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Hexa-acylated lipopolysaccharide (hexa LPS)

Pro-inflammatory microbial components

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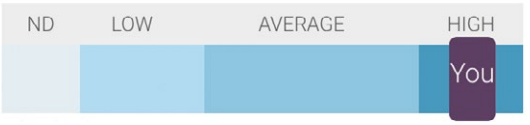
Metabolite overview

Interpretation

Hexa-acylated lipopolysaccharide production

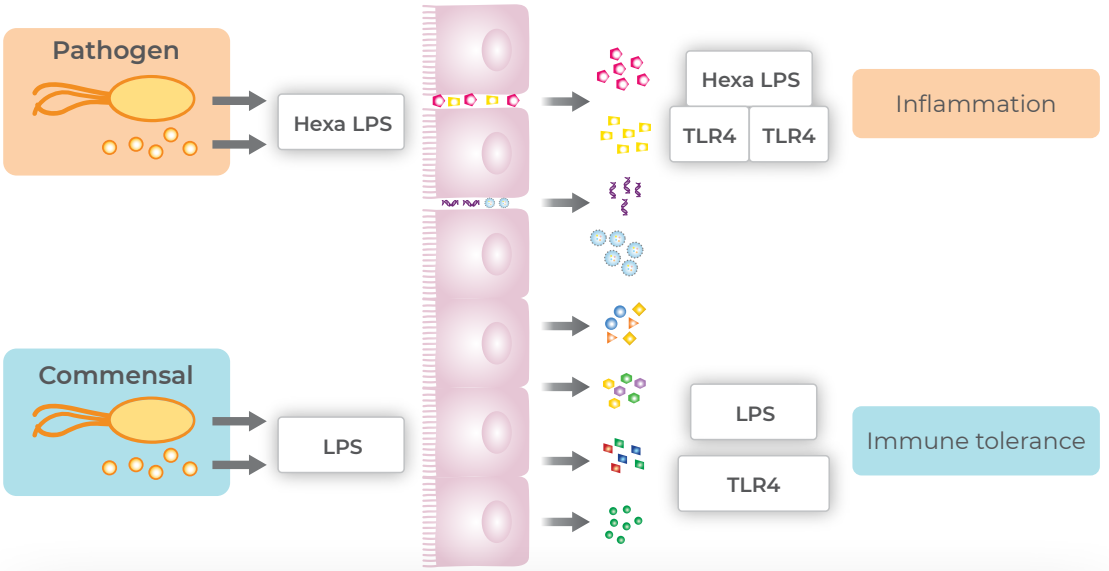


A high potential to produce hexa- acylated lipopolysaccharide is associated with immune activation and systemic inflammation.

Clinical relevance

Inflammation
Obesity
Heart disease
Type 2 diabetes
Non-alcoholic fatty liver disease
Alzheimer's disease

Mechanism



The immune system recognizses bacterial LPS to distinguish between invading pathogens and harmless commensal bacteria.

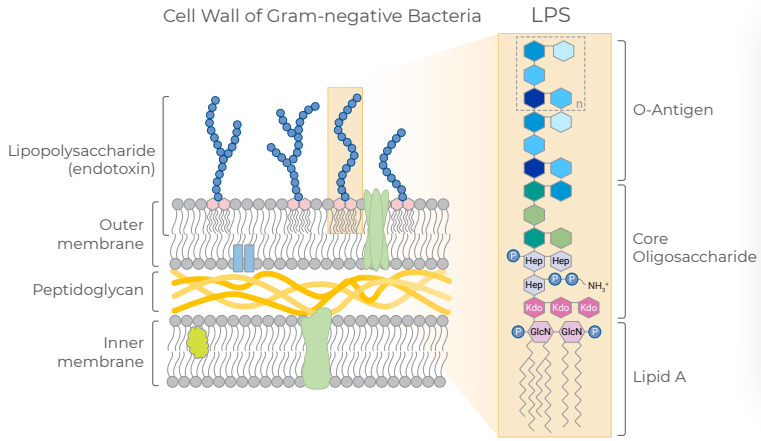
Hexa- LPS that crosses the gut barrier can trigger inflammation.

