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Neurodevelopmental benefits of combined human milk oligosaccharides and lactoferrin supplementation: evidence from *in vivo* magnetic resonance spectroscopy based metabolic profiling in piglets

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Human milk oligosaccharides (HMOs) are the third most abundant biomolecules in breast milk, with over 200 structural variants, mainly fucosylated, sialylated, and neutral core types. Key HMOs include 2′-fucosyllactose (2′-FL), and 3′/6′-sialyllactose (3′/6′-SL), which enhance brain development in animal models(1). Lactoferrin (Lf), a sialylated glycoprotein, also supports neurodevelopment by promoting neurogenesis and reducing neuroinflammation(2). However, the combined effects of HMOs and Lf on brain metabolism remain unknown. We therefore investigated their synergy on brain metabolites and neurotransmitters in neonatal piglets using *in vivo* ^{1}H-MRS. Three-day-old male domestic piglets (*Sus scrofa* – Large White × Duroc × Belgian Landrace) were randomly assigned to one of three groups and fed a standard pig milk replacer with the following supplements: control (methyl cellulose at 1.8 g/L; n = 14), combined HMOs (70% 2′-FL and 30% 3′-SL:6′-SL in a 1:2.5 ratio at 1.8 g/L; n = 16), or cHMOs + Lf (cHMOs at 1.8 g/L + lactoferrin at 0.5 g/L; n = 14). *In vivo* ^{1}H-MRS was performed on postnatal day 38/39 using a 3T scanner (TE = 30 ms) to assess regional brain metabolite profiles. The research protocol was approved by the ACECs of Charles Sturt University (A23566) and Monash University (38776). Our results demonstrated that the group received combined HMOs and Lf exhibited significantly higher absolute levels of total lipids and macromolecules, along with increased relative concentrations of glutathione (Glth), total creatine (TCr), total choline (TCh), and total lipids and macromolecules at 2.0 ppm (TLM20) ($p < 0.05$). In contrast, the cHMOs group were observed to have significantly increased levels of absolute total N-acetylaspartate (TNAA) ($p < 0.05$). Collectively, these findings suggest that combined HMOs and lactoferrin supplementation may synergistically support neurodevelopment by enhancing lipid mobilization, energy metabolism, and antioxidant capacity, while cHMOs alone promotes brain development by improving neuronal integrity and synaptic activity in piglets—a translational model for human infants. To our knowledge, these findings have not been previously reported.

References

1. Wang B, Yu B, Karim M, *et al.* (2007) *Am J Clin Nutr* **85**(2), 561–569.
2. Chen Y, Zheng Z, Zhu X, *et al.* (2015) *Mol Neurobiol* **52**(1), 256–269.

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