

2018/11/01

来自妈妈的“第一口糖”

母乳低聚糖最新研究进展及其与微生态
健康的关系



杜邦营养与健康大中华区产品经理
李灵



母乳喂养是金标准

> 母乳喂养促进了婴儿的健康成长

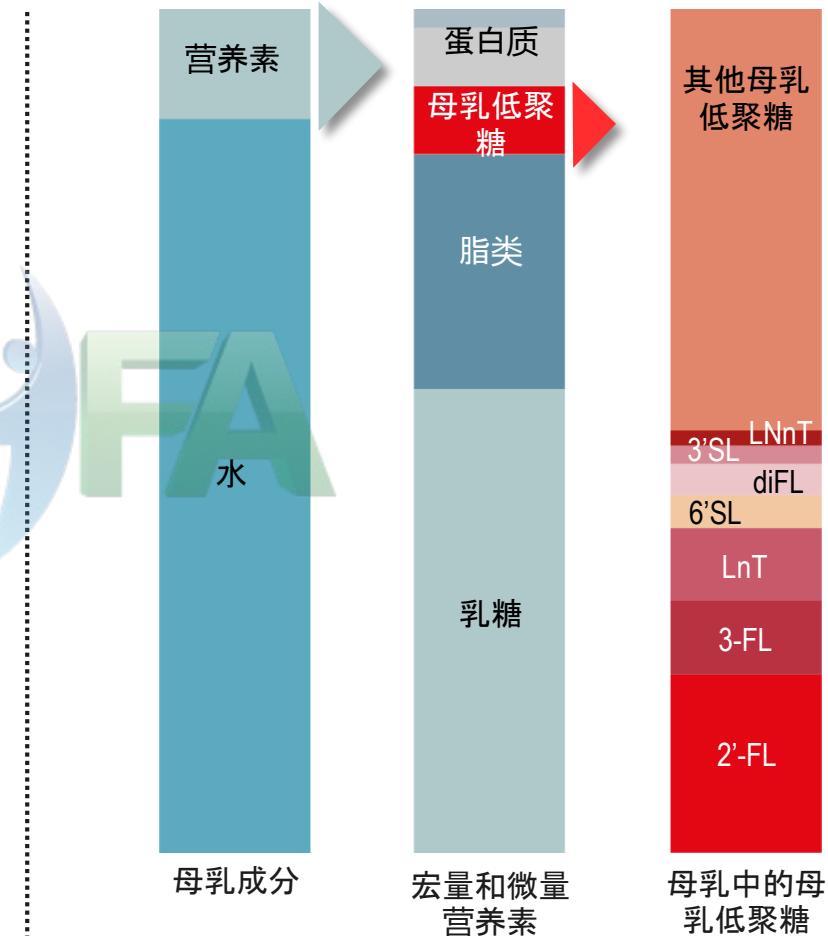
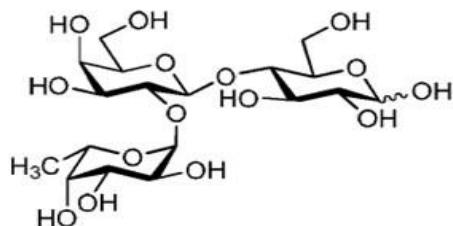
> 婴儿配方粉无法完全模仿母乳的成分

> 母乳低聚糖可以模仿一部分母乳促进健康的功用



母乳低聚糖

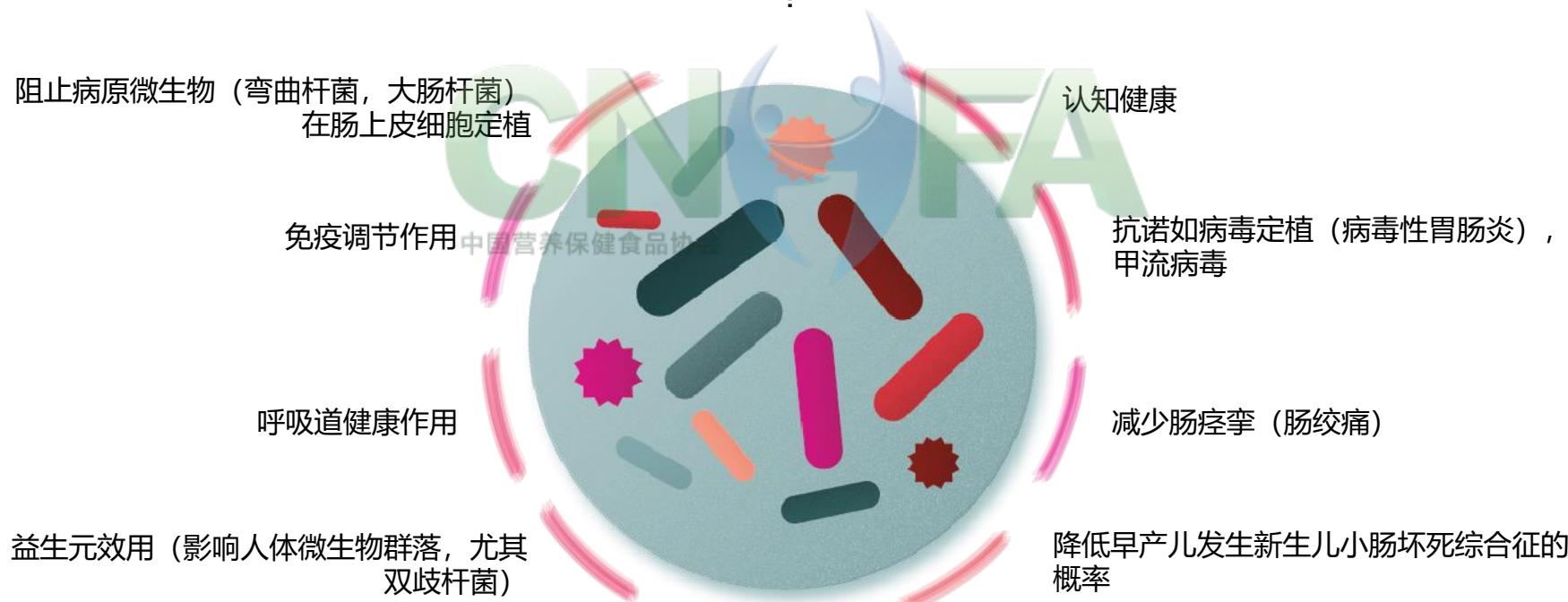
- 母乳低聚糖 (HMO) 是一组独特的来源于母乳的低聚糖
- HMO是母乳中仅次于乳糖和脂肪之外的第三大可溶物
- 在所有从母乳中被发现的130种不同的低聚糖中, 2'-岩藻糖基乳糖 (2'-FL) 是含量最丰富的~ 2.4 g/L
- 母乳低聚糖的种类和水平在不同女性中, 不同的地域中以及泌乳的不同阶段都差异巨大



