THE EFFECTS OF FRUCTOOLIGOSACCHARIDE AND GALACTOOLIGOSACCHARIDE SUPPLEMENTATION ON IMMUNE ACTIVITY IN WISTAR RATS

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ABSTRACT

Currently, there is controversy over the potential benefits of fermentable carbohydrate (prebiotic) supplements presently being added to infant formula. Two of the most commonly used prebiotic supplements are fructooligosaccharides (FOS) and galactooligosaccharides (GOS). It has been proposed that when these two prebiotics are added to formula, they promote the growth of bifidobacteria and lactobacilli in the infant gut, ultimately fostering a microbial and immunological environment similar to that which results from ingesting human milk oligosaccharides. In order to determine whether these dietary interventions result in a permanent impact on the immune system, two cohorts of Wistar rats each ingested either FOS, GOS or a control diet for 10 days in early infancy. Systemic and mucosal immune tissues were collected from these rats at 16 or 70 days of age and were subsequently examined to compare cytokine and chemokines concentrations, key markers of immunological activity. The findings resulting from this study indicated differences in immune activity between sexes, but did not demonstrate a benefit of FOS or GOS feeding during infancy on the immune system.

INTRODUCTION

- Breastfed infants possess a number of health advantages relative to formula fed infants[4].
- Human milk oligosaccharides (HMOs), which act as prebiotics[11], appear to foster healthy gut and immune system development[9].
- FOS and GOS are potential HMO supplements, currently being added to infant formula[6], however, the benefits of these prebiotics are widely debated.
- Recent research has also suggested that there are sex-based differences in the processing of prebiotics, such as FOS[13].
- By examining the immunological responses during both acute and prolonged periods of FOS and GOS supplementation, it is possible to determine whether or not the immune system is impacted by dietary intervention during development.

Proposed Benefits of FOS & GOS Ingestion:

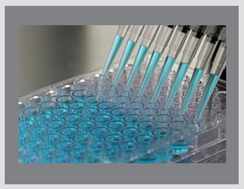
- ✓ Stimulates bifidobacterial growth[6]
- ✓ Immune benefits[10]
- ✓ Increased faecal SIgA concentrations[2, 12]
- ✓ Increased salivary SIgA[15]
- ✓ Resistance to allergy development[1, 5]
- ✓ Lowering intestinal pH[14]

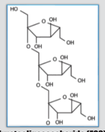
Proposed Dangers of FOS & GOS Ingestion:

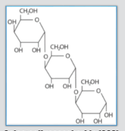
- ✗ Increased intestinal permeability, resulting in increased bacterial translocation[3]
- ✗ Increased systemic endotoxin presence[7]
- ✗ Increase in proinflammatory markers[15]
- ✗ Increased SIgA in the GI tract[9]

METHODS

1. Timed pregnant Wistar dams were acclimatized on AIN-93G chow.
2. Following partuition, 8 male rats and 8 female rats were segregated into treatment groups.
3. Infant Wistar rats were gavaged daily with a treatment from day 6 --> day 16. Treatments included:
   No gavage (control)
   Glucose (control)
   FOS
   GOS
4. Infant rats were weaned and received AIN-93G chow until day 70.
5. At necropsy, blood, systemic and mucosal tissues were collected. Tissues were homogenized, and cytokines/chemokines were measured by ELISA.







