Protein ingredient quality and structure of infant formulas impact plasma amino acid kinetics in piglets

Lucile Chauvet, Alexy Brunel, Sylvie Guerin, Yann Le Gouar, Gwénaële Henry, Armelle Cahu, Didier Dupont, Marion Lemaire, Isabelle Luron Le Huërou-Luron, Amélie Deglaire

PROTEIN INGREDIENT QUALITY AND STRUCTURE OF INFANT FORMULAS IMPACT PLASMA AMINO ACID KINETICS IN PIGLETS

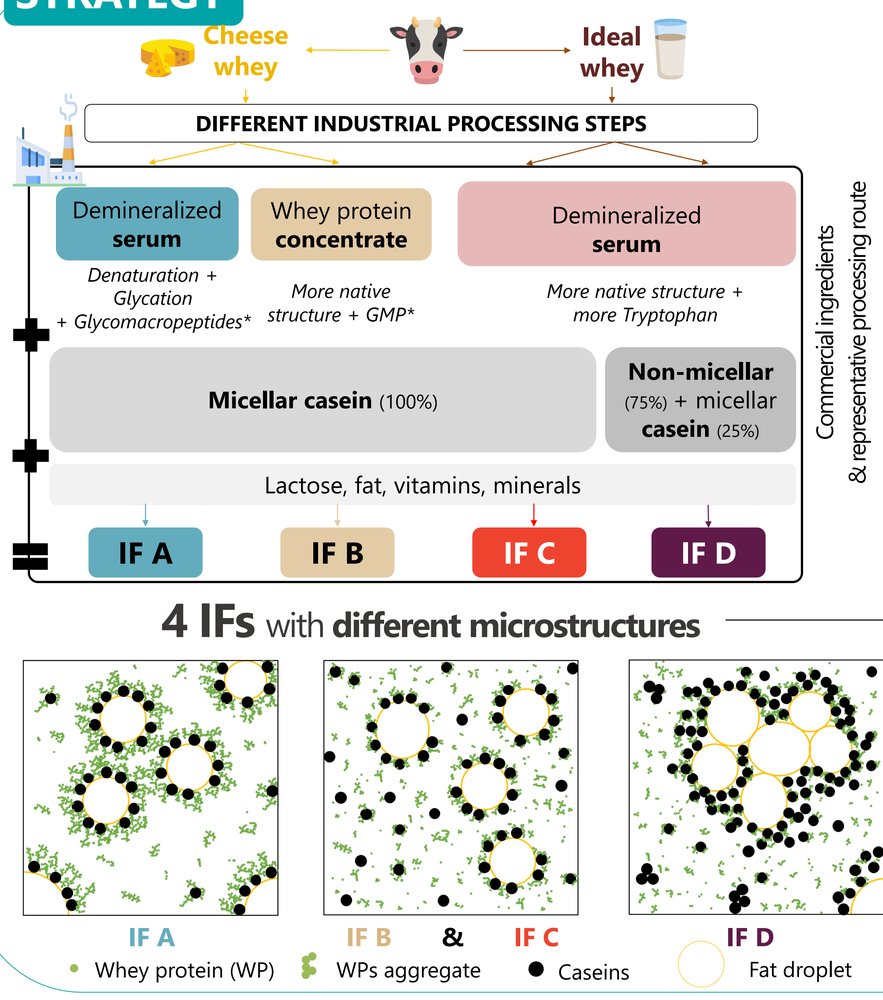
CHAUVET L.[1,2,3], BRUNEL A.[1], GUÉRIN S.[2], LE GOUAR Y.[1], HENRY G.[1], CAHU A.[2], DUPONT D.[1], LEMAIRE M.[3], LE HUËROU LURON I.[2], DEGLAIRE A.[1]

[1] UMR STLO, INRAE, Institut Agro-Rennes Angers, Rennes ; [2] SODIAAL International, Centre Recherche & Innovation, Rennes ; [3] Institut NuMeCan, INRAE, INSERM, Univ Rennes, Saint Gilles FRANCE

INTRODUCTION and OBJECTIVE

Infant formulas, the only **adequate substitute** to **human milk**, are complex matrices that require **numerous ingredients and processing steps.** The objective was to understand **how protein ingredient quality (structure** and **composition) within Infant milk Formulas** (IFs) **impacts plasma amino acid** (AA) **kinetics**.

