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Food matrix structure (from biscuit to custard) impacts on folate bioavailability in healthy volunteers

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Introduction

Because folate deficiency has been associated with an increased risk of development of neural tube defect, depression… folate fortification is recommended for populations at risk (pregnant, frail population), including supplementation within food-matrix. However, folates, when incorporated within a food matrix, can differently interact with food components. This could ultimately impact on bioavailability of folates in plasma. The aim of the present study is to assess, in human volunteers, the impact of folic acid supplementation within 4 different food models characterized by similar composition (ingredients and chemical composition) but 4 various structures (Biscuit, Sponge cake, Pudding, Custard) on plasma folates appearance postprandially.

Material & Methods

Eleven young adult volunteers (22.6 ± 0.4 years old) were offered the four tested matrix according to a randomized, controlled cross over design. Plasma folate concentrations were determined before and up to 8 hours post matrix ingestion (Simultrac SNB kit, MP Bio). The concentration of other major macronutrients were also determined both in the fasted and the fed states (glucose, insulin, alpha amino nitrogen, triglycerides) to be compared to folate data. Data were presented as means ± SEM, Comparisons between groups determined using 1 or 2 factors repeated measures ANOVA and Holm-Sidak post-hoc analysis. Difference considered significant for P<0.05; tendency (P<0.10)

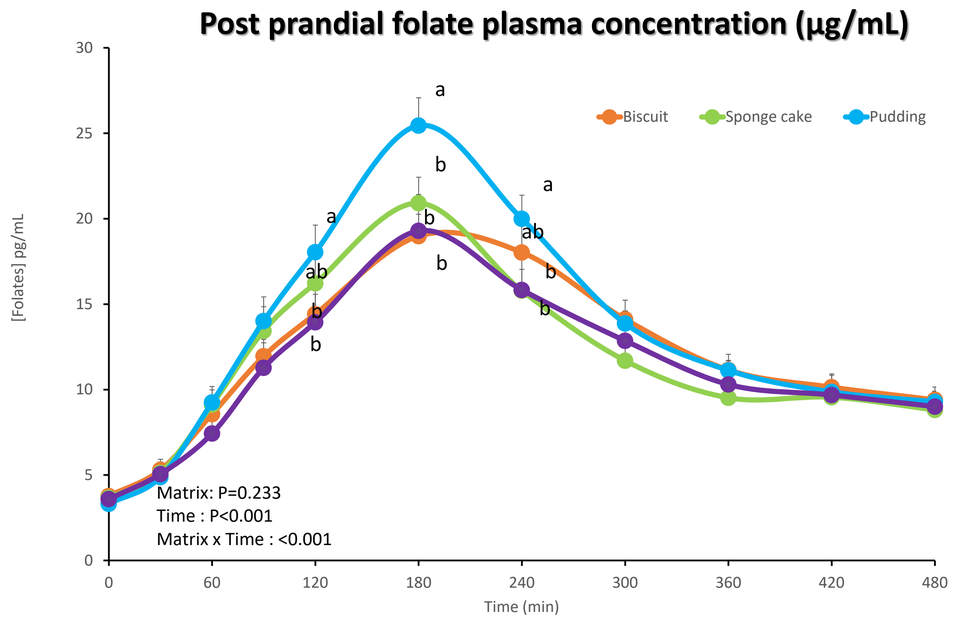
Folates ingestion (µg)

µg	Mean	SEM
Biscuit	966.8	38.7
Sponge cake	889.3	59.8
Pudding	1096.1	35.4
Custard	1095.9	100.0

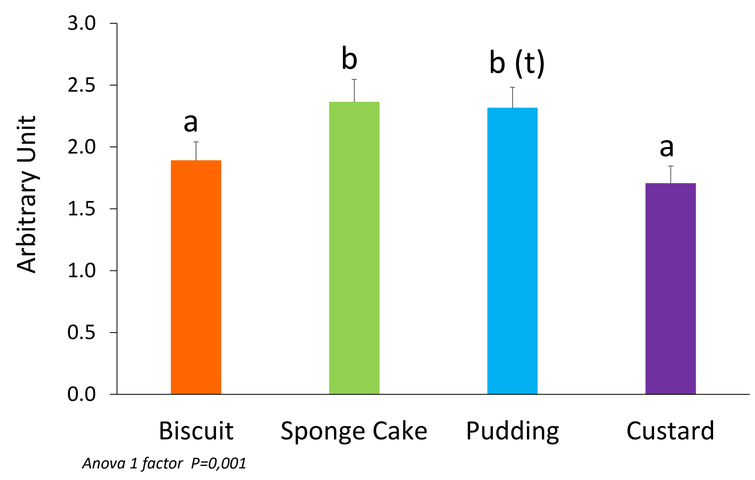
Folates ingestion is not statistically different between matrix
ANOVA 1 factor : P=0,64

Folates

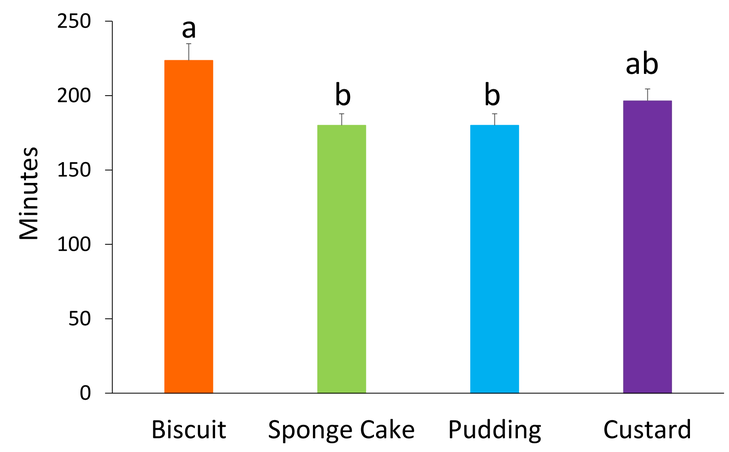
Post prandial folate plasma concentration (µg/mL)



