AIS SPORTS SUPPLEMENT FRAMEWORK

PREBIOTICS

It is now well established that acute and chronic exercise perturbs various aspects of an athlete's gastrointestinal tract (e.g. exercise-induced gastrointestinal syndrome (EIGS) and subsequent exercise-associated gastrointestinal symptoms (Ex-GIS)).[1] It has been proposed that prebiotic supplements may prevent or mitigate these perturbations.[2,3]

What does it do?

- A **prebiotic** is defined as 'a substrate that is selectively utilised by host microorganisms conferring a health benefit'.[4] Dietary and/or supplementary prebiotics may include **non-digestible and/or non-absorbed material that can be fermented** by bacteria in the lower gastrointestinal tract and result in metabolic by-products (e.g., short chain fatty acids (SCFA: acetate, butyrate, and propionate)) that have been shown to present beneficial local gastrointestinal and internal systemic physiological effects.[5-8]

What does it look like?

- Prebiotic dietary sources include foods and products that contain one or more concentrated extracts: Fructo-oligosaccharides (FOS), galacto-oligosaccharides (GOS), soybean-oligosaccharides, mannan-oligosaccharides, xylo-oligosaccharides, inulin, partially hydrolysed guar gum, lactulose, and resistant starches (types 1, 2, 3, and 4). In addition, monosaccharides, especially fructose (in excess of glucose), which is liable to bacterial fermentation if unabsorbed, resulting in similar metabolic by-products.
- The ability for the gastrointestinal microbial population to ferment unabsorbed highly fermentable short-chain carbohydrates (i.e. fermentable oligo- di- mono-saccharides and polyols (FODMAPs)) and increase luminal and/or systemic SCFA concentration, categorises FODMAPs as prebiotics.[4,5]
- The doses used in studies demonstrating a significant alteration in gastrointestinal microbial composition and metabolic by-product, vary greatly and are individual-microbiome dependent.[2,3,9,10]

Table 1. Example of practical guidance to increase prebiotic of diet.

	Good standard meal	Improved prebiotic content
Breakfast	Porridge: rolled oats, quinoa flakes, walnuts, cranberries, and raisins.	Porridge: rolled oats, quinoa flakes, raisins, dried apricots, prunes, dried apples, and skimmed milk powder.
Lunch	Soup content: Capsicum, zucchini, carrot, egg white, water, herbs and spices Bread: White spelt.	Soup content: onion, sweet potato, garlic, barley, leek, cauliflower, butter beans, egg white, water, herbs & spices). Bread: Whole wheat flour with wholegrains
Dinner	Standard pasta. Pasta sauce: canned tomatoes, spring onions, eggplant, carrots, with lean beef or alternatives.	Wholegrain pasta. Pasta sauce: canned tomatoes, red onions, garlic, mushrooms, sweet potato, with soya-based texture vegetable protein or mycoprotein granules/mince.
Snacks	Low FODMAP fruits and/or breads from white spelt.	High FODMAP fruits and/or breads from wholegrains.

Note: Some foods and beverages have more potent fermentable properties (i.e., FODMAPS, fibres, and resistant starches) than other. Adjustments need to be made in accordance with each individual athlete's tolerance (i.e. inclusion that does not exacerbate gastrointestinal symptoms). Adapted from [11,12].

How and when do I use it?

- For general health benefits…
    - Most human studies evaluating the effects of prebiotics from a broader health perspective have explored effects on the composition of the gastrointestinal microbiota. These studies report significant increases in *Bifidobacterium* and to a lesser-degree *Lactobacillus, Faecalibacterium prausnitzi*, *Roseburia,* and *Eubacterium spp* and their by-products. The main prebiotics researched are fructo-oligosaccharides (FOS), galacto-oligosaccharides (GOS), lactulose, and partially-hydrolysed guar gum. Administration of lactulose or oligofructose-enriched inulin has been found to reduce beta-glucuronidase activity (protective against colon cancer).
    - Generally increasing fruit, vegetable, wholegrains, pulses, and/or low fat dairy options in every meal and snack will likely allow to reach the minimal effective prebiotic dose.

