

A WHOLESOME LIFE
IN THE BEST OF TASTE

Glico

FDA Notified GRAS



QUICK AND SUSTAINABLE ENERGY

- **HIGH** absorption
- **FAST** gastric emptying time
- **STRONG** stamina



Cluster Dextrin[®]
New Energy Source for Athletes

HBCD

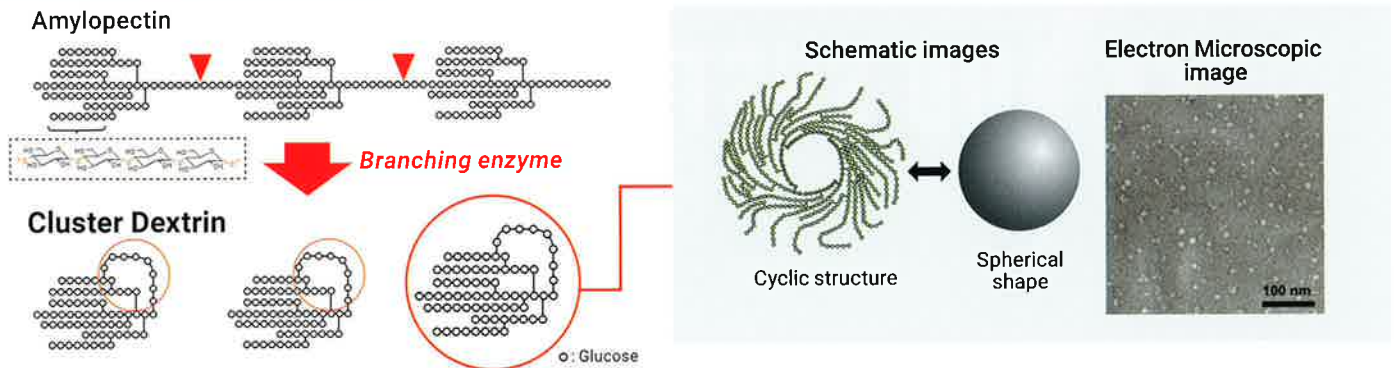
Highly Branched Cyclic Dextrin

Glico Nutrition Co., Ltd.

Cluster Dextrin®

is a new type of carbohydrate, "SuperCarbo", produced from amylopectin through a cyclization reaction involving a branching enzyme. Cluster Dextrin obtained **FDA Notified GRAS** status in October 2012.

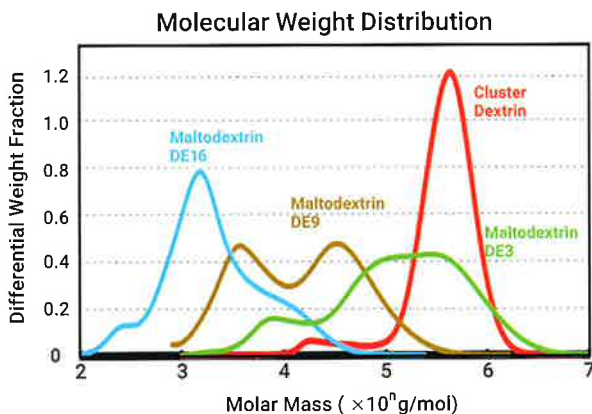
What is Cluster Dextrin?



- Cluster Dextrin is manufactured from cornstarch through a process utilizing a branching enzyme.
- The branching enzyme acts on the joints of the cluster structures of amylopectin, and separates them by cyclization.
- Cluster Dextrin maintains the cluster structure that constitutes the basic structural unit of amylopectin.

Basic Characteristics

- Narrow molecular weight distribution
- High molecular weight
- Low reducing power (low dextrose equivalent [DE])
- Highly soluble and stable in water



Stability of the Solution

5% Solution after 3 cycles of freezing and thawing



Cluster Dextrin DE 2 DE 5 DE 8 DE 12
High ← Molecular Weight → Low

Cluster Dextrin can be dissolved easily in water, and the solution is stable and less cloudy when compared to other maltodextrins, even following three cycles of freezing and thawing.