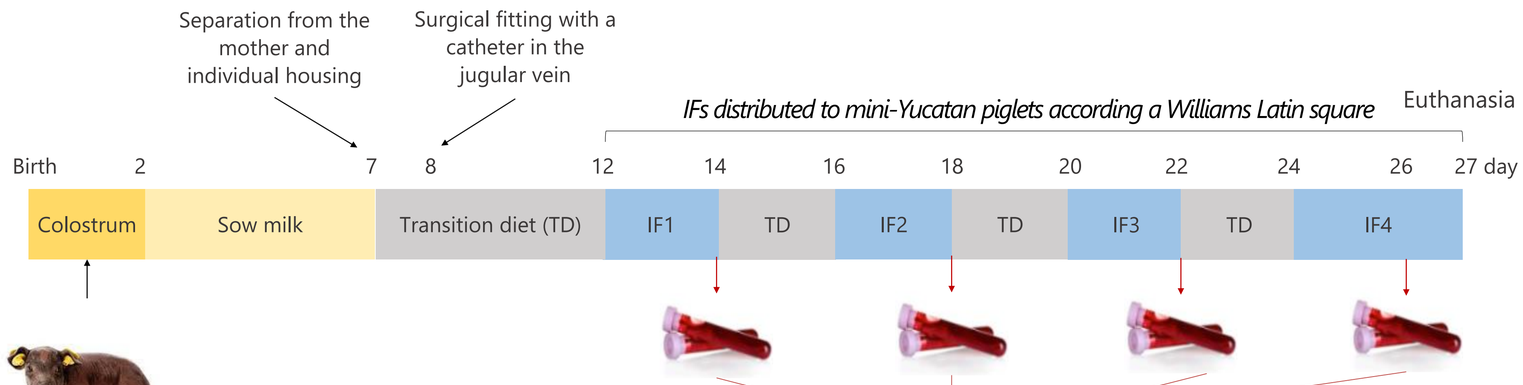
STRATEGY



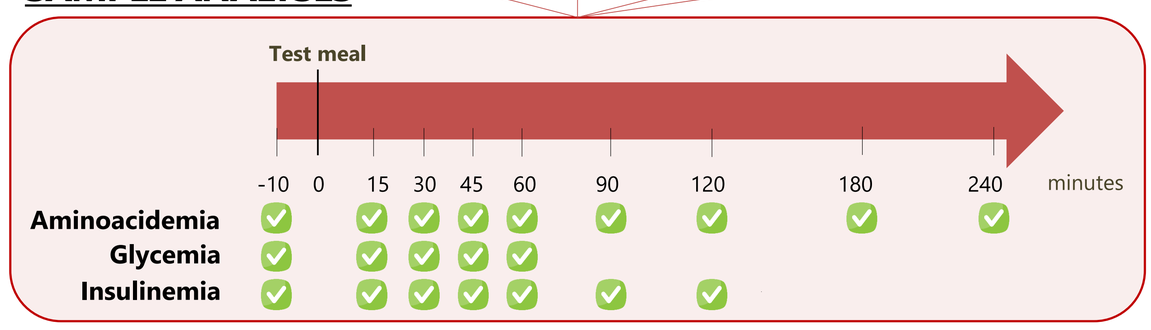
n = 10

4 IFs with different microstructures

EXPERIMENTAL PROTOCOL



SAMPLE ANALYSES



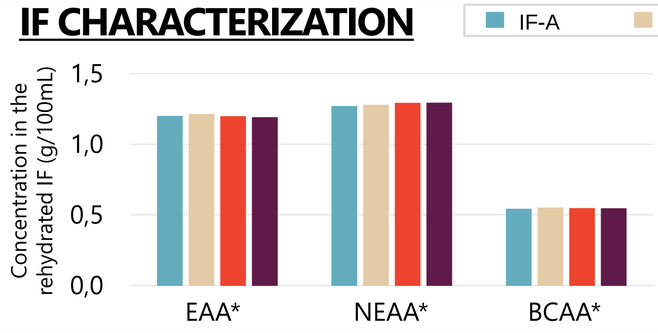
STATISTICAL ANALYSIS

Linear mixed model with *diet*, *time* and *gender* as fixed factors, and *piglet* as random factor.
The interaction between *diet* and *time* was included in the model.