- For exercise associated benefits…
    - Two to eight weeks (~ 4-11 g/day) with prebiotic supplementations (e.g. resistant starches, fructooligosaccharides (FOS) and/or galactooligosaccharides (GOS)) appears to alter the gastrointestinal microbial composition, particularly increasing the absolute and relative abundance of commensal bacteria, and subsequent fecal SCFA concentration at rest in active populations.[2]
    - Eight weeks prebiotic supplementation intervention (i.e. 16 g/day; fructooligosaccharides, galactooligosaccharides, resistant start, and dietary fibre formulation), before a 3 h exertional-heat stress experimental protocol, resulted in a noticeable reduction in intestinal epithelial injury and luminal to systemic bacterial endotoxin translocation, but had no impact on attenuating systemic inflammatory response and did not influence gastrointestinal functional responses.[3] Supplementation did not enhance Ex-GIS. Eight weeks prebiotic supplementation increase α-diversity and relative abundance of commensal bacteria (e.g. *Ruminococcaceae*) vs placebo, but did not increase faecal SCFA concentration. Prebiotic may be creating other local bacterial metabolic changes outside SCFA that appear protective.
    - A 24h prebiotic type high (~47 g/day) FODMAP diet (including a high lactose and fructose in excess of glucose load) increases relative abundance of commensal bacterial and faecal + plasma SFCA, which may have supported the attenuated exercise associated intestinal epithelial injury and luminal pathogenic translocation seen after 2 h of exertional-heat stress, compared with a 24 h low prebiotic (~2 g/day) FODMAP diet.[9,11]
    - Lowering prebiotic dietary content up to 48 h before reduces Ex-GIS severity, but at the expense of potentially causing greater disturbance to gastrointestinal integrity.[11,12]
    - Consuming 16 g/day (8 g in AM and PM) of a prebiotic nutritional supplement containing soluble fibre from guar gum, inulin-type fructan, green banana and sweet potato resistant starch, and dairy based β-GOS, will reach the minimal effective prebiotic dose linked with changes in commensal bacterial profile in faecal samples and corresponding mitigation of EIGS, without exacerbating Ex-GIS[3].

Prescription

Practitioners are advised to implement a method of tracking GI symptoms when changing the prebiotic composition of an athlete's diet or introducing prebiotic supplements in order to provide an objective assessment of changes.

- **What:** Food-based sources of FODMAPS, inulin, lactulose and/or partially hydrolysed guar gum
- **When:** Daily, with particular attention to ensuring adequate amounts ahead of potential heat-stress inducing endurance events.
- **How much:** 4-12g/day
- See Table 1 above regarding examples of modifications which could be made to the athlete's diet to increase prebiotic content.

Are there any concerns or considerations?

- To date only one study has investigated the effects of a specifically formulated prebiotic supplement blend on markers of gastrointestinal status in response to exercise, including the gut microbiome and SCFA.[3] However, several laboratory-controlled studies and professional practice cases have explored the role of prebiotic high FODMAP diet on markers of gastrointestinal status, with positive outcomes.[11,12]
- All current studies have shown some modest beneficial effects on markers of gastrointestinal integrity, and no detrimental effects. Negative outcomes have been only seen with greater Ex-GIS severity with higher prebiotic intake.[2,3,11,12]
- Current studies have followed the best practice recommendations for exercise gastroenterology research.[18]

Where can I find more information?

Sports Dietitians Australia	www.**sportsdietitians.com.au**
Batch tested products list	https://www.informed-sport.com/ https://hasta.org.au/
Supplement safety information	www.sportintegrity.gov.au/what-we-do/anti-doping/supplements-sport

References

1. Costa, R.J.S., Snipe, R.M.J., Kitic, C., Gibson, P., (2017). Systematic review: Exercise-induced gastrointestinal syndrome- Implication for health and disease. Alimentary & Pharmacology Therapeutics, 46(3):246-265.
2. Rauch, C.E., Mika, A.S., McCubbin, A.J., Huschtscha, Z, Costa, R.J.S. (2022). Effect of prebiotics, probiotics, and synbiotics on gastrointestinal outcomes in healthy adults and active adults at rest and in response to exercise-a systematic literature review. Frontiers in Nutrition, 9:1003620.
3. Rauch, C., Henningsen, K., Martinez, I., Young, P., Mika, A., Huschtscha, Z., McCubbin, A., Henry, R., Anderson, D., Costa, R.J.S. (2025). The effects of prebiotic supplementation on markers of exercise-induced gastrointestinal syndrome in response to exertional-heat stress. International Journal of Sports Nutrition & Exercise Metabolism, Feb 25:1-18. doi: 10.1123/ijsnem.2024-0127.
4. Gibson, G.R., Hutkin, R., Sanders, M.E., Prescott, S.L., Reimer, R.A., Salminen, S.J., Scott, K., Stanton, C., Swanson, K.S., Cano, P.D., Verbeke, K., Reid, G. (2017). The International Scientific Association of Probiotics and prebiotics (ISAPP) consensus statement on the definition and scope of prebiotics. Nature Reviews- Gastroenterology & Hepatology, 14: 491-502.
5. Gibson, P.R., Halmos, E.P., Muir, J.G. (2020). Review article: FODMAPS, prebiotics and gut health-the FODMAP hypothesis revisited. Alimentary and Pharmacology Therapeutics, 52(2): 233-246.
6. Gurunathan, S., Thangaraj, P., Kim, J.H. (2023). Postbiotics: Functional food materials and therapeutic agents for cancer, diabetes, and inflammatory diseases. Foods,13(1): 89.
7. Salminen, S., Collado, M.C., Endo, A., Hill, C., Lebeer, S., Quigley, E.M.M., Sanders, M.E., Shamir, R., Swann, J.R., Szajewska, H., Vinderola, G. (2021). The International Scientific Association of Probiotics and prebiotics (ISAPP) consensus statement on the definition and scope of postbiotics. Nature Reviews-Gastroenterology & Hepatology, 18: 649-667.
8. Thorakkattu, P., Khanashyam, A,C., Shah,K., Babu, K.S., Mundanat, A.S., Deliephan, A., Doekar, G.S., Santivarangkna, C., Nirmal, N.P. (2022. Postbiotics: Current trends in food and pharmaceutical industry. Food, 11(9):3094.
9. Gaskell, S.K., Henningsen,K., Young, P., Gill, P., Muir, J., Henry, R., Costa, R.J.S. (2023). The impact of a 24-h low and high fermentable oligo- di- mono-saccharide and polyol (FODMAP) diet on plasma bacterial profile in response to exertional-heat stress. Nutrients, 10.3390/nu15153376.
10. Young, P., Russo, I, Gill, P., Muir, J., Henry, R., Davidson, Z., Costa, R.J.S., (2023). Reliability of pathophysiological markers reflective of exercise-induced gastrointestinal syndrome (EIGS) in response