Intervention

Decrease saturated fat intake	Increase omega 3 fatty acid intake	Maximise fibre intake
Saturated fat is pro-inflammatory and increases the absorption of LPS from the gut into the blood [1].	Omega 3 fatty acids are anti-inflammatory and reduce the absorption of LPS from the gut into the blood[1].	Fibre protects the gut barrier and prevents LPS from entering the blood leading to reduced inflammation[2].

Hexa LPS drives inflammation

LPS are components of bacterial cell walls composed of lipid (Lipid A) and polysaccharide (core oligosaccharide and O-antigen) components.



Hexa-LPS are pro-inflammatory compounds produced by some species of bacteria within the Proteobacteria phylum

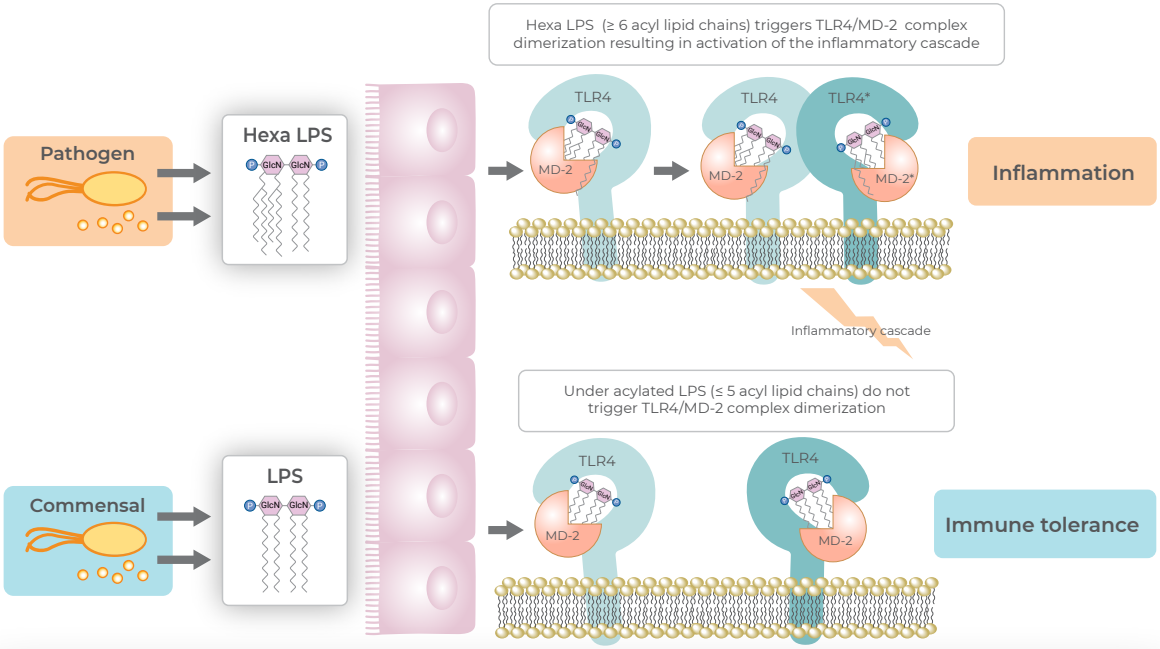
LPS structures vary between bacterial species with the lipid A component being most important in terms of interaction with the immune system.

Most species of bacteria within the Proteobacteria phylum produce lipid A with 6 (hexa) or 7 (hepta) fatty acids acyl chains which have strong immunostimulatory power.

The TLR4/MD-2 complex on immune cells binds to the lipid A component of LPS. The MD-2 binding pocket accommodates up to 5 acyl chains.

If the LPS has 5 or less acyl chains it does not trigger an immune response.

If the LPS has 6 or more acyl chains (hexa acylated) the sixth acyl chain interacts with a second TLR4 resulting in activation of the inflammatory cascade.



The hexa- LPS result in the *Insight*™ report reflects the capacity of the microbiome to produce LPS with 6 or more acyl chains.