HMO帮助构建健康的肠道菌群

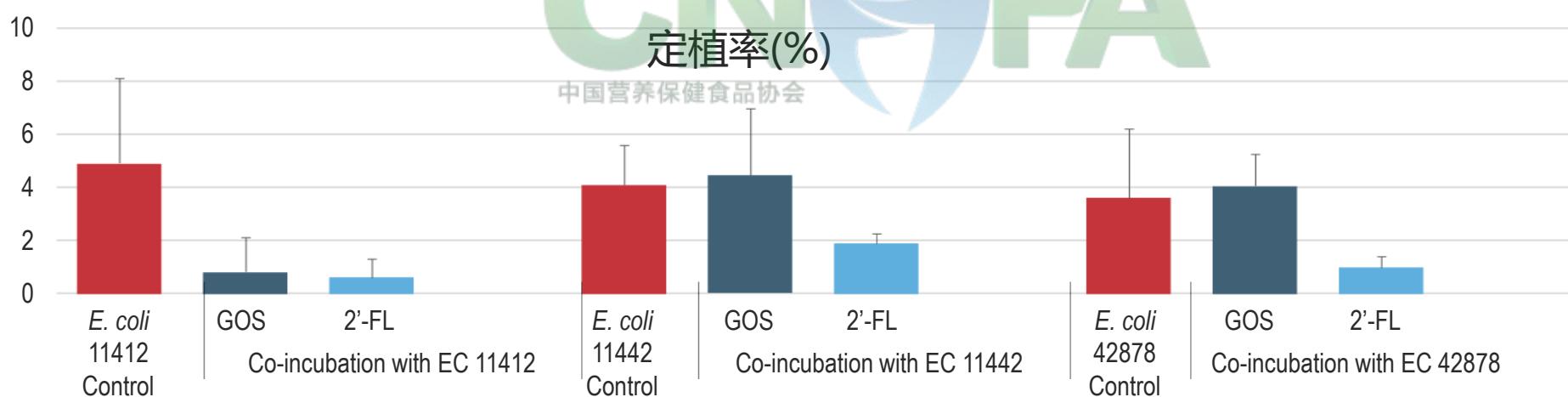
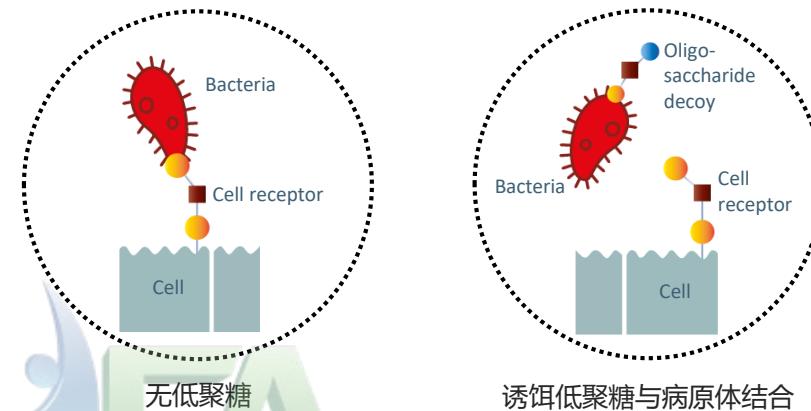
HMO是重要的生物活性物质
能从生命早期开始帮助人体促进和
维持健康

- HMO有效促进双歧杆菌增长，并且能够帮助形成以双歧杆菌占主导的肠道菌群环境
- HMO增强了肠屏障功能并且扮演了病原微生物诱饵的角色



HMO充当病原微生物的诱饵

- 研究发现HMO充当了诱饵受体，阻止病原微生物定植在上皮细胞，因此HMO可能抑制了感染性疾病的发生
- 我们的研究显示2' FL减少了导致婴儿腹泻的3株大肠杆菌在Caco-2肠上皮细胞的定植



2' -岩藻糖基乳糖和低聚半乳糖对于大肠杆菌11412, 11442和42878在Caco-2细胞上定植的影响, 使用了SYTO24细菌标记和荧光检测

HMO有效促进双歧杆菌生长

- **体外婴儿肠道模拟器**模型是研究HMO的益生元特性的十分有用的工具，它获得的是与人类相关的数据，而不是动物数据
- 当使用具有相对高双歧杆菌含量的婴儿粪便作为接种物时，2'-FL增加了模拟器中双歧杆菌的总量，但是在其他没有检测到双歧杆菌的粪便样品的模拟器中双歧杆菌数量没有增加。