5 Benefits for Sports Nutrition

- 1 | Fast Gastric Emptying Time (GET)
- 2 | Low Gastrointestinal Disorder
- 3 | Enhancement of Stamina
- 4 | Reduction of Fatigue
- 5 | Suppression of Inflammatory Stress Reaction Induced by Vigorous Exercise

1

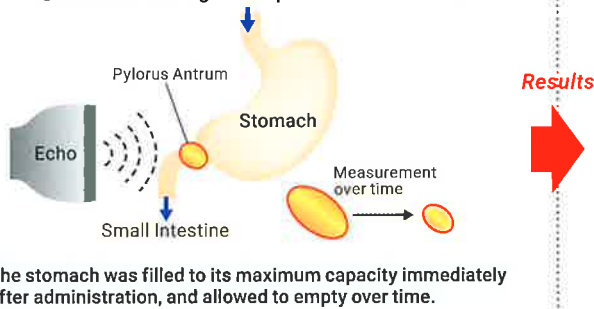
Fast Gastric Emptying Time (GET)

Fluids Containing a Highly Branched Cyclic Dextrin Influence the Gastric Emptying Rate

H. Takii et al., *Int. J. Sports Med.*, 26: 314-319, 2005

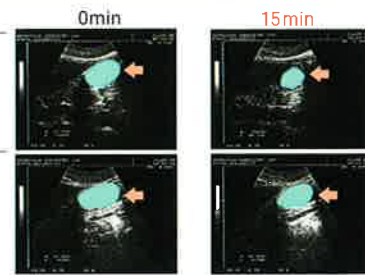
① Measurement of the Amount of Beverage Transferred from the Stomach to the Small Intestine in Humans

[Schematic image of experimental method]



• The stomach was filled to its maximum capacity immediately after administration, and allowed to empty over time.

After drinking

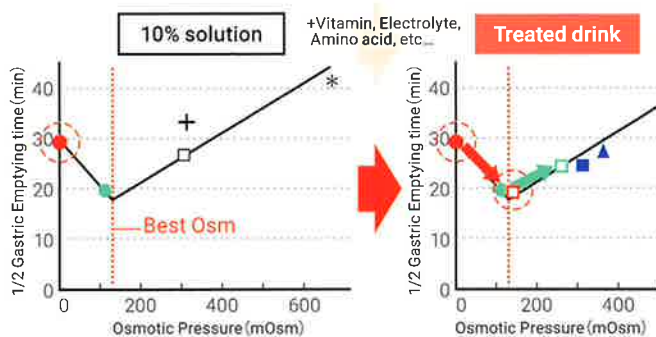


Cluster Dextrin solution (10%)

Glucose solution (10%)

• The pylorus antrum area decreased significantly more quickly after administration of Cluster Dextrin solution compared to that of glucose solution.

② Gastric Emptying Time of Various Carbohydrates in Solution



- Cluster Dextrin
- Maltodextrin (DE16)
- Sucrose
- + Maltose
- * Glucose
- Drink based on Cluster Dextrin
- Drink based on Maltodextrin (DE16)
- Japanese Sports Drink A (using Fructose-Glucose)
- ▲ Japanese Sports Drink B (using Fructose)

• Almost zero osmolality in Cluster Dextrin alone (●).
 • Even after formulating a drink with a sufficient amount of carbohydrates, and adding low molecular weight vitamins and minerals, the solution still has low osmolality (□).

→ By using Cluster Dextrin, it is possible to design a sports drink that is suitable for a variety of purposes.

2

Low Gastrointestinal Disorder

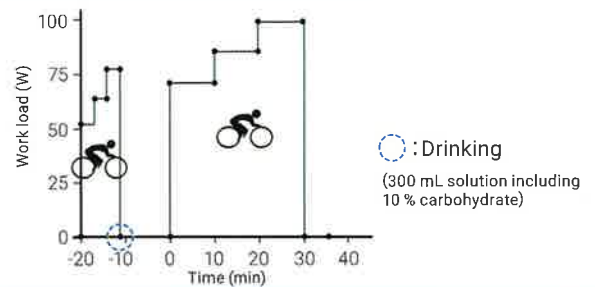
A Sports Drink Based on Highly Branched Cyclic Dextrin Generates Few Gastrointestinal Disorders in Untrained Men during Bicycle Exercise

