

The Science behind L-Arabinose

by EVOLVA™

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L-Arabinose is a pentose, rare sugar with a similar taste profile to sucrose; it is used in a wide range of applications in diverse industries. This versatile ingredient has recently gained attention, with numerous studies reporting health benefits including blood glucose control, weight management, and as a prebiotic. L-Arabinose, as a “bioactive sugar”, combines the functionality of a reducing sugar with potential health benefits, in particular related to its sugar-blocking properties.

What are the sources of L-Arabinose?

L-Arabinose is rarely present as a free sugar in plants but is usually found in hemicelluloses and pectin, which are part of the rigid structure in plants called the cell wall. In order to “extract” L-Arabinose, a couple of processes have been developed and are currently in use: acid hydrolysis and enzymatic hydrolysis.¹ However, the use of plant sources and acid hydrolysis not only limits the scalability of the production process but also risks negative consumer perception, with more and more consumers seeking environmentally friendly and sustainable products. Evolva, a pioneer in bringing ingredients to the market that are produced by a patented fermentation process, now offer their B2B customers a natural L-Arabinose product with a reliable supply chain.

What are the current applications for L-Arabinose?

L-Arabinose is a versatile ingredient with several applications in a diverse range of industries around the globe. Some of the applications are described below:

- Flavor: L-Arabinose is currently used in the food and flavor industry as a flavoring agent. Due to its sugar-reducing properties, it can be used in the Maillard reaction, resulting in appealing flavors in the bakery, confectionary and pet-food industries;
- Dietary supplements: Research, including human clinical studies, has demonstrated that, due to its sugar-blocker properties, L-Arabinose is effective when combined with sucrose at lowering blood glucose levels;
- Cosmetics: L-Arabinose is currently used as an excipient in topical applications. In addition, some products list it as an active ingredient in anti-aging formulations;
- Pharma: L-Arabinose can be used as a precursor as part of the biotechnological production of L-nucleoside analogs as well as in medical weight-loss devices.



L-Arabinose is a versatile ingredient with several applications in diverse industries

Sugar substitutes are known to cause gastrointestinal discomfort. What about L-Arabinose?

Both high - and low-intensity sweeteners have reports of side effects related particularly to gastrointestinal (GI) discomfort such as diarrhea, flatulence, and bloating, even when they are consumed within the Acceptable Daily Intake (ADI), which can vary from 0.3 g/60 kg bodyweight (bw) (sucralose) to 36 g/60 kg bw (allulose). Although these sugar substitutes, which are sweet, non-caloric and have a low glycemic index, offer an alternative to sucrose, GI issues can limit consumer acceptance of these ingredients. On the contrary, L-Arabinose is neither absorbed nor metabolized by humans, with published clinical studies showing no significant side effects reported for daily dosages of up to of 15 g/60 kg bw.²

What is the science to support the use of L-Arabinose?

With over 1,800 studies published on the scientific database PubMed Medline, there is a growing interest in the potential use of L-Arabinose for health purposes. The interest in L-Arabinose has increased over the years particularly due to the clinical studies that show its promising results as a sugar blocker when in presence of sucrose. Table 1 summarizes the data on the published clinical studies reporting the benefits of L-Arabinose for blood glucose and insulin levels as well as weight management. Although the results are promising and indicative of beneficial effects, there is a significant difference in study designs, mostly in terms of the investigated population (age, gender and health status), administered dose and duration (hours to months); there is an urgent need, therefore for additional, more well-designed clinical studies.

