/g plasma)	Δ1	Δ2	Δ3	Δ4	Δ5	SEM	*p*
C14:0	0.15	0.22	0.24	0.08	1.00	0.13	0.27

Figure 3. Chromatographic profile of FAMEs of human plasma by GC-MS.



C14:0	0.15	0.32	0.84	0.08	1.09	0.13	0.27
C16:0	55.48	63.44	72.24	60.26	81.48	2.98	0.18
C16:1	-0.35	-0.29	-0.25	-0.28	-0.27	0.01	0.37
C18:0	27.44	33.06	39.56	31.38	44.21	1.93	0.07
C18:1c9	47.56	47.34	50.83	48.16	65.04	2.18	0.45
C18:2c9,c12	76.23	76.42	76.19	69.03	79090	1.15	0.90
C20:4 AA	18.63	19.40	19.66	17.83	23.73	0.66	0.89
Total	240.75	255.10	274.26	241.69	329.88	10.67	0.58

Δ1:(t1-t0)/t0; Δ2:(t2-t0)/t0; Δ3:(t3-t0)/t0; Δ4:(t4-t0)/t0; Δ5:(t5-t0)/t0;
AA:arachidonic acid; c:cis. Significant difference $p < 0.05$



IS: Internal standard; DMA: dimethyl acethal

Conclusions: The intake of a skim milk formula enriched in polar lipids from buttermilk increases the content of phosphatidyl-ethanolamine and other lipids as MAG and DAG in human plasma in the first three hours after ingestion.

Keywords: Buttermilk, plasma, polar lipids

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