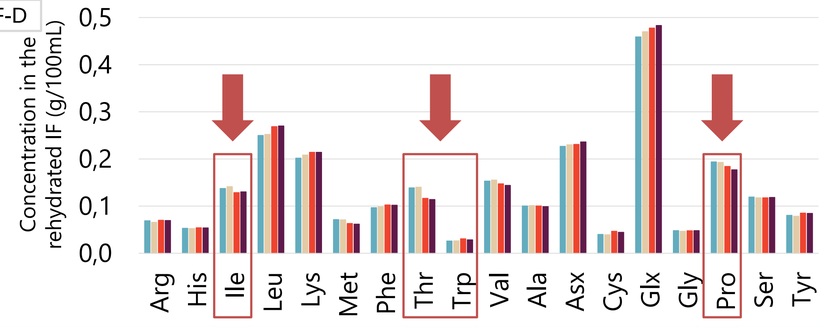
RESULTS

TAA : total amino acids, EAA : essential amino acids, NEAA : non-essential amino acids, BCAA : branched-chain amino acids, GMP : glycomacropeptide

IF CHARACTERIZATION



➞ Similar sum of **total**, **essential**, **non-essential** and **branched-chain AAs** among IFs.



Few individual differences related to the **fine protein composition** of IFs :

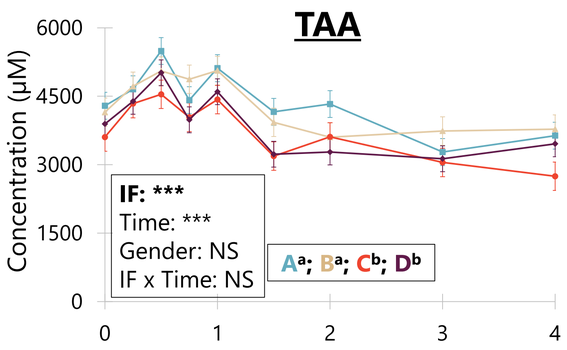
➞ **IFs-A and -B** = presence of **GMP (cheese whey)** = ↑ **Thr, Pro and Ile** contents

➞ **IFs-C and -D** = ↑ **α-lactalbumin** content = ↑ **Trp** content

PLASMA AMINO ACIDS

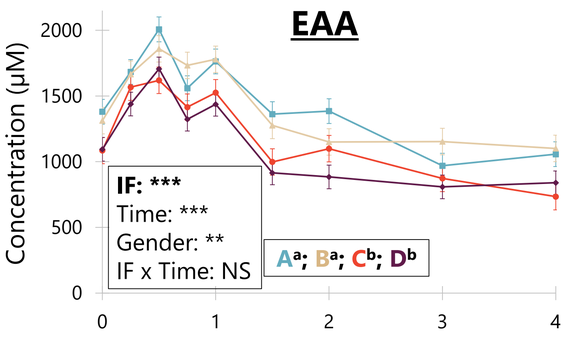
IF-A IF-B IF-C IF-D

TAA



Plasma TAA concentrations : IFs-**A** & **-B** > IFs-**C** (+17%) & **–D** (+12%) at both **preprandial** and **postprandial times**.

EAA



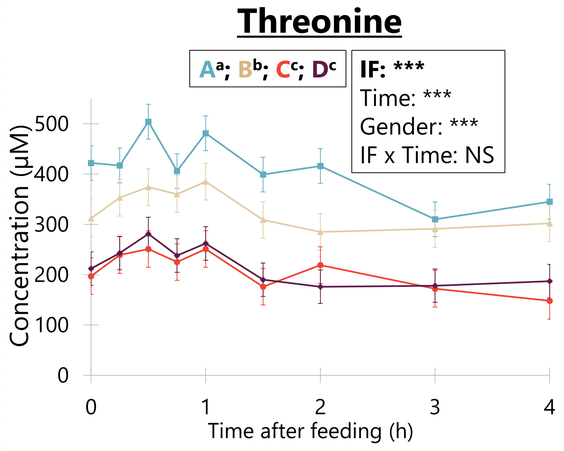
Plasma TAA differences are mainly due to the plasma EAA concentrations : IFs-**A** & **-B** > IFs-**C** (+20%) and **-D** (+26%)

Modifications since preprandial time
= **Modification of AA homeostasis**

Rapid metabolic adaptation after a 2-day period of IF consumption.