In vitro infant colon simulator
in Kantvik Finland

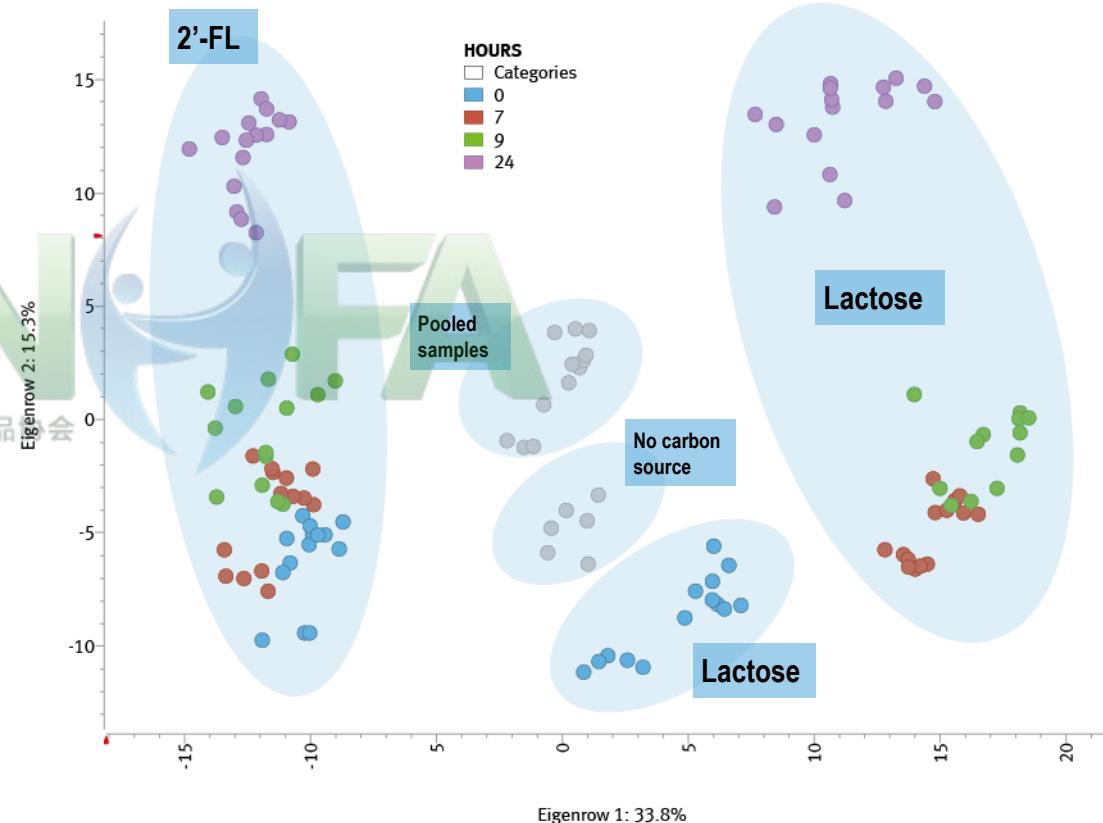


Bacterium	Strain	Carbon source			
		GLU	LACT	GOS	2'-FL
<i>Clostridium perfringens</i>	ATCC 3626	+	+	+	-
<i>Clostridium perfringens</i>	ATCC 13124	+	+	+	-
<i>Escherichia coli</i>	ATCC 11775	+	+	+	-
<i>Salmonella typhimurium</i>	EELA	+	+	-	-
<i>Escherichia coli</i> (O111:K(58):H-)	CCUG 11412	+	+	+	-
<i>Escherichia coli</i> (O142:K86(B):H4)	CCUG 11442	+	+	+	-
<i>Escherichia coli</i> (O111:K58(B4):H2)	CCUG 42878	+	+	+	-
<i>Lactobacillus acidophilus</i>	NCFM	+	+	+	-
<i>Lactobacillus paracasei</i>	Lpc-37	+	+	+	-
<i>Bifidobacterium animalis</i> subsp. <i>lactis</i>	Bi-07	+	+	+	-
<i>Bifidobacterium animalis</i> subsp. <i>lactis</i>	Bi-04	+	+	+	-
<i>Bifidobacterium longum</i> subsp. <i>longum</i>	BI-05	+	+	+	-
<i>Lactobacillus rhamnosus</i>	HN001	+	+	+	-
<i>Bifidobacterium lactis</i>	HN019	+	+	+	-
<i>Bifidobacterium longum</i> subsp. <i>infantis</i>	Bi-26	+	+	+	+
<i>Bifidobacterium longum</i> subsp. <i>infantis</i>	ATCC 15697	+	+	+	+
<i>Bifidobacterium breve</i>	Bb-03	+	+	+	-
<i>Bifidobacterium bifidum</i>	Bb-06	+	+	+	+

母乳低聚糖区别于乳糖的不同代谢产物

- > 当婴儿双歧杆菌Bi-26以2' -FL作为碳源时的代谢产物与以乳糖作为碳源时的代谢产物差异很大
- > 与以乳酸相比，当以2' -FL为碳源时，Bi-26产生更多的1, 2-丙二醇，醋酸酯，甲酸盐和丙酮酸等
- > 除了已知的代谢产物，以2' -FL作为碳源时，与以乳糖作为碳源相比，Bi-26产生了一系列更高含量的未知分子
- > Bi-26含有转运和降解母乳低聚糖的基因簇

PRINCIPAL COMPONENT ANALYSIS OF GC-TOF-MS PROFILING



近期临床研究

临床研究显示使用HMO的配方是安全并且有良好的耐受性的

- Correlation between less diarrhea incidents in infants and higher 2' FL concentration in human milk (identified via epidemiological studies)
- *Nestlé intervention study, 2016*: Infant formula supplemented with HMOs (2'Fucosyllactose and Lacto-N-neotetraose) shifts stool microbiota and metabolic signatures closer to that of breastfed Infants
- *Simeoni et al, 2016*: B.lactis + bovine oligosacch → demonstrated the role of nutritional intervention in modulating the diversity and composition of the gut microbiota so that it becomes closer to those of breastfed infants
- *Goehring et al. 2016*: Infants fed formula supplemented with 2' FL exhibit lower plasma and ex vivo inflammatory cytokine profiles, similar to those of a breastfed reference group.
- *Abbott, 2016*: Growth and 2' FL uptake were similar between infants fed formula and human milk fed with the same caloric density
- *Elison et al. 2016*: Supplementing the diet with 2'FL and LNnT may be a valuable tool to restore homoeostasis in adults having an imbalanced microbiota
- *Puccio et al. 2017*: Infant formula with 2' FL and LNnT is safe, well-tolerated, and supports age-appropriate growth. Infants receiving HMOs-supplemented formula had significantly fewer parental reports of bronchitis and respiratory tract infections, and medication use (antipyretics and antibiotics)

HMO应用广泛



- 标准婴儿配方粉（1-2段）
- 3-4段婴儿配方粉
- 成长奶粉
- 特殊用途婴儿配方粉



- 肠易激综合征
- 旅行者腹泻
- 流感和诺如病毒感染的预防
- 呼吸道疾病预防
- 孕期营养



- 婴儿食品
- 婴幼儿酸奶
- 儿童营养
- 老年营养（双歧杆菌不足引起的问题）



- 腹泻预防-牛奶替代品
- 动物免疫系统激发
- 家禽-预防弯曲杆菌

全球已上市的HMO产品



欧盟和美国法规现状

- >2017年12月杜邦2' -FL获得欧盟新资源食品批准
- >2018年4月杜邦2' -FL获得欧盟在婴儿奶粉中的使用批准
- >从2017年7月开始，杜邦2' -FL就获得了美国GRAS通知
- >在2018年4月，杜邦2' -FL得到了在婴幼儿奶粉中使用的FDA无异议通知，最大添加量为2.4g/L



GRN No. 546

Substance: 2'-Furoxyfucose
Intended Use: Intended for use in term infant formula at a maximum level of 2.400 milligrams/mg/L. Also intended for use in baked goods, confectionery, beverages and beverage bases, coffee and tea, dairy product analogs, infant and toddler foods, grain products and pastas, milk (whole and skim), processed fruits and juices, processed vegetables and soups, and sugar substitutes at maximum levels ranging from 0.084 to 2.4 grams/milliliter.