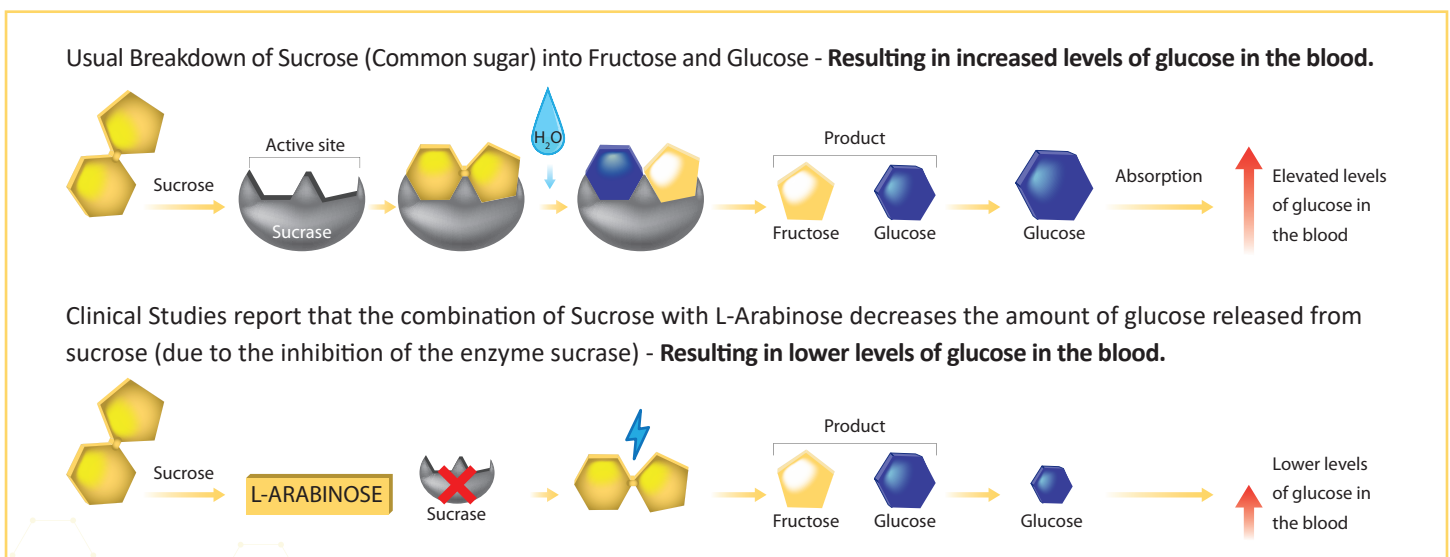
Other health benefits have also been investigated, although mostly within *in vitro* and animal models, including the potential as prebiotic to promote a beneficial change in gut microbiota composition, and to act as anti-aging component in skincare.¹

How does L-Arabinose act as a sugar blocker?

L-Arabinose selectively inhibits intestinal sucrase activity.³ Sucrase is the enzyme involved in the breakdown of sucrose to glucose and fructose. Studies have reported that sucrose in combination with L-Arabinose results in delayed digestion of sucrose and consequently a slower absorption of glucose, which ultimately leads to decreased blood glucose levels and insulin responses.⁴ A few human clinical studies have also observed the delayed absorption of glucose when in the presence of L-Arabinose (Table 1).



Proposed mechanism: inhibition of sucrase (the enzyme that catalyzes the hydrolysis of sucrose to fructose and glucose)



Human clinical studies indicate great potential for the use of L-Arabinose particularly for blood glucose management, although additional, more well-designed studies are still needed.