RESULTS

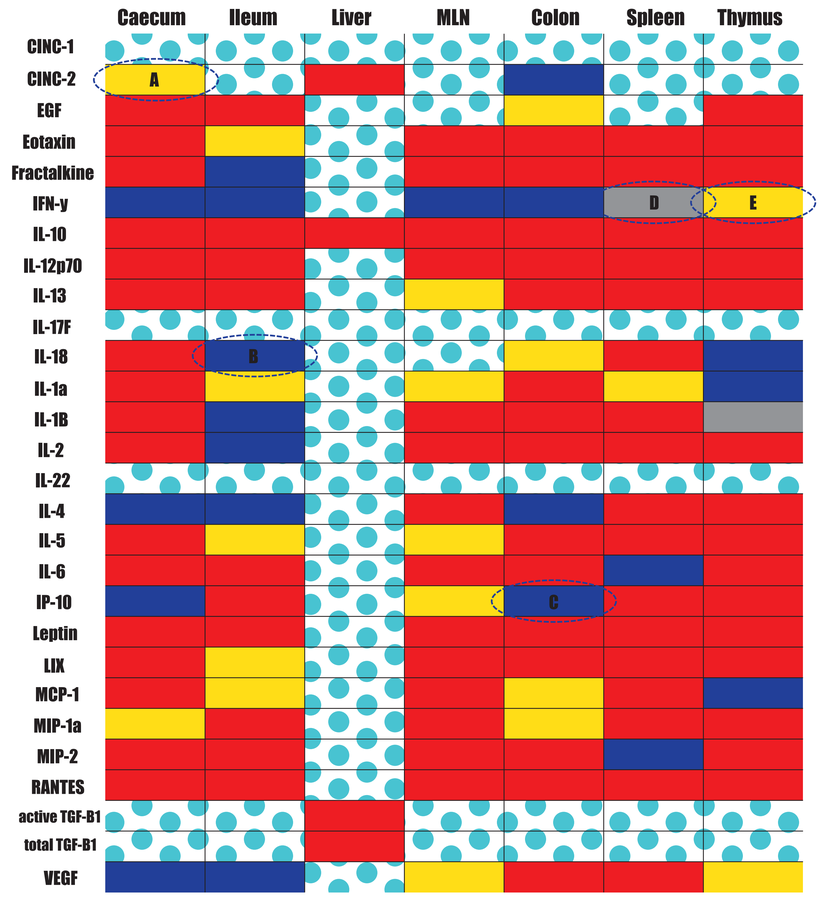


Figure 1. Cytokine/chemokine concentrations measured from tissue of 16-day-old rats gavaged with either a glucose control, FOS, GOS, or a no gavage control for 10 days during infancy . Significant differences between treatment groups and sex were determined using Tukey's multiple comparison test.

