2019 Issue 2

WNSC Hong Kong Bulletin

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Produced by:
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WYE-PM-135-APR-19

HEADLINE

Bovine milk oligosaccharides (BMOs) — An upcoming novel functional ingredient

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Mother's milk is a complex nutrient matrix, complemented with a range of biologically active components to meet the needs of the growing infant[1]. There has been much research interest in the oligosaccharide fraction of human milk in recent years, which is considered **an important part of innate immunity delivered from the mother to the newborn**[1]. For example, sialylated human milk oligosaccharides (HMOs), such as **3'-sialyllactose (3'-SL) and 6'-sialyllactose (6'-SL), may act locally in the gastrointestinal tract, reach the circulation and modulate the infant's immune system at a cellular level**[1].

Oligosaccharides derived from animals, plants or synthetic origins, are all considered to have prebiotic effects and impact on human health[2].

However, there is no structural similarity between HMOs and prebiotics such as galacto-oligosaccharides (GOS) and fructooligosaccharides (FOS), as well as a lack of studies to support comparable immune effects[2]. There has instead been discussion in the potential of employing oligosaccharides from other mammals' milk, such as bovine milk oligosaccharides (BMOs), as alternatives for HMOs[2]. **With chemical structures similar to HMOs, BMOs are suggested to have bioactivity and functional attributes alike**[3].

There are over 40 types of BMOs identified so far, of which 3'-SL is an acidic species usually present in higher abundance[3,4]. Although cow's milk is readily available in large volumes[2], most BMOs are only available at trace levels[4]. BMOs would be a better replacement for GOS and FOS if their concentrations can be significantly increased[4]. A recent study found BMOs were highly heritable with major gene effects, suggesting that targeted marker-assisted selection may lead to a significant increase in the production of BMOs[4]. Abundances of some BMOs were also found to vary by breeds and increase in second-parity cows[5].

Continued research like these can help to develop strategies to recover masses of BMOs from processing streams, enabling their use as a functional ingredient in foods and potentially mimicking HMO functions[2,5].

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FEATURED NEWS

Consuming fish during pregnancy — Opportunities and risks

Emily Tai PhD, Mphil, MSc, BSc (Hons)

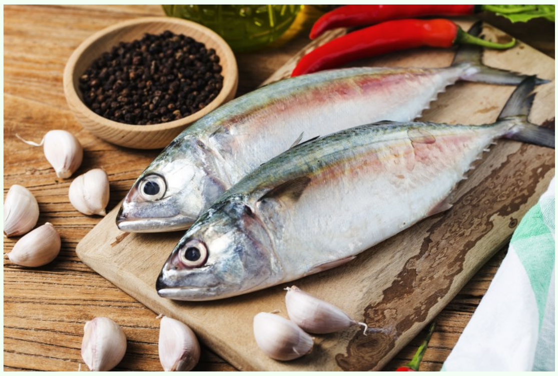
A recent report on sashimi issued by the Consumer Council alerted the public to the risks of consuming raw seafood. Methylmercury was detected in 98% (49 out of 50) samples whereas 10 out of 19 tuna samples contained methylmercury exceeding the statutory limit for mercury level in Hong Kong by almost twofold[1]. In addition, 2 samples (tuna and salmon) had roundworm and worm eggs were also noted in the tuna sample[1].

Although National Health Services (NHS) stated it is usually safe to consume sushi and other dishes made with raw fish during pregnancy, it would depend on what fish the sushi is made from and it is important to ensure it has been frozen first[2]. Seafood including fish and shellfish is part of a health diet and provides vital nutrients like protein, iodine and DHA[3]. Maternal fish intake during pregnancy was associated with benefits on child neurodevelopment and congenital gastrointestinal tract atresia[4,5]. US FDA recommendations would help to make a wiser fish choice (Table 1).

DHA, a key nutrient in fish, has been studied widely and 600 mg supplementation in the last half of pregnancy reduced early preterm (< 34 weeks) and very-low birth weight (< 1500 g) versus control group[6]. Follow-up studies furthermore suggested desirable influences on child health and development[7,8]. Children of supplemented mothers maintained high level of sustained attention (SA) across the first year of life whereas SA decreased in the control group[7].

In a newly published analysis including 171 children, there was **significant interaction between prenatal DHA treatment and child BMI status for both systolic blood pressure (SBP) and diastolic blood pressure (DBP)** (p = 0.04 for SBP; p = 0.01 for DBP)[8]. Overweight or obese children whose mothers received 600 mg DHA supplementation during pregnancy showed lower SBP and DBP versus children whose mothers in the control group (SBP, 100.34 mm Hg vs 104.28 mm Hg; DBP, 59.76 mm Hg vs 64.70 mm Hg)[8]. Maternal DHA intake may program a healthier generation.