H. Takii et al., *Food Sci. & Tech. Res.*, 10(4): 428-431, 2004

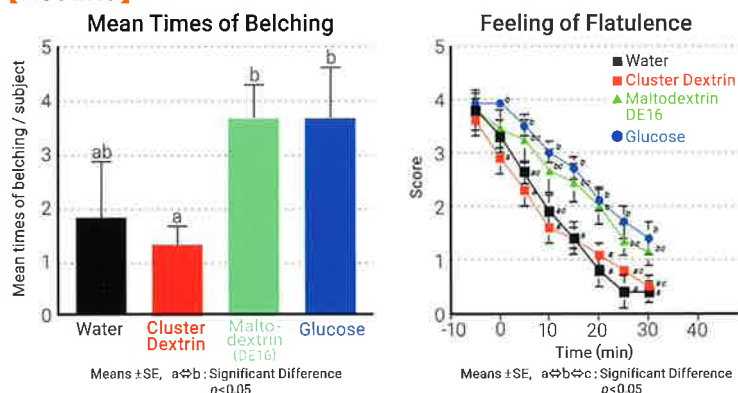
[Design of the Trial]

Experimental design	Crossover test
Number of subjects	7 (Untrained males, age 34.4 ± 2.8)
Number of experimental groups	4 (Water, Cluster Dextrin, maltodextrin:DE16, or glucose)
Exercise loading	30 continuous min. consisting of three 10-min. blocks at each of 3 loads with ergometer
Measurement	Mean times of belching, and feeling of flatulence

[Protocol of the Exercise Test]



[Results]



• Incidence of belching after drinking Cluster Dextrin-based drink was significantly lower than with glucose- or maltodextrin-based drinks.

• Experience of flatulence after drinking Cluster Dextrin-based drink was significantly lower than with glucose- or maltodextrin-based drinks.

→ Cluster Dextrin-based drink is associated with a lower level of gastrointestinal disorder.

3

Enhancement of Stamina

Evaluation of Exercise Performance with the Intake of Highly Branched Cyclic Dextrin in Athletes

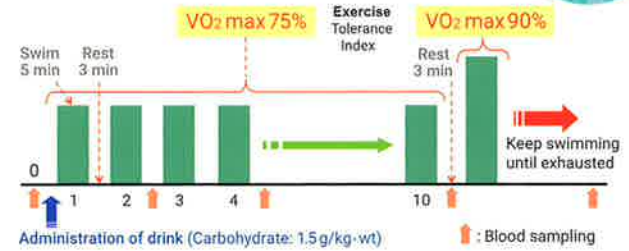
T. Shiraki et al., *Food Sci. & Tech. Res.*, 21 (3): 499-502, 2015



[Design of the Trial]

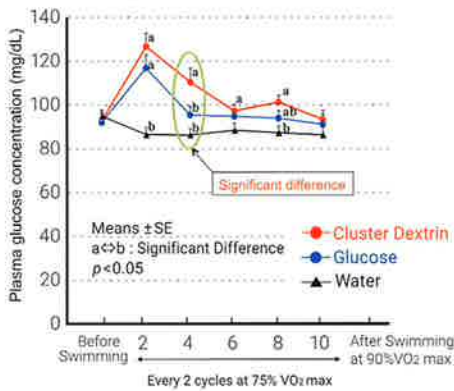
Experimental design	Crossover test
Number of subjects	7 (male elite swimmers, age 20 ±1)
Number of experimental groups	3 (water, Cluster Dextrin, or glucose)
Interval	1 week
Exercise loading	10 cycles of 5 min. swimming at 75% VO ₂ Max then at 90% VO ₂ Max until exhausted
Measurement	Blood glucose, and Endurance time

[Protocol of the Exercise Test]

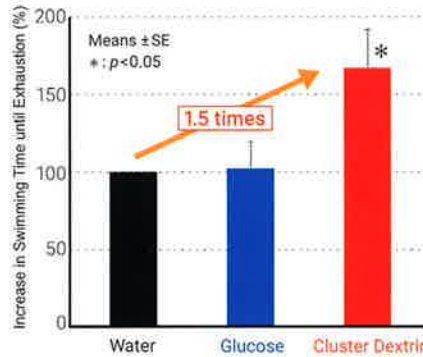


[Results]

Change in Blood Glucose Level



Enhancement of Endurance Capacity



• Blood glucose of Cluster Dextrin group was higher during swimming trial than glucose group.

• With Cluster Dextrin, swimmers swam about 1.5 times longer than with water or glucose.

→ Cluster Dextrin contributes to making the ideal sports drink. It hydrates and increases stamina when used during exercise.