Area under the curve (AU) 0-180 min (corrected for folate intake)



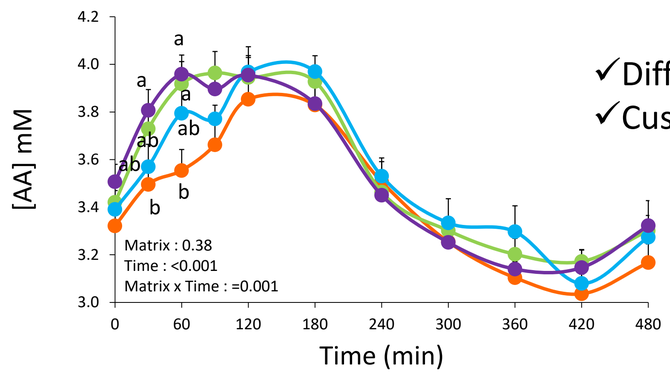
Time (min) for maximum folate plasma level



- ✓ Plasma folates are more ↗ in plasma following **pudding** ingestion. This is also the case after calculation of the area under the curve and correction for folate ingested in the first 3 hours post matrix ingestion. The AUC calculation also showed that Sponge cake allows a better plasma bioavailability, within the first 3 hours following matric ingestion .
- ✓ Biscuit and Custard : lowest plasma PP levels; **28.9% difference in AUC 480 min (i.e. total availability) between Custard and Pudding**
- ✓ Plasma folate peak delayed with Biscuit

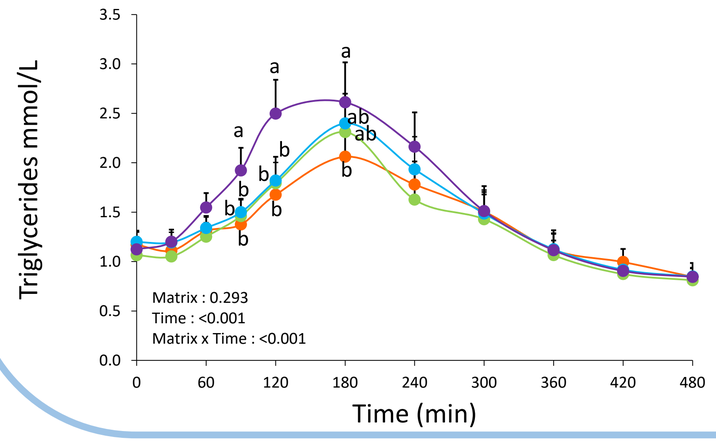
Macronutrients / hormones

Post prandial plasma Alpha Amino Nitrogen (mM)

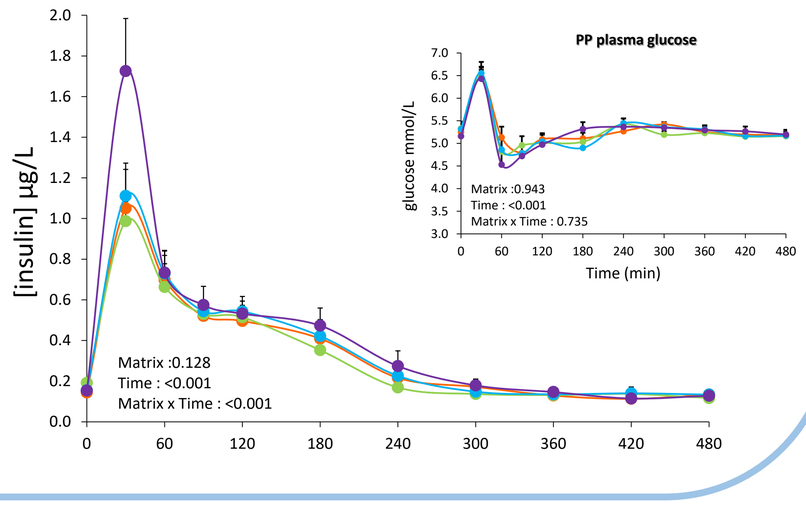


- ✓Different profiles observed compared to folates
- ✓Custard - higher insulin peak (30 min PP)
  - higher TG peak vs pudding, biscuit ans sponge cake
  - higher amino-N vs biscuit (not the case anymore when corrected for fasting level)

Post prandial plasma triglycerides (mmol/L)



Post prandial plasma insulin (µg/L)



Conclusion

- For macronutrients, Custard ingestion (liquid matrix) leads to the highest plasma levels, but it is not true for folates
- Matrix impacts greatly on overall folates availability : 28.9% difference between Biscuit and Pudding
- Folates levels in plasma post prandially are the consequence of different digestive/metabolic processes compared to what happens for amino nitrogen, triglycerides or glucose/insulin.

Custard :
Macronutrients (glucose, TG, amino N)
Rapidly available for digestion and absorption at duodenum/jejunum levels

Pudding and sponge cake :
Folates
- Specific interaction with diet components ?
- Is custard reaches too rapidely duodenum for an appropriate absorption of folates?
- Specific metabolism of folates / interaction with insulin ?