Basis: Scientific procedures
Notifier: Glycom A/S
Diplomvej 373DK-2800 Kgs. Lyngby/Denmark
Date of filing: Oct 16, 2014
GRAS Notice (releasable information): GRN 546 (in PDF) (1.1 MB)
Date of closure: Sep 16, 2015
FDA's Letter: FDA has no questions
Notes: Correction letter issued September 24, 2014.

GRN No. 735

Substance: 2'-Furoxyfucose
Intended Use: For use as an ingredient in beverages and beverage bases; breakfast cereals; dairy product analogs; frozen dairy desserts and mixes; gelatin; puddings and fillings; grain products and pastas; jams and jellies; milk; whole and skim; milk products; processed fruits and fruit juices; sweet sauces; toppings; and syrups; non-exempt infant and follow-on formulas; baby foods; and medical foods at levels ranging from 0.24 to 4 grams/serve.

Basis: Scientific procedures
Notifier: Glycom, LLC and Friesland Campina Domé B.V.
890 Winter Street
Suite 208
Waltham, MA 02451
FDA's Letter: Pending

中国法规现状

中国政府机构刚经历了重组，包括

- 新的农业农村部(过去的农业部)
- 新的国家卫健委（过去的国家卫计委）
- 新的市场监督管理总局(过去的国家食品药品监督管理总局+国家质量监督检验检疫总局+国家工商总局)
- 政府对监管批准和监管的责任需要澄清
- HMO的供应商和应用企业正在通力合作，积极推动法规批准的进程，但是目前还没有时间表

GLOBAL TIMES
WEEKLY CHINA, INSIGHTS THE WORLD

HOME CHINA BIZ WORLD OPINION LIFE ARTS SCI-TECH ODD SPORT METRO

HOME >> CHINA

China to set up national health commission

Source: Xinhua Published: 2018/3/13 11:45:43

China plans to set up a national health commission, according to a document on a State Council institutional reform plan submitted Tuesday to the ongoing national legislative session for deliberations.

The move aims to promote the Healthy China initiative and ensure the delivery of comprehensive lifecycle health services for the Chinese people, said the document.

The proposed commission will be responsible for formulating national health policies, coordinating and advancing medical and

中华人民共和国农业部
Ministry of Agriculture of the People's Republic of China

首页 机构 新闻 公开 政务服务 专题 互动 数据 业务管理

农业部门负责人实施乡村振兴战略推进农业转型升级专题轮训班的通知 2018年度农业部软科学研究课题指南发布 ...
农业部2018年“百万户调查”活动行前动员会

国务院信息 农业部动态 全国信息联播

- 农业部部署2018-2020年全国农机购置补贴工作 03-19
- 农业部推出农村创新创业五大典型模式 03-19
- 华北地区出现降水天气 河北等受旱区墒情改善 03-17
- 韩长赋主持召开农业部党组（扩大）会议强... 03-16
- 农业部兽医局负责人就家禽H7N9流感防治工... 03-09
- 农业部开展纪念“三八”国际劳动妇女节活动 03-08
- 实施乡村振兴战略 推动农业转型升级——农... 03-08
- 农业部召开2018年全国重大动物疫病防控工... 03-07



杜邦人体微生物组平台

益生菌
领先地位



杜邦益生菌
杜邦营养与健康

母乳低聚糖
2018进入市场



杜邦在2016年宣布与Inbiose合作

下一代微生物组解决方案



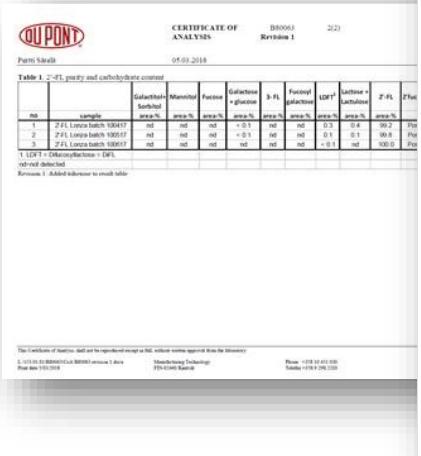
2017 杜邦在2017年宣布成立微生物组
创投部门

CARE4U™ 2'-FL



高纯度，婴儿级2'FL，粉体质量优异：

- >98% 2'-FL
 - 密度 > 0.6 kg/L (稀疏孔洞)
 - 最高的纯度和密度 → 成品中产品使用量少
 - 给益生菌更多的空间
 - 高度可溶，几乎清澈的浊度，优异的即时溶解性
 - 知识产权保护程序（已在世界各地申请多项专利）



供应链-三步走策略



首批产品

- 1到2个第三方工厂来满足市场引进和中短期需求

初步上市阶段

Grindsted, 丹麦

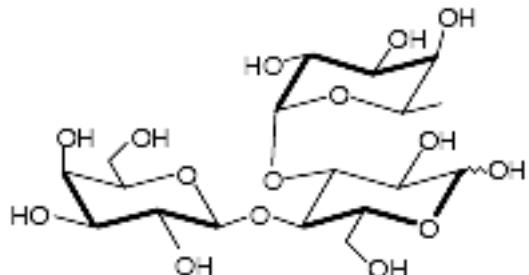
- 灵活的工厂生产线满足规模扩张和市场开发的需求

大规模生产阶段

- 时间, 地点和规模将取决于市场渗透程度
- 由于规模效应, 大批量生产将带来更大的价格优势
- 多种生产设施保证供应

3-FL

- 3-FL存在于所有母亲的母乳中，在哺乳期浓度或许会增加
- 与2'FL（以及唾液酸化HMOs）相比，3-FL已被证明在减少结肠运动收缩方面更有效
- 3-FL与Caco-2细胞中的2'FL相比表现出更强的细菌粘附抑制作用



inbiose Pre-clinical differentiator for 3-FL

Fucosylated but Not Sialylated Milk Oligosaccharides Diminish Colon Motor Contractions