4

Reduction of Fatigue

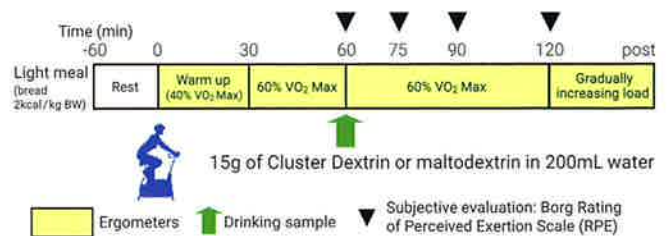
Effects of Ingesting Highly Branched Cyclic Dextrin During Endurance Exercise on Rating of Perceived Exertion and Blood Components Associated with Energy Metabolism

T. Furuyashiki et al., *Biosci. Biotech. Biochem.*, 78:2117-2119, 2014

[Design of the Trial]

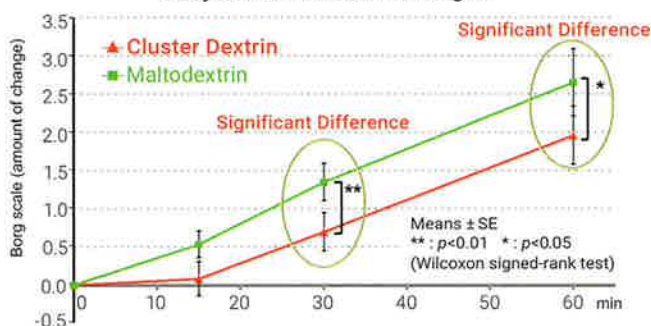
Experimental design	Double-blind crossover test
Number of subjects	24 (regularly exercising males, 25-39 years old, average age 34 ±4)
Number of experimental groups	2 (Cluster Dextrin, or maltodextrin)
Interval	2 weeks
Exercise loading	Load of 60% VO ₂ Max with ergometer for 2h
Measurement	Subjective evaluation of fatigue

[Protocol of the Exercise Test]



[Results]

Subjective Evaluation of Fatigue



• The Borg scale is commonly used to measure the level of exertion in individual exercise.

• Subjective exertion level among the Cluster Dextrin group was significantly lower than that of the maltodextrin group at 30 min. and 60 min. after use.

→ Cluster Dextrin reduces fatigue during exercise more effectively than maltodextrin.

5

Reduction of Inflammatory Stress Reaction Induced by Vigorous Exercise

Effect of a Sports Drink based on Highly Branched Cyclic Dextrin on Cytokine Responses to Exhaustive Endurance Exercise

K. Suzuki et al., J. Sports Med. Phys. Fitness, 54: 622-630, 2014



[Design of the Trial]

Experimental design	Double-blind crossover test
Number of subjects	7 (well-trained male triathletes, age 29.7 ± 5.2)
Number of experimental groups	2 (Cluster Dextrin, or Glucose)
Interval	1 month
Exercise loading	Duathlon race (5 km of running, 40 km of cycling, and 5 km of running)
Measurement	Urinary cytokines and plasma catecholamine

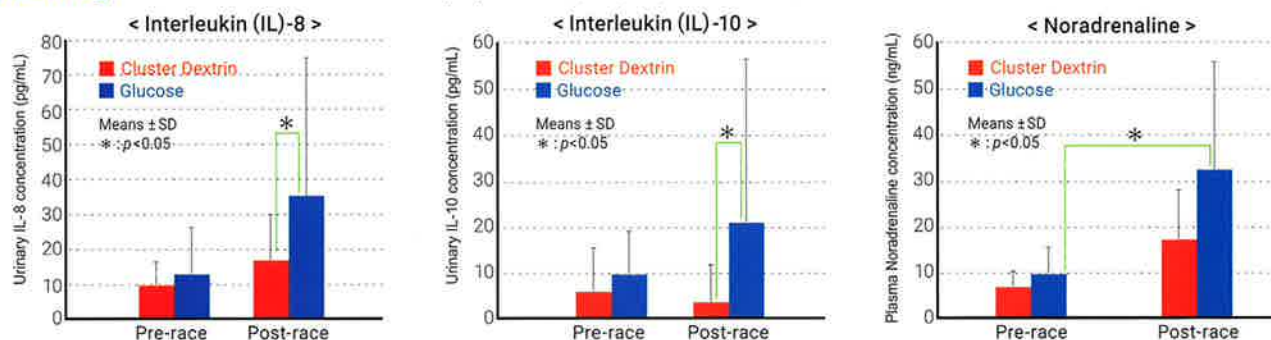
[Protocol of the Exercise Test]