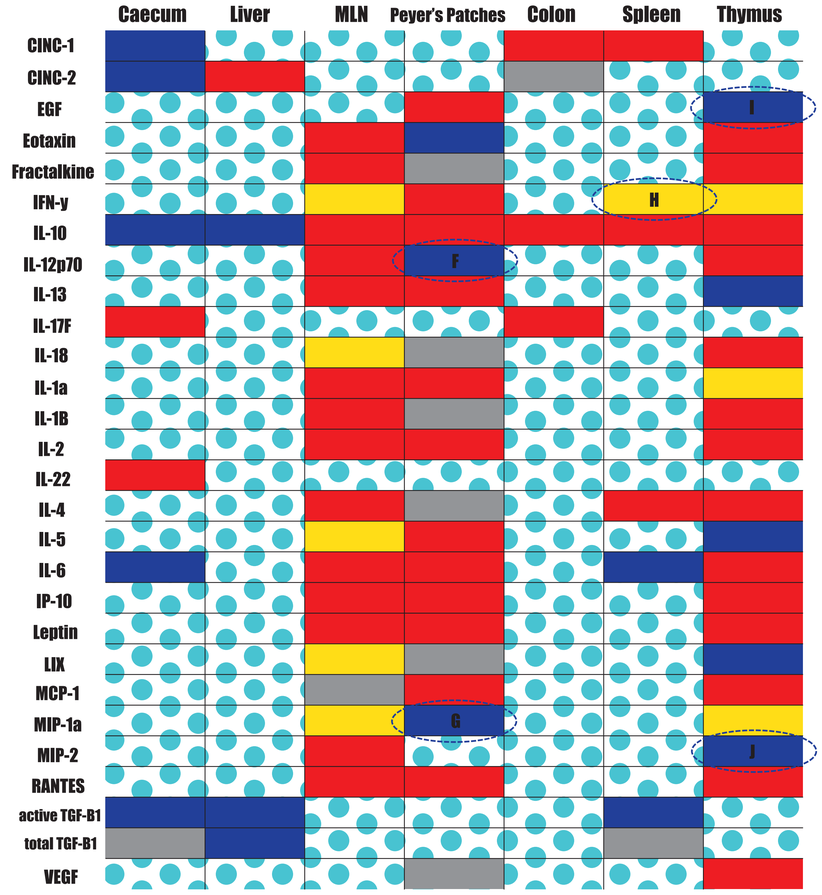
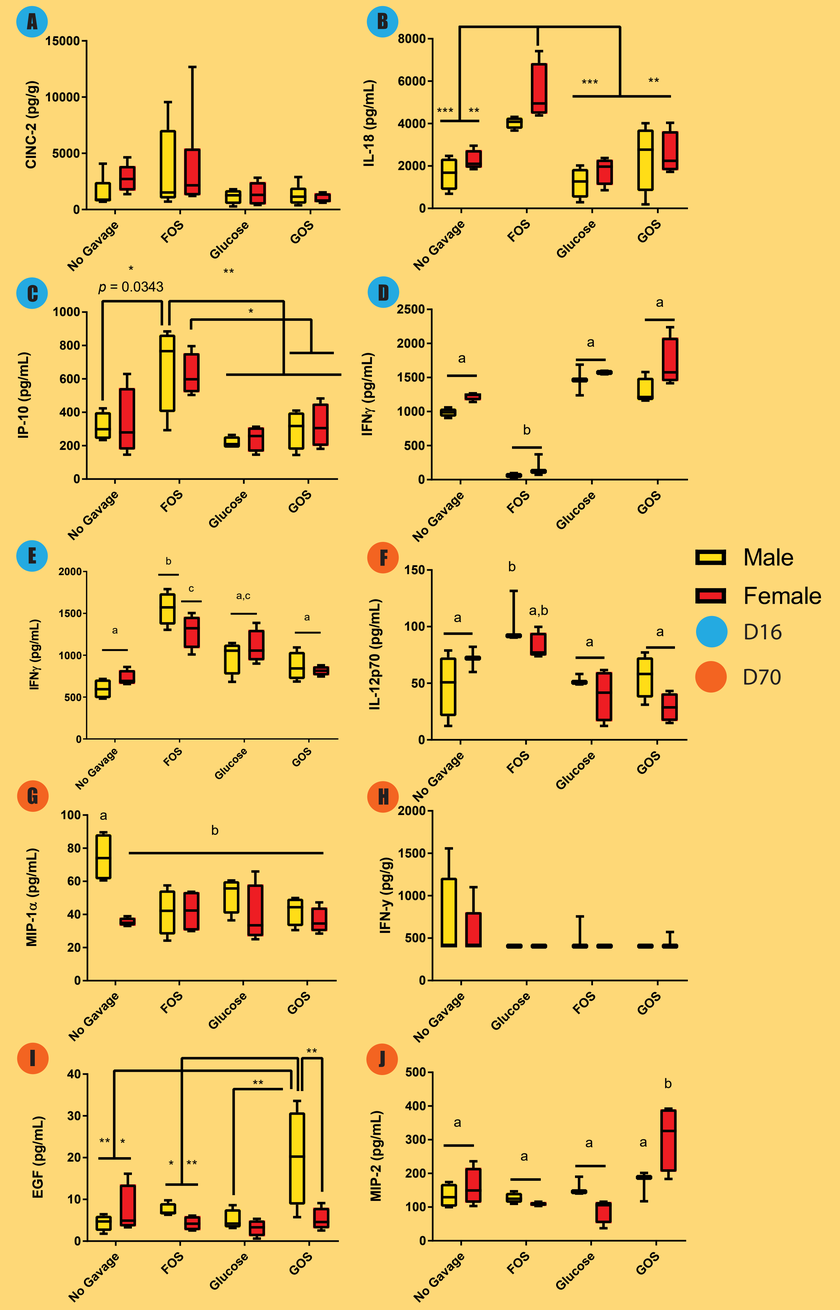


Figure 2. Cytokine/chemokine concentrations measured from tissue of 70-day-old rats gavaged with either a glucose control, FOS, GOS, or a no gavage control for 10 days during infancy . Significant differences between treatment groups and sex were determined using Tukey's multiple comparison test.

LEGEND

- Not investigated
- No significance
- Significant treatment-based difference
- Significant sex-based difference
- Significant diet-sex interaction



CONCLUSIONS

- Differential impacts of diet and sex on cytokine and chemokine profiles were observed mucosally and systemically.
- FOS- and GOS- supplemented diets had minimal impact on cytokine profiles in the tissues investigated from day 16 rats, while tissues from day 70 rats illustrated significant differences primarily linked to sex rather than diet, a finding in keeping with our earlier studies of FOS fed rats[14].
- **Overall:** changes in immune activity varied between systemic and mucosal tissue, suggesting that sex-based differences account for more effects than any dietary intervention tested.

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