to prolonged strenuous exercise: A comprehensive methodological efficacy exploration. Frontiers in Physiology, 14:1063335.

11. Gaskell, S.K., Taylor, B., Muir, J., Costa, R.J.S., (2020). Impact of 24-hour low and high fermentable oligo- di- mono- saccharide polyol diets on markers of exercise-induced gastrointestinal syndrome in response to exertional-heat stress. Applied Physiology Nutritition and.Metabolism, 45(6):569-580.
12. Scrivin, R., Slater, G., Mika, A., Rauch, C., Young, P., Martinez, I.G., Costa, R.J.S. (2024). The impact of 48-h high carbohydrate diets with high and low FODMAP content on gastrointestinal status and symptoms in response to endurance exercise, and subsequent endurance performance. Applied Physiology Nutrition and.Metabolism, 49(6):773-791.
13. Gaskell, S.K., Rauch, C.E., Costa, R.J.S. (2021). Gastrointestinal Assessment and Therapeutic Intervention for the Management of Exercise-Associated Gastrointestinal Symptoms: A Case Series Translational and Professional Practice Approach. Frontiers in Physiology, 12:719142.
14. Scrivin, R., Slater, G., Costa, R.J.S. (2024). Case series: management of exercise-associated gastrointestinal symptoms in endurance athletes using a high carbohydrate low FODMAP therapeutic intervention. In review.
15. Bennett, C., Snipe, R., Henry, R., Costa, R.J.S. (2020). Is the gut microbiota bacterial abundance and composition associated with intestinal epithelial injury, systemic inflammatory profile, and gastrointestinal symptoms in response to exertional-heat stress? Journal of Science and Medicine in Sport. 23(12): 1141-1153.
16. de Vos, W.M., Tilg, H., Van Hul, M., Cani, P.D. (2022). Gut microbiome and health: mechanistic insights. Gut, 71(5):1020-1032.
17. Martin-Gallausiaux, C., Marinelli, L., Blottiere, H., Larraufie, P., Lapaque, N. (2021. SCFA: Mechanisms and functional important in the gut. Proceedings of the Nutritional Society, 80(1):37-49.
18. Costa, R.J.S., Gill, S.K., Snipe, R.M.J., Gaskell, S.K., Russo, I., Burke, L.M., (2022). Assessment of exercise-associated gastrointestinal perturbations in research and practical settings: Methodological concerns and recommendations for better practice. International Journal of Sport Nutrition and Exercise Metabolism, 32(5): 387-418

The Australian Institute of Sport (AIS) Supplement Framework is an initiative of the Australian High Performance Sport System. The AIS acknowledges the support of members of the National Institute Network (NIN) and National Sporting Organisations (NSO) and their staff in delivering content expertise. This information is intended to help athletes, coaches and scientists make evidence-based decisions about the use of supplements and sports foods. Before engaging in supplement use, we recommend that each individual refer to the specific supplement policies of their sporting organisation, sports institute or parent body, and seek appropriate professional advice from an accredited sports dietitian (https://www.sportsdietitians.com.au/).

Athletes should be aware that the use of supplements may have anti-doping implications. Athletes are reminded that they are responsible for all substances that enter their body under the 'strict liability' rules of the World Anti-Doping Code. We recommend that all athletes consult the advice of Sport Integrity Australia (SIA) regarding contamination issues related to supplements and sports foods. The ASADA Clean Sport mobile app is also a useful resource to help mitigate the risk of inadvertent doping via supplement use by helping to identify supplements that have been independently verified to be free of WADA banned substances. (https://www.sportintegrity.gov.au/what-we-do/supplements-sport)

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