Duathlon race



[Results]

Measurement of Urinary Cytokines (IL-8, 10) and Plasma Catecholamine (Noradrenaline)

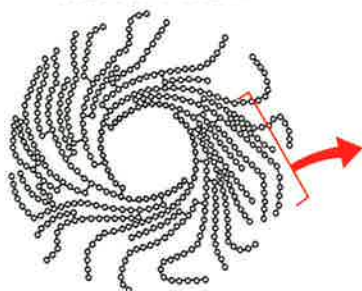


• Cluster Dextrin-based drink suppressed urinary cytokine concentrations such as IL-8 and IL-10, as well as plasma catecholamine concentrations after the race, compared to drink containing the same amount of glucose, suggesting modification of immune system.

→ Cluster Dextrin suppresses excess stress reaction and immune response resulting from vigorous exercise, effectively suggesting improved conditioning of athletes.

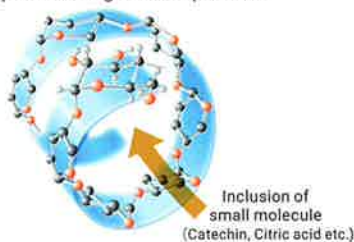
Additional Property: Taste-Masking

Cluster Dextrin



"Helical structure"

Composed of 6 glucoses per turn

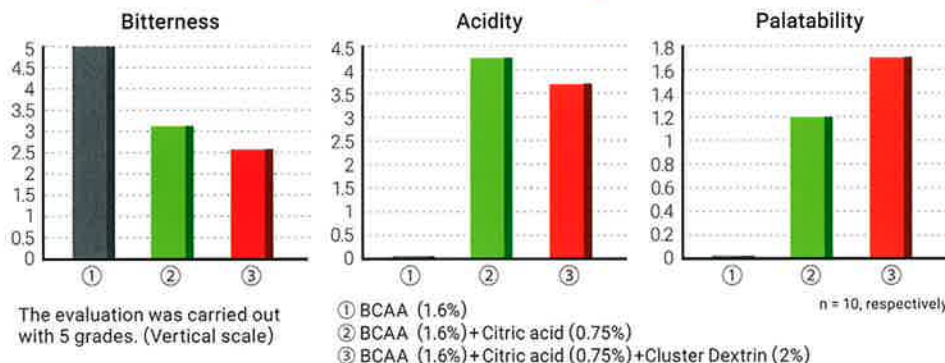


[Taste-masking Effect]

- Cluster Dextrin has many long glucose chains per molecule.
- The glucose chains with alpha-1,4 linkages are known to have a helical structure composed of 6 glucose molecules per turn.
- The helical structure has the ability to form inclusion complexes with low molecular weight substances.
- This enables Cluster Dextrin to subdue bitterness, acidity and other harsh tastes.

[Evaluation of the Taste of Drinks Containing BCAA®, Citric Acid, and Cluster Dextrin]

※ Branched chain amino acid



The evaluation was carried out with 5 grades. (Vertical scale)

- 1 BCAA (1.6%)
- 2 BCAA (1.6%) + Citric acid (0.75%)
- 3 BCAA (1.6%) + Citric acid (0.75%) + Cluster Dextrin (2%)

- Citric acid and BCAA are very important components of sports drinks. However, citric acid is very sour and BCAA is very bitter.
- Citric acid suppresses the bitterness of BCAA, whereas Cluster Dextrin suppresses the acidity of citric acid.

→ Using Cluster Dextrin with citric acid and BCAA produces a sports drink with less bitterness and acidity.

Cluster Dextrin®



Specifications

Appearance	White powder
Loss on drying	≤ 5.5 %
Residue on ignition	≤ 0.05 %
DE (Dextrose equivalent)	< 5
Micro-organisms	≤ 300 CFU/g
Coliforms	Negative
Moulds	≤ 50 CFU/g
Yeast	≤ 50 CFU/g

Name & Information

Trade name : CLUSTER DEXTRIN®

CAS No. : 9050-36-6

FDA Notified GRAS since October 2012.

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