D-TAGATOSE

Chemical and Technical Assessment (CTA)

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1 Summary

D-Tagatose is a ketohexose, an epimer of D-fructose isomerised at C-4. It was identified as a component of a gum exudate of the cacao tree (*Sterculia setigera*) and also detected as a component of an oligosaccharide in lichens of the *Rocella* species. In the bacterial metabolism of lactose, it may be formed from D-galactose by enzymatic isomerization catalyzed by L-arabinose isomerase under alkaline conditions in the presence of calcium. It is as virtually odourless, white or almost white, non-hygroscopic crystals and it has almost same sweetness as sucrose and less than half the calories of sucrose. Functional uses of D-tagatose as food additives are used as sweetener, texturizer, stabilizer, humectant, and formulation aid.

D-Tagatose was evaluated at 55th JECFA (2000), but an ADI could not be allocated. At 57th JECFA (2001) an ADI of 0-80 mg/kg bw was established. Current JECFA specifications for D-tagatose were prepared at the 55th JECFA (2001), maintained at 57th JECFA and published in FNP 52 Add 9 (2001). In the light of additional toxicological data, an ADI and specifications were reviewed at 61st JECFA (2003) and they were maintained.

2 Description

D-Tagatose occurs as virtually odorless, white or almost white, non-hygroscopic crystals and it has almost same sweetness as sucrose.

3 Manufacturing

3.1 Raw materials

Lactose (food-grade), hydrochloric acid (food-grade), calcium hydroxide (technical-grade), sulfuric acid (technical-grade), immobilized lactase, ion exchange resins

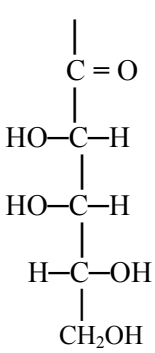
3.2 Method of manufacture

D-Tagatose is produced from lactose in a two-step process. In the first step, lactose is enzymatically hydrolyzed to d-galactose and d-glucose using immobilized lactase. d-galactose is separated using a cation exchange resin. In the second step, the d-galactose is isomerized to d-tagatose under alkaline conditions (pH 12) using calcium hydroxide as a complexant. Treatment of the precipitate with sulfuric acid liberates d-tagatose and filtrate is demineralized in a cation and anion exchanger. The solution is concentrated and purified by chromatographic fractionation using a cation exchanger. D -tagatose is crystallized from the syrup.

4 Chemical characterization

4.1 Composition and properties

Common or usual name:	D-Tagatose
Synonyms	D -*lyxo*-hexulose, α-D-tagatose
CAS Registry Number:	87-81-0
Empirical formula:	$C_6H_{12}O_6$
Molecular weight:	180.16
Structural formula:	D-Tagatose is an epimer of D-fructose inverted at C-4



Solubility in water:	160 g/100 ml at 20°C
Solubility in ethanol:	0.02 g/100 ml at 22°C
Specific rotation $[\alpha]^{20}_{,D}$:	Between - 4 and -5.6° (1% aqueous solution)
Melting range	133 – 137 °C
Heat of solution:	- 42.3 kJ/kg at 20°C

4.2 Possible impurities

D-Galactose, D-talose, aldol condensation products, extractives from immobilized lactase resin and ion exchange resins; they are removed during the chromatographic purification of the demineralized isomerization solution and during the crystallization of D -tagatose.

4.3 Analytical methods

Refer specifications in FNP 52 Add 9, FNP 52 Add 11 and FNP 5 (Guide to specifications).

5 Functional uses

5.1 Technological function

D -Tagatose is used as a bulk sweetener, and like other sugars (sucrose, glucose, fructose) it is also used as a humectant, texturizer and stabilizer. It is also useful in formulating dietetic foods with a low glycemic index.

5.2 Food categories and use levels

Considering its technological properties and nutritional benefits, D-tagatose is expected to be used in ready-to-eat breakfast cereals, diet soft drinks, low/non-fat ice cream and frozen yogurt, hard and soft confectioneries, frostings, chewing gum, formula diets for meal replacement, and dietary supplements. The proposed use levels of D-tagatose in these applications and the technological functions that it fulfills are presented in Table 1.

Table 1 Proposed food application of D-tagatose and maximum levels of use[1]

Food Category	Use Level (w/w)	Purpose
Ready-to-eat breakfast cereals	15%	sweetener
Diet soft drinks	1%	for improving "mouth feel" flavor enhancement
Hard confectionery	15%	sweetener
Soft confectionery including chocolate	15%	sweetener, humectant
Ice cream and frozen yogurt	3%	sweetener, flavor enhancement
Chewing gum	60%	sweetener
Frostings	15%	sweetener
Formula diets for meal replacement	15 – 20%	sweetener
Dietary supplements	90%	formulation aid (tablets)

6 Reactions and Fate in Food

D-Tagatose is stable in the foods to which it is added during the processing and storage of food. However, D-tagatose undergoes Maillard reactions as a reducing sugar.

7 References

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[1] Note: These use levels have been identified as representative and were used for intake calculations. Their publication does not imply any recommendation whether they are suitable as maximum levels for standard setting purposes, a question which is not within the mandate of JECFA.