Effects of L-arabinose on glycaemic response, satiety and body weight in humans: a literature review

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Background

High sugar consumption increases blood glucose levels which may lead to increased risk for type II diabetes. Approaches that improve postprandial glycaemic response, such as sugar reduction, would help address this, and may also lead to more satiety and better weight management. Besides sweetening foods/drinks, sugar has an important structural functionality in some foods. Reformulation of foods/drinks is one way of reducing the glycaemic effects, however another promising approach is by enriching them with alternative sugars that hinder sugar uptake.

L-arabinose inhibits uncompetitively the brush border enzyme sucrase, which hydrolyses sucrose enabling sugar uptake. L-arabinose is a five-carbon sugar widely found in nature, for example in hemicellulose and pectin, and it may be manufactured from sugar beets.
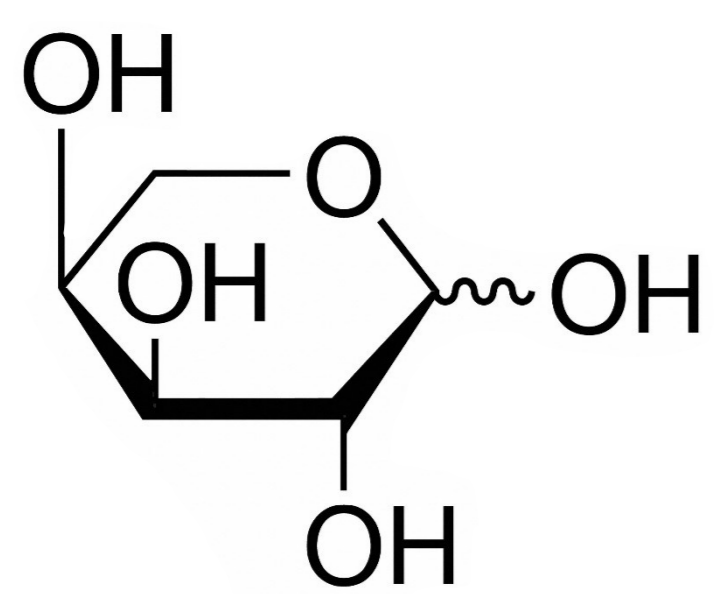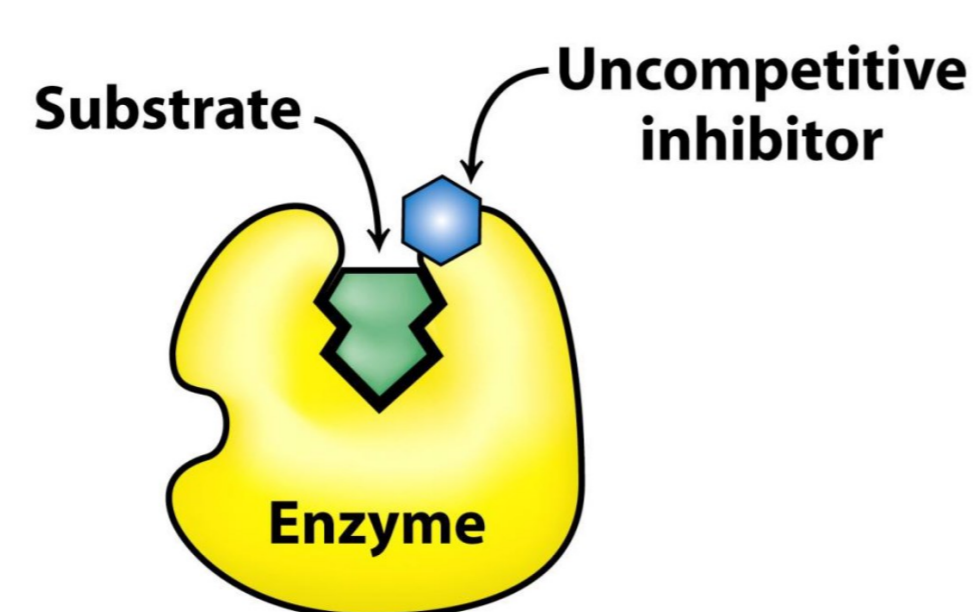

Figure 1. Structure of L-arabinose

Figure 2. Uncompetitive inhibition (*Biochemistry, 6th edition*)

Objective

We examined the effects of addition of L-arabinose to the human diet on glycaemic responses, satiety and body weight in the reduction of glucose homeostasis in humans.

