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# Presence of milk phospholipids and milk lipids modified the immunomodulatory properties of infant formula in neonatal pigs

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Research has been done to improve the nutritional and functional quality of infant formulas. Milk phospholipids and lipids have been associated with modulation of membrane properties and intestinal inflammation, but less is known on their effects on the development of gut physiology and immune system in neonates.

Three adapted formulas differing by the presence of either bovine milk phospholipids or milk lipids (F1: a standard-based formula; F2: F1 plus phospholipids; F3: F2 plus lipids) were distributed with an automatic milk feeder to 40 piglets until slaughter at 7 or 28 days of age. Intestinal contents and tissues (proximal jejunum and ileum) and mesenteric lymph nodes (MLN) were collected. The residual immunoreactivity of  $\beta$ -lactoglobulin ( $\beta$ -lg) and caseins (Cns) present in the digestive compartments was determined by ELISA. The paracellular permeability (using FITC-dextran 4000) was evaluated using Ussing chambers. Mononuclear cells have been isolated from MLN and cultured *in vitro* to evaluate their cytokine pattern.

The immunoreactivity of  $\beta$ -lg and Cns was higher in F3 than F1 or F2 digestas at both 7 d and 28 d, though the low concentration (less than 1% of intake). Ileal density (g/cm) was greater in F2 and F3-fed piglets at 28 d. The decreased jejunal permeability observed between d7 and d 28 in F3-fed piglets was not observed with F1 and F2. The secretory activity of MLN was modified by the formula composition, greater IFN $\gamma$  and lower IL-10 secretion in F3-fed piglets. Finally, the immunomodulatory capacity of the protein and lipid fractions extracted from jejunal digestas of F1 and F3-fed piglets were tested *in vitro* on naïve MLN. A major immunosuppressor effect of proteins extracted from F3 digestas was evidenced.

Variation in the formula composition induced modifications in the dynamic of protein hydrolysis that was associated with changes in their immunomodulatory activity.