John Bannerman^{1,*}, Rachel H. Burk¹, Hawley Linke¹, Paul Forsyth¹, Andrew M. Stanier¹, Wolfgang A. Kunz^{2,3}

¹ Institute for Child Health Research, University Ontario, Canada; ² Abbott Nutrition, a Division of Abbott Laboratories, Columbus, Ohio, United States of America; ³ Department of Pathology and Laboratory Medicine, University of Alberta, Edmonton, Alberta, Canada; ⁴ Department of Cell Biology, University of Alberta, Edmonton, Alberta, Canada; ⁵ Department of Biochemistry, University of Alberta, Edmonton, Alberta, Canada; ⁶ Department of Molecular Genetics, University of Toronto, Toronto, Ontario, Canada; ⁷ Department of Biochemistry, Molecular Biology, and Biophysics, University of Minnesota, Minneapolis, Minnesota, United States of America

Abstract

Human milk oligosaccharides (HMOs) are being studied by different groups exploring a broad range of potential biological effects on the intestinal system. Many of these effects have been attributed to a growth promotion effect or to certain gut organisms such as bifidobacteria. Additionally, evidence indicates that HMOs are able to directly promote gut motility. Only the fucosylated HMOs, which are decreased contractility in a dose-dependent manner, decreased gut motility. This study shows that the 3-fucosylated HMO, 3'-fucosyllactose (3FL), was used as a reference material. Fucosylation seems to reduce this functional regulation of gut contractility by HMOs. 3FL, while it was also capable of reducing contractility, was substantially less effective than 3FL and 2FL. These results indicate that the fucosylation of HMOs is important for their biological activity. The inhibitory action on neuromuscular dependent gut migrating motor complexes is likely and biocurative is important in preventing this disease. This study also suggests that the fucosylation of HMOs may be important in the prevention of colic. It is possible that fucosylated sugar and lactose might be used as therapeutic or preventative elements in instances of gut motility and possibly also have beneficial central nervous system effects.

3-FL effect on ex-vivo mouse colon model

3-FL decreased gut motor contractions (better than 2FL, LNnT and GOS: no effects)