CLINICAL STUDY	STUDY DESIGN	SAMPLE SIZE (N)	HEALTH STATUS	AGE (RANGE, YO)	BIOMARKER (S)	DURATION	TREATMENT	REPORTED RESULTS	SIDE EFFECTS
Pol et al. (2020)	Randomized & Controlled	16	healthy	20 +	blood glucose and insulin levels	3 h	max 15 g (drink) / 8% or 13% in cereals	observed effect only in drinks and in the presence of sucrose	not reported
Halschou-Jensen et al. (2015)- Study 1	Randomized & Controlled	17	healthy	20 +	blood glucose, insulin levels and C-peptide	3 h	0, 5, or 10% arabinose added to different meals (starch or fat)	not conclusive	not reported
Halschou-Jensen et al. (2015)- Study 2	Randomized & Controlled	7	healthy	20 +	blood glucose, insulin levels and C-peptide	3 h	0, 20% arabinose added to different meals (starch or fat)	not conclusive	not reported
Liu et al. (2013) - Study 1	Randomized & Controlled	50	healthy	20 +	blood glucose and body weight	1 month	3%, 5%, 10% and 100% L-Arabinose (solution)	decreased blood glucose levels occurred for the L-Arabinose diets	3 people in the 10% arabinose group experienced mild diarrhea
Liu et al. (2013) - Study 2	Randomized & Controlled	20	obese	20 +	body weight	6 months	30 g L-Arabinose/day (3 x10 g) before a meal	participants lost around 6 kg over the period of the study	not reported
Yang et al. (2013)	Randomized	30	metabolic syndrome	50+	blood glucose, insulin levels, C-peptide and body weight	6 months	45 g per day (3 x 15 g) if they weighed more than 60 kg or 20 g per day (2 x 10 g) if they weighed less than 60 kg	blood glucose levels, body weight, and total cholesterol decreased	13 people with mild diarrhea and one person with mild nausea after treatment with L-Arabinose
Kaats et al. (2011)- Study 1	Randomized & Controlled	20	healthy	50+	blood glucose and insulin levels	1.5 h	70 g sucrose in water plus 1 g L-Arabinose (1.4%) and 200 µg of chromium	18% to 31% reduction in glucose when taking LA-Cr supplement compared to ingesting the sucrose alone	none
Kaats et al. (2011)- Study 2	Randomized & Controlled	50	healthy	40+	blood glucose and insulin levels	1 month	70 g sucrose in water plus 1 g L-Arabinose (1.4%) and 200 µg of chromium	28% reduction in circulating insulin	none
Krog-Mikkelsen et al. (2011)	Randomized & Controlled	15	healthy	20+	blood glucose, insulin levels and C-peptide	3 h	0, 2.7%, 4% L-Arabinose combined with 75 g sucrose in 300 mL water	4% L-Arabinose produced an 11% lower glucose peak, a 33% lower and delayed insulin peak	none
Shibanuma et al. (2011)	Randomized & Controlled	21	healthy	20+	blood glucose	2 h	40 g sucrose in water with 0 g (control) or 2 g L-Arabinose (5%)	Blood glucose values were significantly lower (Δ change: with L-Arabinose, 53.8 ± 19.7 mg/dL; without L-Arabinose, 65.0 ± 17.7 mg/dL)	not reported
Inoue et al. (2000)- Study 1	Randomized & Controlled	8	healthy	20 to 89	blood glucose and insulin levels	2 h	50 g sucrose in 300 mL water with 0 or 2 g L-Arabinose (4%)	The authors reported decreased blood glucose levels for the L-Arabinose diets but no difference in insulin levels	none
Inoue et al. (2000)- Study 2	Randomized & Controlled	40	healthy	40+	blood glucose and insulin levels	2 h	Jelly with 30 g sucrose and either 0, 2, 3, or 4% L-Arabinose		
Inoue et al. (2000)- Study 3	Randomized & Controlled	10	type 2 diabetes	50+	blood glucose and insulin levels	2 h	30 g sucrose and 0 or 3% L-Arabinose		

Table 1. Summary of the human clinical studies reporting benefits of L-Arabinose mainly in blood glucose control, insulin levels and weight management.

L-ARABINOSE: THE UNIQUE AND ONLY “BIOACTIVE SUGAR”

Sugars have long been regarded solely as a source of energy for cells. The emerging field of glycoscience, however is providing increasing evidence that specific carbohydrates can play important roles in overall health.

Incorporated in foods and beverages, L-Arabinose has a pleasant, sweet taste. But while all other sugar alternatives require a full replacement of sucrose, L-Arabinose can be combined with sucrose (in specific ratios) for its sugar-blocker properties.

In dietary supplements and in medical weight-loss devices, L-Arabinose has proven properties for prebiotic and weight management when used as a single ingredient or in combination with other healthy ingredients.

As a “bioactive sugar”, L-Arabinose brings a competitive advantage for formulators who want to propose a real option to the consumers who are looking for sweet-tasting ingredients that are compatible with their healthy lifestyle.



L-Arabinose by Evolva: Commitment to Build up the Science of Ingredients

Evolva's investment in scientific research to develop its ingredients has taken a step further in terms of determining L-Arabinose's potential health benefits. In addition to providing its customers with a sustainably produced ingredient, Evolva is currently investing in ongoing studies that aim to provide science-based evidence on the use of L-Arabinose as a health ingredient and in cosmetic applications.

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ABOUT EVOLVA

Evolva is a Swiss biotech company focused on the research, development and commercialization of ingredients based on nature. We have leading businesses in Flavors and Fragrances, Health Ingredients and Health Protection. Evolva's employees, half of which are women, are dedicated to make the best products that can contribute to health, wellbeing and sensory enjoyment.

To know more about Evolva. <https://www.evolva.com>

PROVEN TRACK RECORD IN THE SUGAR SUBSTITUTES DOMAIN

Back in 2017, Evolva announced a major collaboration agreement with Cargill for the production and commercialization of EverSweet™, now produced and commercialized by Avansya, a joint venture between Cargill and DSM. EVERSWEET™ is a calorie-free stevia sweetener, made from steviol glycosides Reb M and Reb D through fermentation. EVERSWEET™ delivers a high-quality sweetness profile. It is based on proven, manufacturing techniques that are more scalable and sustainable than those used for traditional stevia products. EVERSWEET™ can reduce sugar in a wide range of food and beverages while maintaining the sweetness that consumers love.

To know more about EVERSWEET™: <https://www.avansya.com/>

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