Dig deeper into the details

Dietary fat quality impacts blood LPS levels and inflammation

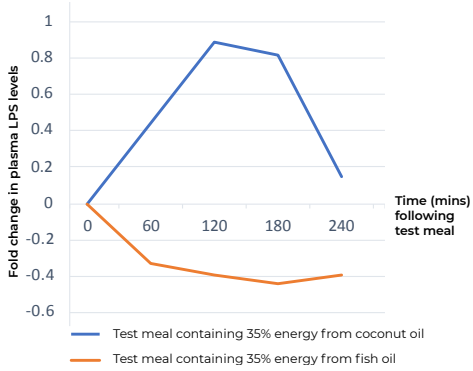
Endotoxaemia refers to accumulation of LPS (also known as endotoxin) in the blood resulting in systemic inflammation.

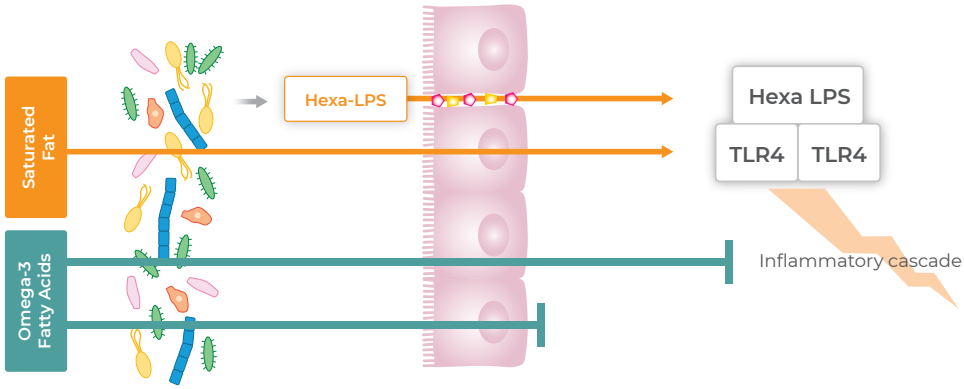
Protecting the gut barrier can prevent LPS from entering the blood.

The fat quality of a meal has been shown to impact postprandial LPS levels with saturated fat increasing blood LPS levels and omega 3 fatty acids decreasing blood LPS levels[1].

Saturated fat is pro-inflammatory and able to trigger TLR4 induced inflammation.

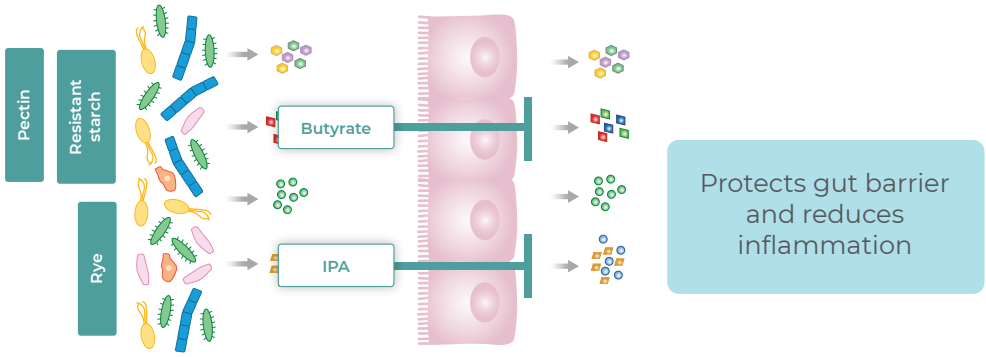
Omega-3 fatty acids are anti-inflammatory and can inhibit the inflammatory cascade.





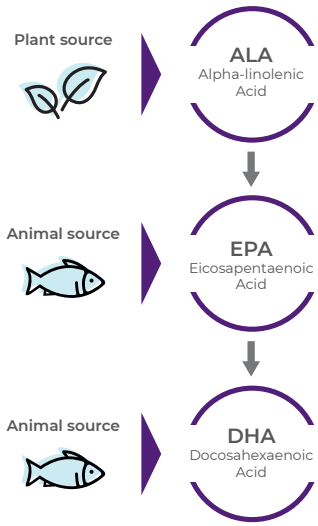
Fibre protects the gut barrier

Increasing fibre intake has been associated with reducing blood LPS levels and inflammatory markers[2]. The fibre fuelled metabolites butyrate and IPA are associated with improved gut barrier function.