inbiose Also antiviral action indications

Structural Basis for Norovirus Inhibition by Human Milk Oligosaccharides

Geert Bonthuis¹, Anne Koenigsmann², Balbir K. Singh³, Sabine Hammes⁴, Stefan Jantsch⁵, Harald Schubert⁶, Stephan Wenzel⁷, Michaela Lohmann⁸, Michaela Lohmann⁹, Michaela Lohmann¹⁰, Michaela Lohmann¹¹, Michaela Lohmann¹², Michaela Lohmann¹³, Michaela Lohmann¹⁴, Michaela Lohmann¹⁵, Michaela Lohmann¹⁶, Michaela Lohmann¹⁷, Michaela Lohmann¹⁸, Michaela Lohmann¹⁹, Michaela Lohmann²⁰, Michaela Lohmann²¹, Michaela Lohmann²², Michaela Lohmann²³, Michaela Lohmann²⁴, Michaela Lohmann²⁵, Michaela Lohmann²⁶, Michaela Lohmann²⁷, Michaela Lohmann²⁸, Michaela Lohmann²⁹, Michaela Lohmann³⁰, Michaela Lohmann³¹, Michaela Lohmann³², Michaela Lohmann³³, Michaela Lohmann³⁴, Michaela Lohmann³⁵, Michaela Lohmann³⁶, Michaela Lohmann³⁷, Michaela Lohmann³⁸, Michaela Lohmann³⁹, Michaela Lohmann⁴⁰, Michaela Lohmann⁴¹, Michaela Lohmann⁴², Michaela Lohmann⁴³, Michaela Lohmann⁴⁴, Michaela Lohmann⁴⁵, Michaela Lohmann⁴⁶, Michaela Lohmann⁴⁷, Michaela Lohmann⁴⁸, Michaela Lohmann⁴⁹, Michaela Lohmann⁵⁰, Michaela Lohmann⁵¹, Michaela Lohmann⁵², Michaela Lohmann⁵³, Michaela Lohmann⁵⁴, Michaela Lohmann⁵⁵, Michaela Lohmann⁵⁶, Michaela Lohmann⁵⁷, Michaela Lohmann⁵⁸, Michaela Lohmann⁵⁹, Michaela Lohmann⁶⁰, Michaela Lohmann⁶¹, Michaela Lohmann⁶², Michaela Lohmann⁶³, Michaela Lohmann⁶⁴, Michaela Lohmann⁶⁵, Michaela Lohmann⁶⁶, Michaela Lohmann⁶⁷, Michaela Lohmann⁶⁸, Michaela Lohmann⁶⁹, Michaela Lohmann⁷⁰, Michaela Lohmann⁷¹, Michaela Lohmann⁷², Michaela Lohmann⁷³, Michaela Lohmann⁷⁴, Michaela Lohmann⁷⁵, Michaela Lohmann⁷⁶, Michaela Lohmann⁷⁷, Michaela Lohmann⁷⁸, Michaela Lohmann⁷⁹, Michaela Lohmann⁸⁰, Michaela Lohmann⁸¹, Michaela Lohmann⁸², Michaela Lohmann⁸³, Michaela Lohmann⁸⁴, Michaela Lohmann⁸⁵, Michaela Lohmann⁸⁶, Michaela Lohmann⁸⁷, Michaela Lohmann⁸⁸, Michaela Lohmann⁸⁹, Michaela Lohmann⁹⁰, Michaela Lohmann⁹¹, Michaela Lohmann⁹², Michaela Lohmann⁹³, Michaela Lohmann⁹⁴, Michaela Lohmann⁹⁵, Michaela Lohmann⁹⁶, Michaela Lohmann⁹⁷, Michaela Lohmann⁹⁸, Michaela Lohmann⁹⁹, Michaela Lohmann¹⁰⁰, Michaela Lohmann¹⁰¹, Michaela Lohmann¹⁰², Michaela Lohmann¹⁰³, Michaela Lohmann¹⁰⁴, Michaela Lohmann¹⁰⁵, Michaela Lohmann¹⁰⁶, Michaela Lohmann¹⁰⁷, Michaela Lohmann¹⁰⁸, Michaela Lohmann¹⁰⁹, Michaela Lohmann¹¹⁰, Michaela Lohmann¹¹¹, Michaela Lohmann¹¹², Michaela Lohmann¹¹³, Michaela Lohmann¹¹⁴, Michaela Lohmann¹¹⁵, Michaela Lohmann¹¹⁶, Michaela Lohmann¹¹⁷, Michaela Lohmann¹¹⁸, Michaela Lohmann¹¹⁹, Michaela Lohmann¹²⁰, Michaela Lohmann¹²¹, Michaela Lohmann¹²², Michaela Lohmann¹²³, Michaela Lohmann¹²⁴, Michaela Lohmann¹²⁵, Michaela Lohmann¹²⁶, Michaela Lohmann¹²⁷, Michaela Lohmann¹²⁸, Michaela Lohmann¹²⁹, Michaela Lohmann¹³⁰, Michaela Lohmann¹³¹, Michaela Lohmann¹³², Michaela Lohmann¹³³, Michaela Lohmann¹³⁴, Michaela Lohmann¹³⁵, Michaela Lohmann¹³⁶, Michaela Lohmann¹³⁷, Michaela Lohmann¹³⁸, Michaela Lohmann¹³⁹, Michaela Lohmann¹⁴⁰, Michaela Lohmann¹⁴¹, Michaela Lohmann¹⁴², Michaela Lohmann¹⁴³, Michaela Lohmann¹⁴⁴, Michaela Lohmann¹⁴⁵, Michaela Lohmann¹⁴⁶, Michaela Lohmann¹⁴⁷, Michaela Lohmann¹⁴⁸, Michaela Lohmann¹⁴⁹, Michaela Lohmann¹⁵⁰, Michaela Lohmann¹⁵¹, Michaela Lohmann¹⁵², Michaela Lohmann¹⁵³, Michaela Lohmann¹⁵⁴, Michaela Lohmann¹⁵⁵, Michaela Lohmann¹⁵⁶, Michaela Lohmann¹⁵⁷, Michaela Lohmann¹⁵⁸, Michaela Lohmann¹⁵⁹, Michaela Lohmann¹⁶⁰, Michaela Lohmann¹⁶¹, Michaela Lohmann¹⁶², Michaela Lohmann¹⁶³, Michaela Lohmann¹⁶⁴, Michaela Lohmann¹⁶⁵, Michaela Lohmann¹⁶⁶, Michaela Lohmann¹⁶⁷, Michaela Lohmann¹⁶⁸, Michaela Lohmann¹⁶⁹, Michaela Lohmann¹⁷⁰, Michaela Lohmann¹⁷¹, Michaela Lohmann¹⁷², Michaela Lohmann¹⁷³, Michaela Lohmann¹⁷⁴, Michaela Lohmann¹⁷⁵, Michaela Lohmann¹⁷⁶, Michaela Lohmann¹⁷⁷, Michaela Lohmann¹⁷⁸, Michaela Lohmann¹⁷⁹, Michaela Lohmann¹⁸⁰, Michaela Lohmann¹⁸¹, Michaela Lohmann¹⁸², Michaela Lohmann¹⁸³, Michaela Lohmann¹⁸⁴, Michaela Lohmann¹⁸⁵, Michaela Lohmann¹⁸⁶, Michaela Lohmann¹⁸⁷, Michaela Lohmann¹⁸⁸, Michaela Lohmann¹⁸⁹, Michaela Lohmann¹⁹⁰, Michaela Lohmann¹⁹¹, Michaela