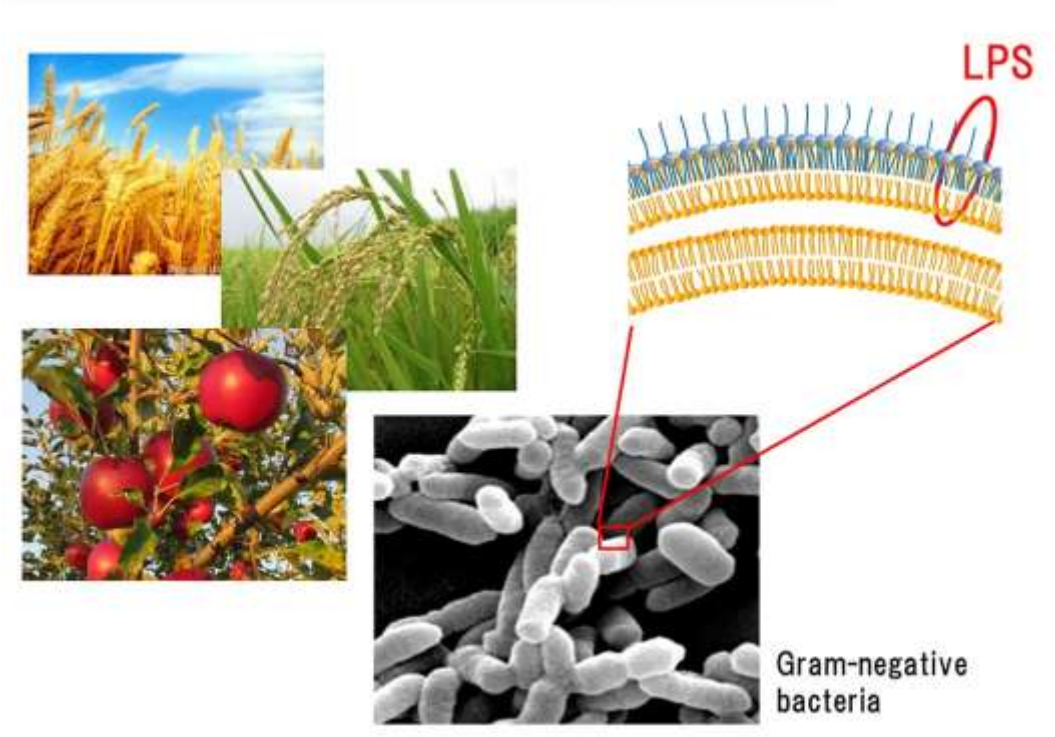
Basic Knowledge of Lipopolysaccharide (LPS)

(3)LPS All Around Us

Bacteria-derived LPS, the "Immuno Vitamin", is found abundantly in edible plants, such as grains, vegetables, and seaweed. Bacteria reside in the soil, where they help plants grow by converting nitrogen and phosphorus into forms accessible to the plants. Therefore, a high bacterial count correlates with good soil. Numerous soil bacteria attach not only to root of vegetables but also to leaf of vegetables, grain surface and seaweed in the sea. Even though bacteria on edible plants are sterilized before eating, LPS, a constituent of bacteria, remains, so LPS is taken naturally with edible plants. This natural intake of LPS has beneficial effects on our body.

LPS exists in our environment

LPS content in edible plants and Chinese herbal medicines



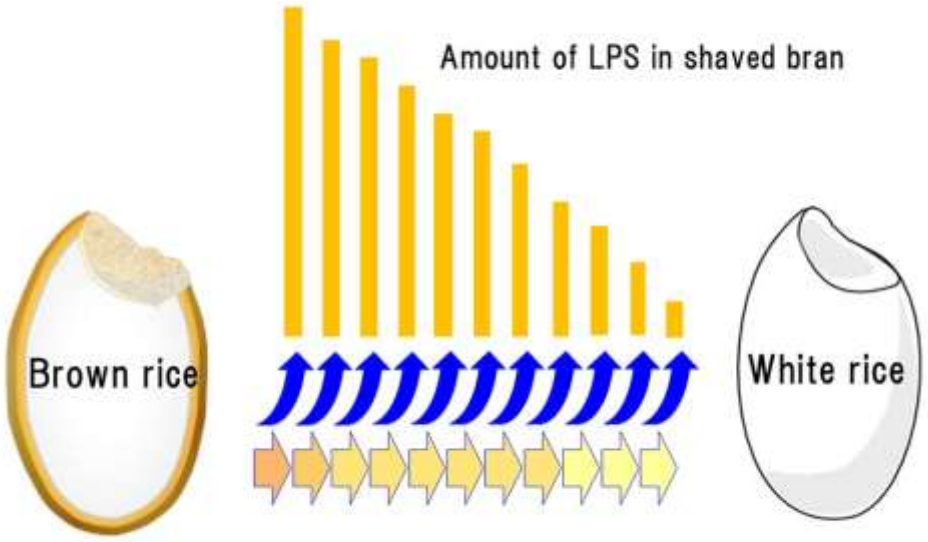
LPS content in edible plants and Chinese herbal medicines