Methods

Literature search via Scopus and Google Scholar.

("Arabinose" OR "L-arabinose") AND (sucrose OR sucrase OR glucose OR glycaemic response OR glycemic response OR appetite OR satiety OR energy intake OR body weight OR body-weight).

Inclusion criteria:
1) Had at least an abstract in English,
2) Publications in scientific journals or being peer reviewed (e.g. PhD thesis)
3) Published after 1989
4) Included humans
5) Had studied at least one of the following outcome measures: blood glucose levels, blood insulin levels, appetite, satiety, food or energy intake, body weight, gastrointestinal effects, or adverse effects
6) Comparison treatment should make it possible to isolate the effect of L-arabinose, e.g. combined treatments were not included.

Conclusions

L-arabinose enrichment of foods/drinks high in sucrose is a promising approach for lowering postprandial glycaemic responses. Though, no effects on satiety or food intake were found. The evidence for body weight reduction is poor. Therefore, well-designed randomized clinical trials are needed to further explore the potential for enrichment of L-arabinose for sugar containing food applications.

Results

In total 8 papers were included based on the criteria, 5 studies looked at acute effects – one-time exposure to an enriched food/drink - and 3 investigated longer term effects of L-arabinose enrichment.

Table 1. Overview of human studies that investigated effects of L-arabinose on postprandial blood glucose and insulin

	Exp	Design	Blood glucose	Insulin
Inoue S, Sanai K, Seri K, 2000 Translated (2)	1	50g+0g 50g+2g or 4%	30 min ↘ AUC(0-60min) ↘	30 min ↘
	2	30g+0% 30g+0.6g or 2% 30g+0.9g or 3% 30g+1.2g or 4%	30min and AUC: 3% ↘ 4% ↘	n.a.
	3	DM2 30g+0g 30g+0.9g or 3%	60 min ↘ AUC(0-60min) ↘	30, 60, 120 min ↔
Krog-Mikkelsen, I et al. 2011 (3)	1	75g sucrose in 300ml water +0g +1g or 1.3% +2g or 2.7% +3g or 4%	Peak ↘ TTP and iAUC ↔	Peak ↘ TTP 2g and 3g ↗ iAUC 3g ↗
Shibanuma K, Degawa Y, Houda K, 2011 (4)	1	40g sucrose in test liquid +0g +2g	Peak and AUC ↘ 15 and 30 min ↘	n.a.
	2	2h after test product Sucrose load jelly 40g sucrose	Peak and AUC ↘ 30 min ↘	
Krog-Mikkelsen I, et al. 2013 (5)	1	75g sucrose in 300ml water + 0g + 3g or 4% D-xylose + 6g or 8% D-xylose + 6g or 8% L-arabinose	Peak 6g xyl ↘ 6g ara ↘ TTP 3g xyl ↗ 6g ara ↗ iAUC All ↔	Peak All ↘ TTP 3g xyl ↗ 6g xyl ↗ iAUC All ↔

Halschou-Jensen K, et al. 2015 (8)	1	A bun muffin jam butter
		  0%, 5% or 2.9g, 10% or 5.9g
		B bun cheese butter
		  0%, 5% or 2.5g, 10% or 4.9g
			Peak and TTP ↔
			B 10% iAUC ↗
				Peak and TTP ↔
				B 10% iAUC ↗

	2	Solid Bun cheese butter 0, 5, 10, 20% Semi solid 0, 5, 10, 20% Liquid 0, 5, 10, 20%	Peak, TTP, iAUC ↔	Peak, TTP, iAUC ↔
Liu X, et al. 2013 Translated (6)	1	30 days 3% or 43.65 + 1.35g 5% or 42.75 + 2.25g 10% or 40.5 + 4.5g 100% or 45g	All doses Before breakfast ↔ 1h ↔ 2h ↘	n.a.

Almost all studies showed a beneficial effect on blood glucose, as well as a beneficial effect on insulin (2-6, 8). This effect was supported by GLP-1 and GIP responses (3, 5). No effects were observed on hunger or satiety feelings or food intake (3, 5). Body weight seemed to reduce during 6 months, but design and reporting of studies was poor (6, 7). Importantly, no side effects were reported (1-3, 5).

Heterogeneity of the studies, poor design and reporting of the studies made further quantitative analyses impossible. Studies varied in the dose of L-arabinose, the dose of sucrose, type of product / matrix / nutrition composition and the population under study, i.e. healthy or diabetic population.

References

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