Lohmann¹⁹², Michaela Lohmann¹⁹³, Michaela Lohmann¹⁹⁴, Michaela Lohmann¹⁹⁵, Michaela Lohmann¹⁹⁶, Michaela Lohmann¹⁹⁷, Michaela Lohmann¹⁹⁸, Michaela Lohmann¹⁹⁹, Michaela Lohmann²⁰⁰, Michaela Lohmann²⁰¹, Michaela Lohmann²⁰², Michaela Lohmann²⁰³, Michaela Lohmann²⁰⁴, Michaela Lohmann²⁰⁵, Michaela Lohmann²⁰⁶, Michaela Lohmann²⁰⁷, Michaela Lohmann²⁰⁸, Michaela Lohmann²⁰⁹, Michaela Lohmann²¹⁰, Michaela Lohmann²¹¹, Michaela Lohmann²¹², Michaela Lohmann²¹³, Michaela Lohmann²¹⁴, Michaela Lohmann²¹⁵, Michaela Lohmann²¹⁶, Michaela Lohmann²¹⁷, Michaela Lohmann²¹⁸, Michaela Lohmann²¹⁹, Michaela Lohmann²²⁰, Michaela Lohmann²²¹, Michaela Lohmann²²², Michaela Lohmann²²³, Michaela Lohmann²²⁴, Michaela Lohmann²²⁵, Michaela Lohmann²²⁶, Michaela Lohmann²²⁷, Michaela Lohmann²²⁸, Michaela Lohmann²²⁹, Michaela Lohmann²³⁰, Michaela Lohmann²³¹, Michaela Lohmann²³², Michaela Lohmann²³³, Michaela Lohmann²³⁴, Michaela Lohmann²³⁵, Michaela Lohmann²³⁶, Michaela Lohmann²³⁷, Michaela Lohmann²³⁸, Michaela Lohmann²³⁹, Michaela Lohmann²⁴⁰, Michaela Lohmann²⁴¹, Michaela Lohmann²⁴², Michaela Lohmann²⁴³, Michaela Lohmann²⁴⁴, Michaela Lohmann²⁴⁵, Michaela Lohmann²⁴⁶, Michaela Lohmann²⁴⁷, Michaela Lohmann²⁴⁸, Michaela Lohmann²⁴⁹, Michaela Lohmann²⁵⁰, Michaela Lohmann²⁵¹, Michaela Lohmann²⁵², Michaela Lohmann²⁵³, Michaela Lohmann²⁵⁴, Michaela Lohmann²⁵⁵, Michaela Lohmann²⁵⁶, Michaela Lohmann²⁵⁷, Michaela Lohmann²⁵⁸, Michaela Lohmann²⁵⁹, Michaela Lohmann²⁶⁰, Michaela Lohmann²⁶¹, Michaela Lohmann²⁶², Michaela Lohmann²⁶³, Michaela Lohmann²⁶⁴, Michaela Lohmann²⁶⁵, Michaela Lohmann²⁶⁶, Michaela Lohmann²⁶⁷, Michaela Lohmann²⁶⁸, Michaela Lohmann²⁶⁹, Michaela Lohmann²⁷⁰, Michaela Lohmann²⁷¹, Michaela Lohmann²⁷², Michaela Lohmann²⁷³, Michaela Lohmann²⁷⁴, Michaela Lohmann²⁷⁵, Michaela Lohmann²⁷⁶, Michaela Lohmann²⁷⁷, Michaela Lohmann²⁷⁸, Michaela Lohmann²⁷⁹, Michaela Lohmann²⁸⁰, Michaela Lohmann²⁸¹, Michaela Lohmann²⁸², Michaela Lohmann²⁸³, Michaela Lohmann²⁸⁴, Michaela Lohmann²⁸⁵, Michaela Lohmann²⁸⁶, Michaela Lohmann²⁸⁷, Michaela Lohmann²⁸⁸, Michaela Lohmann²⁸⁹, Michaela Lohmann²⁹⁰, Michaela Lohmann²⁹¹, Michaela Lohmann²⁹², Michaela Lohmann²⁹³, Michaela Lohmann²⁹⁴, Michaela Lohmann²⁹⁵, Michaela Lohmann²⁹⁶, Michaela Lohmann²⁹⁷, Michaela Lohmann²⁹⁸, Michaela Lohmann²⁹⁹, Michaela Lohmann³⁰⁰, Michaela Lohmann³⁰¹, Michaela Lohmann³⁰², Michaela Lohmann³⁰³, Michaela Lohmann³⁰⁴, Michaela Lohmann³⁰⁵, Michaela Lohmann³⁰⁶, Michaela Lohmann³⁰⁷, Michaela Lohmann³⁰⁸, Michaela Lohmann³⁰⁹, Michaela Lohmann³¹⁰, Michaela Lohmann³¹¹, Michaela Lohmann³¹², Michaela Lohmann³¹³, Michaela Lohmann³¹⁴, Michaela Lohmann³¹⁵, Michaela Lohmann³¹⁶, Michaela Lohmann³¹⁷, Michaela Lohmann³¹⁸, Michaela Lohmann³¹⁹, Michaela Lohmann³²⁰, Michaela Lohmann³²¹, Michaela Lohmann³²², Michaela Lohmann³²³, Michaela Lohmann³²⁴, Michaela Lohmann³²⁵, Michaela Lohmann³²⁶, Michaela Lohmann³²⁷, Michaela Lohmann³²⁸, Michaela Lohmann³²⁹, Michaela Lohmann³³⁰, Michaela Lohmann³³¹, Michaela Lohmann³³², Michaela Lohmann³³³, Michaela Lohmann³³⁴, Michaela Lohmann³³⁵, Michaela Lohmann³³⁶, Michaela Lohmann³³⁷, Michaela Lohmann³³⁸, Michaela Lohmann³³⁹, Michaela Lohmann³⁴⁰, Michaela Lohmann³⁴¹, Michaela Lohmann³⁴², Michaela Lohmann³⁴³, Michaela Lohmann³⁴⁴, Michaela Lohmann³⁴⁵, Michaela Lohmann³⁴⁶, Michaela Lohmann³⁴⁷, Michaela Lohmann³⁴⁸, Michaela Lohmann³⁴⁹, Michaela Lohmann³⁵⁰, Michaela Lohmann³⁵¹, Michaela Lohmann³⁵², Michaela Lohmann³⁵³, Michaela Lohmann³⁵⁴, Michaela Lohmann³⁵⁵, Michaela Lohmann³⁵⁶, Michaela Lohmann³⁵⁷, Michaela Lohmann³⁵⁸, Michaela Lohmann³⁵⁹, Michaela Lohmann³⁶⁰, Michaela Lohmann³⁶¹, Michaela Lohmann³⁶², Michaela Lohmann³⁶³, Michaela Lohmann³⁶⁴, Michaela Lohmann³⁶⁵, Michaela Lohmann³⁶⁶, Michaela Lohmann³⁶⁷, Michaela Lohmann³⁶⁸, Michaela Lohmann³⁶⁹, Michaela Lohmann³⁷⁰, Michaela Lohmann³⁷¹, Michaela Lohmann³⁷², Michaela Lohmann³⁷³, Michaela Lohmann³⁷⁴, Michaela Lohmann³⁷⁵, Michaela Lohmann³⁷⁶, Michaela Lohmann³⁷⁷, Michaela Lohmann³⁷⁸, Michaela Lohmann³⁷⁹, Michaela Lohmann³⁸⁰, Michaela Lohmann³⁸¹, Michaela Lohmann³⁸², Michaela Lohmann³⁸³, Michaela