Sample	LPS content (μg/g)	Sample	LPS content (μg/g)
Angelica	13.8	Persimmon	17.1
Bitter gourd	0.2	White sorghum flour	2.3
Mulberry leave	1.1	Wheat bran	8.8
Barley Grass	0.5	Wheat germ	7.5
Kale	0.2	Germinated barley	3.0
Spinach	1.3	Brown rice	10
Seaweed	21.2		
Sporophyll	42.8	Kanbomi (Crude drug)	600
Chlorella	0.2	Ginseng (Crude drug)	50
Saw Palmetto	0.4	Saiko (Crude drug)	40
Mushroom mycelium	0.8	Licorice (Crude drug)	30
Shiitake mushrooms	2.0	Kudzu root (Crude drug)	30

※1 μg of LPS corresponds to 1 billion gram negative bacteria

Brown rice, conventionally believed to be good for health in Japan, is rich in LPS. Because bacteria exist on the grain surface, LPS is mostly present on the outermost portions, which is why brown rice is richer in LPS than polished rice. Large amounts of LPS are also found in Chinese herbal medicines; one paper reported LPS as the active ingredient of Juzen-taiho-to (*1).

LPS content in rice bran



During plant cultivation, the use of chemical fertilizer biases the type of bacteria, and pesticides cause bacterial death. Under these circumstances, the quantity of LPS on vegetables has been decreasing in recent years. The low amount of LPS in vegetables, as well as less vitamins and minerals, than in the past means that natural power of vegetable is weakening.

(*1) Uncovering potential ‘herbal probiotics’ in Juzen-taiho-to through the study of associated bacterial populations, Bioorganic & Medicinal Chemistry Letters 25 (2015) 466-469

Lipopolysaccharides (LPS) are endotoxins found in Gram-negative bacteria, which are prevalent in high-fat, high-calorie, and processed foods, contributing to low-grade inflammation. Key food sources include fatty animal products (meats, dairy), processed snacks, and deep-fried items, with high-fat diets significantly increasing their absorption.

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Foods High in Lipopolysaccharides (LPS)

- **High-Fat Animal Products:** Red meat (hamburgers, steak), dairy products like cream and high-fat cheese, and butter.

- **Processed Foods:** Packaged snacks, fast food, and highly processed meat products.
- **Deep-Fried Items:** French fries, fried chicken, and donuts.
- **Refined Carbohydrates:** White flour bread and pasta.
- **Probiotic Products:** While generally healthy, some, particularly those containing specific gram-negative bacteria, can contain small amounts of LPS, though this is usually negligible compared to gut production.

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Key Considerations

- **Mechanism of Inflammation:** Dietary fat facilitates the translocation of LPS from the intestine into the bloodstream, a process that can trigger metabolic endotoxemia.
- **Impact on Gut Health:** A diet high in saturated fats and low in fiber can promote the growth of LPS-producing bacteria in the gut.
- **Reducing Exposure:** Cooking with olive oil, increasing intake of fiber, and consuming diets rich in polyphenols and omega-3 fatty acids may help reduce the inflammatory impact of LPS.

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Disclaimer: While LPS is associated with inflammation, it is a normal part of the intestinal microbiome. Excessive levels, however, are linked to metabolic syndrome, insulin resistance, and weight gain

Lipopolysaccharides (LPS) are essential structural components of the outer membrane of most **Gram-negative bacteria**, acting as potent endotoxins that can trigger strong immune responses. These bacteria are common in the human gut microbiota, and LPS is released during cell division or bacterial death.

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Key LPS-Producing Bacteria:

- Escherichia coli (E. coli): Often used as a model organism in studies, producing high amounts of LPS.
- Salmonella: Known for producing highly toxic LPS.

- **Pseudomonas aeruginosa**: A opportunistic pathogen frequently associated with nosocomial infections.
- **Vibrio cholerae**: The causative agent of cholera.
- **Shigella flexneri**: Causes shigellosis.
- **Klebsiella**, **Enterobacter**, **Proteus**, **Yersinia**: Other common enteric Gram-negative bacteria.
- **Bacteroides species**: Common in the gut; they produce a structurally distinct LPS with reduced TLR-4 inflammatory responses.
- **Porphyromonas gingivalis**: Oral bacteria associated with periodontal disease.

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Characteristics of LPS-Producing Bacteria:

- **Endotoxin Release:** While LPS forms the outer membrane, it is liberated when bacteria die, particularly in the presence of antibiotics or within the host immune system.
- **Immune Stimulation:** LPS molecules activate the innate immune system (via TLR-4 receptors), which can lead to high fever and septic shock in large amounts.
- **Chronic Diseases:** Beyond acute infection, chronic low-grade endotoxemia (caused by gut bacteria) is linked to metabolic and neurodegenerative diseases.
- **Structure:** LPS consists of a lipid A anchor, a core oligosaccharide, and an O-chain.