Consuming foods high in resistant starch or pectin has been shown to increase butyrate levels while studies have indicated that consuming foods high in dietary fibre, in particular rye, can help increase IPA production.

Omega 3 fatty acids reduce plasma LPS levels



Fish and seafood are rich sources of the biologically active omega 3 fats docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA).

Humans can synthesis DHA and EPA from the plant based omega 3 alpha linolenic acid (ALA) but due to low conversion efficiency it is suggested that EPA and DHA may be considered conditionally essential nutrients.

Oestrogen supports the conversion of ALA to DHA so consuming DHA, the active form of omega 3, is of particular importance in postmenopausal women and men[3].

Omega 3 marine sources

The Heart Foundation recommends all Australians aim to include 2-3 servings of fish per week which provides 250-500mg EPA and DHA per day. For those who do not eat fish marine-sourced omega 3 can be obtained from supplements.

mg per 100g	EPA+DHA[4]	EPA[4]	DHA[4]
Salmon	1791	926	865
Canned sardines	1426	674	752
Fish fingers	599	189	410
Mussels	588	260	328
Canned tuna	481	114	367
Squid or calamari	334	89	245
Snapper	235	41	194
Tuna	229	39	190
Flathead	166	50	116
Barramundi	162	55	107
Hoki	154	30	124
Basa	50	7	43
Prawns	96	57	39

People who regularly consume diets high in fish tend to have lower risks of a range of conditions including heart disease, stroke, macular degeneration and dementia in older adults.

Omega 3 plant sources

Alpha linolenic acid (ALA) is a plant – sourced omega 3 fat. ALA is an essential fatty acid as it cannot be synthesised by humans and must be obtained from the diet.

The Nutrient Reference Values for Australia and New Zealand suggested dietary target for ALA is 0.4 to 1% dietary energy which equates to 0.9 to 2.3g for an average adult consuming 8700 KJ per day.

Food	Serve size	ALA content[4] (g)
Flaxseed/ linseeds	3 tsp (10.7g)	2.45
Flaxseed/ linseed oil	1 tsp (4.6g)	2.51
Chia	1 tbsp (14.2g)	2.54
Soy and linseed bread	2 slices (66g)	2.05
Walnuts	30g (~14 nuts)	1.88
Canola oil	1 tbsp (18.4g)	1.67
Soy bean oil	1 tbsp (18.4g)	1.32
Omega 3 enriched eggs	2 large eggs (116g)	0.23
Eggs	2 large eggs (116g)	0.07
Wholemeal bread	2 slices (66g)	0.07

Swapping 2 slices of wholemeal bread for soy and linseed bread provides an extra 2g ALA

References

1. Lyte JM, Gabler NK, Hollis JH. Postprandial serum endotoxin in healthy humans is modulated by dietary fat in a randomized, controlled, cross-over study. Lipids Health Dis. 2016 Nov 5;15(1):186. doi: 10.1186/s12944-016-0357-6.
2. Kopf JC, Suhr MJ, Clarke J, Eyun SI, Riethoven JM, Ramer-Tait AE, Rose DJ. Role of whole grains versus fruits and vegetables in reducing subclinical inflammation and promoting gastrointestinal health in individuals affected by overweight and obesity: a randomized controlled trial. Nutr J. 2018 Jul 30;17(1):72. doi: 10.1186/s12937-018-0381-7.
3. Giltay EJ, Gooren LJ, Toorians AW, Katan MB, Zock PL. Docosahexaenoic acid concentrations are higher in women than in men because of estrogenic effects. Am J Clin Nutr. 2004 Nov;80(5):1167-74. doi: 10.1093/ajcn/80.5.1167. PMID: 15531662.
4. Food Standards Australia New Zealand, 2014. AUSNUT2011-2013. Canberra: FSANZ.

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