Table 1. US FDA recommendations on fish consumption[3]

Target Audiences: • Women of childbearing age (~16-49 years), especially pregnant and lactating women • Parents and caregivers of young children	**What is A Serving?** • Approximate to the palm of your hand • E.g. 4 ounces for an adult • E.g. 2 ounces for a child aged 4 to 7 years 
Recommendations: • Eat 2 to 3 servings of fish weekly from the "**Best Choices**" list or 1 serving from the "**Good Choices**" list • Eat a variety of fish • Serve 1 to 2 servings of fish weekly to children, starting at age 2 • For fish caught by family or friends, check for fish advisories. Eat only 1 serving and no other fish that week if there is no advisory	
Best Choices: Anchovy, Atlantic croaker, Atlantic mackerel, Black sea bass, Butterfish, Catfish, Clam, Cod, Crab, Crawfish, Flounder, Haddock, Hake, Herring, Lobster, American and spiny, Mullet, Oyster, Pacific chub, mackerel	
Good Choices: Bluefish, Buffalofish, Carp, Chilean sea bass, Patagonian toothfish, Grouper, Halibut, Mahi mahi/Dolphinfish, Monkfish, Rockfish, Sablefish, Sheepshead, Snapper, Spanish mackerel, Striped bass (Ocean), Tilefish (Atlantic Ocean), Tuna (albacore/white), Tuna (canned and fresh/frozen), Tuna (yellowfin), Weakfish/Seatrout, White croaker/Pacific croaker	**Choices to AVOID [HIGHEST mercury level!]:** King mackerel, Marin, Orange roughy, Sharp, Swordfish, Tilefish (Gulf of Mexico), Bigeye Tuna

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LATEST SCIENCE

Shaping the gut microbiota within the "window of opportunity"

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Our story with the gut microbes dates back to the first 1000 days of life, or the "window of opportunity", in which **an array of pre- and post-natal factors altogether drove the assembly and stabilization of the new gut microbiome[1] (Figure 1).**

Pregnancy (Day 0 – 270)

Starting from conception, gestational risk factors such as inappropriate weight gain, diet and BMI may already be shaping the mother's microbiota as well as the initial microbial phenotype *in utero*[2]. The subsequent microbial alterations in the soon newborn, say, the depletion of *Bacteroides* due to a high-fat maternal diet, may predispose the young infant to metabolic diseases (e.g. obesity and NAFLD) and immune diseases (e.g. asthma and allergy) later in life[3].

Infancy (Day 270 – 450)

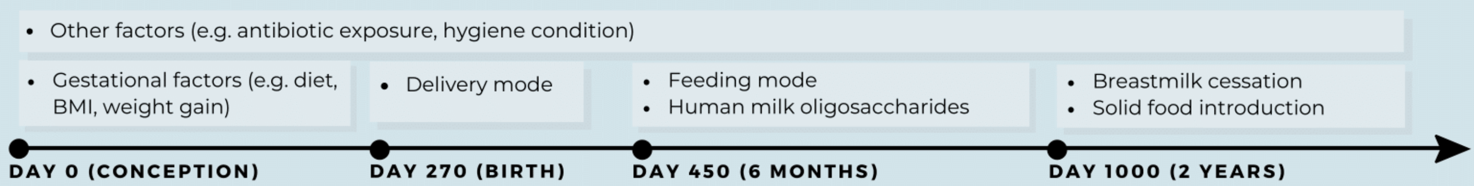
Shortly after birth, microbes from the external begin their colonization. While caesarean section has been linked to neonatal gut dysbiosis, **recent studies reported that such disturbance could be partially corrected by breastfeeding even just for the first month of life[4].** Human milk oligosaccharides (HMOs) also favor the fermentative production of short-chain fatty acids by *Bifidobacteria*, thus, help direct the microflora towards immune maturation and allergy prevention via the induction of T cells[5].

Childhood (Day 450 - 1000)

As the baby grows, breastmilk cessation and solid food introduction trigger the decreased abundance of early-dominating species[6] and the transition to a more adult-like diversity[7]. Notably, microbiota transfer therapy has been reported to improve autism-related symptoms in children which remarkably persisted through 2 years after treatment[8]. Other determinants, counting antibiotic exposure and poor hygiene condition, may contribute to undernutrition of both the microbiota and its host[9].

As emerging evidence continues to **connect early-life microbial changes to lifelong and intergenerational shortfall in pediatric growth and development**, further research is necessary for the application of such knowledge in clinical practices.

FIGURE 1. FACTORS INFLUENCING GUT MICROBIOTA WITHIN THE FIRST 1000 DAYS OF LIFE



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