Major impact of the **AA profile of IFs**, related to the **whey origin**, on the **plasma concentrations** of individual AAs.

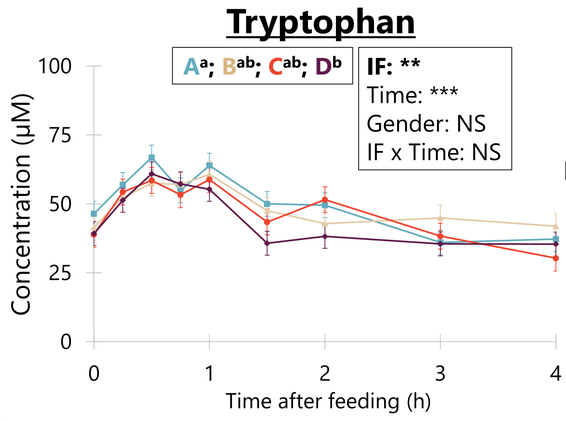
Threonine



↑ **dietary Thr** level (IFs-**A** and **-B**) + **limited Thr degradation enzyme capability** in piglets

= **modification of Thr homeostasis**

Tryptophan



Molar **Trp : Large neutral AAs** ratio

⬇

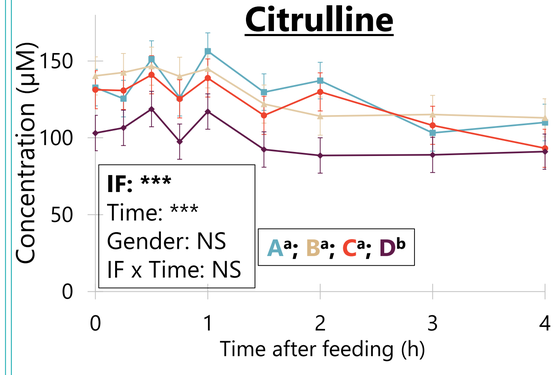
cheese whey > ideal whey
IFs-**A** & **-B** **1:37** IFs-**C** & **-D** **1:32**

⬇

IFs-**A** & **–B** = ↑ **competitive transport of Trp** through the blood brain barrier = ↑ **plasma Trp content**

OXIDATION PARAMETERS

Citrulline



➞ **Plasma AAs involved** in the **urea cycle** (Orn, Citr, Arg) : **IF-D** < IFs-**A**, **-B** & **-C**

➞ **Plasma 3-Mhis and urea** : IFs-**A** & **-D** < IFs-**B** & **-C** = in line with ↓ **endogenous proteolysis**

Oxidation seemed to be affected by IFs microstructure.

PLASMA GLUCOSE & INSULINE

No **difference in plasma glucose and insulin levels**

➞ Could be explained by the **similar levels in plasma BCAAs concentrations.**

CONCLUSION and PERSPECTIVE

- The quality of protein ingredient, and particularly **that of WPs**, **greatly influenced plasma AA patterns**, at both preprandial and postprandial times.
- **Homeostasis of many AAs was modified after a short adaptation period** and most of the differences observed preprandially explained the differences observed postprandially.
- The **origin of the WP ingredients** (cheese *vs.* ideal whey) resulted in the main **differences** in plasma AA levels **due to the presence or not of GMP**,
- The **modification of the casein supramolecular organization** resulted in few **modifications** of AA metabolism, except for **AA oxidation involved in the urea cycle.**

Whether these differences, with a similar or longer adaptation period**, impact the body protein metabolism remains to be investigated.**

Centre
Bretagne - Normandie

STLO SODIAAL numecan nutrition • métabolismes • cancer L'INSTITUT agro Rennes Angers