Lohmann³⁸⁴, Michaela Lohmann³⁸⁵, Michaela Lohmann³⁸⁶, Michaela Lohmann³⁸⁷, Michaela Lohmann³⁸⁸, Michaela Lohmann³⁸⁹, Michaela Lohmann³⁹⁰, Michaela Lohmann³⁹¹, Michaela Lohmann³⁹², Michaela Lohmann³⁹³, Michaela Lohmann³⁹⁴, Michaela Lohmann³⁹⁵, Michaela Lohmann³⁹⁶, Michaela Lohmann³⁹⁷, Michaela Lohmann³⁹⁸, Michaela Lohmann³⁹⁹, Michaela Lohmann⁴⁰⁰, Michaela Lohmann⁴⁰¹, Michaela Lohmann⁴⁰², Michaela Lohmann⁴⁰³, Michaela Lohmann⁴⁰⁴, Michaela Lohmann⁴⁰⁵, Michaela Lohmann⁴⁰⁶, Michaela Lohmann⁴⁰⁷, Michaela Lohmann⁴⁰⁸, Michaela Lohmann⁴⁰⁹, Michaela Lohmann⁴¹⁰, Michaela Lohmann⁴¹¹, Michaela Lohmann⁴¹², Michaela Lohmann⁴¹³, Michaela Lohmann⁴¹⁴, Michaela Lohmann⁴¹⁵, Michaela Lohmann⁴¹⁶, Michaela Lohmann⁴¹⁷, Michaela Lohmann⁴¹⁸, Michaela Lohmann⁴¹⁹, Michaela Lohmann⁴²⁰, Michaela Lohmann⁴²¹, Michaela Lohmann⁴²², Michaela Lohmann⁴²³, Michaela Lohmann⁴²⁴, Michaela Lohmann⁴²⁵, Michaela Lohmann⁴²⁶, Michaela Lohmann⁴²⁷, Michaela Lohmann⁴²⁸, Michaela Lohmann⁴²⁹, Michaela Lohmann⁴³⁰, Michaela Lohmann⁴³¹, Michaela Lohmann⁴³², Michaela Lohmann⁴³³, Michaela Lohmann⁴³⁴, Michaela Lohmann⁴³⁵, Michaela Lohmann⁴³⁶, Michaela Lohmann⁴³⁷, Michaela Lohmann⁴³⁸, Michaela Lohmann⁴³⁹, Michaela Lohmann⁴⁴⁰, Michaela Lohmann⁴⁴¹, Michaela Lohmann⁴⁴², Michaela Lohmann⁴⁴³, Michaela Lohmann⁴⁴⁴, Michaela Lohmann⁴⁴⁵, Michaela Lohmann⁴⁴⁶, Michaela Lohmann⁴⁴⁷, Michaela Lohmann⁴⁴⁸, Michaela Lohmann⁴⁴⁹, Michaela Lohmann⁴⁵⁰, Michaela Lohmann⁴⁵¹, Michaela Lohmann⁴⁵², Michaela Lohmann⁴⁵³, Michaela Lohmann⁴⁵⁴, Michaela Lohmann⁴⁵⁵, Michaela Lohmann⁴⁵⁶, Michaela Lohmann⁴⁵⁷, Michaela Lohmann⁴⁵⁸, Michaela Lohmann⁴⁵⁹, Michaela Lohmann⁴⁶⁰, Michaela Lohmann⁴⁶¹, Michaela Lohmann⁴⁶², Michaela Lohmann⁴⁶³, Michaela Lohmann⁴⁶⁴, Michaela Lohmann⁴⁶⁵, Michaela Lohmann⁴⁶⁶, Michaela Lohmann⁴⁶⁷, Michaela Lohmann⁴⁶⁸, Michaela Lohmann⁴⁶⁹, Michaela Lohmann⁴⁷⁰, Michaela Lohmann⁴⁷¹, Michaela Lohmann⁴⁷², Michaela Lohmann⁴⁷³, Michaela Lohmann⁴⁷⁴, Michaela Lohmann⁴⁷⁵, Michaela Lohmann⁴⁷⁶, Michaela Lohmann⁴⁷⁷, Michaela Lohmann⁴⁷⁸, Michaela Lohmann⁴⁷⁹, Michaela Lohmann⁴⁸⁰, Michaela Lohmann⁴⁸¹, Michaela Lohmann⁴⁸², Michaela Lohmann⁴⁸³, Michaela Lohmann⁴⁸⁴, Michaela Lohmann⁴⁸⁵, Michaela Lohmann⁴⁸⁶, Michaela Lohmann⁴⁸⁷, Michaela Lohmann⁴⁸⁸, Michaela Lohmann⁴⁸⁹, Michaela Lohmann⁴⁹⁰, Michaela Lohmann⁴⁹¹, Michaela Lohmann⁴⁹², Michaela Lohmann⁴⁹³, Michaela Lohmann⁴⁹⁴, Michaela Lohmann⁴⁹⁵, Michaela Lohmann⁴⁹⁶, Michaela Lohmann⁴⁹⁷, Michaela Lohmann⁴⁹⁸, Michaela Lohmann⁴⁹⁹, Michaela Lohmann⁵⁰⁰, Michaela Lohmann⁵⁰¹, Michaela Lohmann⁵⁰², Michaela Lohmann⁵⁰³, Michaela Lohmann⁵⁰⁴, Michaela Lohmann⁵⁰⁵, Michaela Lohmann⁵⁰⁶, Michaela Lohmann⁵⁰⁷, Michaela Lohmann⁵⁰⁸, Michaela Lohmann⁵⁰⁹, Michaela Lohmann⁵¹⁰, Michaela Lohmann⁵¹¹, Michaela Lohmann⁵¹², Michaela Lohmann⁵¹³, Michaela Lohmann⁵¹⁴, Michaela Lohmann⁵¹⁵, Michaela Lohmann⁵¹⁶, Michaela Lohmann⁵¹⁷, Michaela Lohmann⁵¹⁸, Michaela Lohmann⁵¹⁹, Michaela Lohmann⁵²⁰, Michaela Lohmann⁵²¹, Michaela Lohmann⁵²², Michaela Lohmann⁵²³, Michaela Lohmann⁵²⁴, Michaela Lohmann⁵²⁵, Michaela Lohmann⁵²⁶, Michaela Lohmann⁵²⁷, Michaela Lohmann⁵²⁸, Michaela Lohmann⁵²⁹, Michaela Lohmann⁵³⁰, Michaela Lohmann⁵³¹, Michaela Lohmann⁵³², Michaela Lohmann⁵³³, Michaela Lohmann⁵³⁴, Michaela Lohmann⁵³⁵, Michaela Lohmann⁵³⁶, Michaela Lohmann⁵³⁷, Michaela Lohmann⁵³⁸, Michaela Lohmann⁵³⁹, Michaela Lohmann⁵⁴⁰, Michaela Lohmann⁵⁴¹, Michaela Lohmann⁵⁴², Michaela Lohmann⁵⁴³, Michaela Lohmann⁵⁴⁴, Michaela Lohmann⁵⁴⁵, Michaela Lohmann⁵⁴⁶, Michaela Lohmann⁵⁴⁷, Michaela Lohmann⁵⁴⁸, Michaela Lohmann⁵⁴⁹, Michaela Lohmann⁵⁵⁰, Michaela Lohmann⁵⁵¹, Michaela Lohmann⁵⁵², Michaela Lohmann⁵⁵³, Michaela Lohmann⁵⁵⁴, Michaela Lohmann⁵⁵⁵, Michaela Lohmann⁵⁵⁶, Michaela Lohmann⁵⁵⁷, Michaela Lohmann⁵⁵⁸, Michaela Lohmann⁵⁵⁹, Michaela Lohmann⁵⁶⁰, Michaela Lohmann⁵⁶¹, Michaela Lohmann⁵⁶², Michaela Lohmann⁵⁶³, Michaela Lohmann⁵⁶⁴, Michaela Lohmann⁵⁶⁵, Michaela Lohmann⁵⁶⁶, Michaela Lohmann⁵⁶⁷, Michaela Lohmann⁵⁶⁸, Michaela Lohmann⁵⁶⁹, Michaela Lohmann⁵⁷⁰, Michaela Lohmann⁵⁷¹, Michaela Lohmann⁵⁷², Michaela Lohmann⁵⁷³, Michaela Lohmann⁵⁷⁴, Michaela Lohmann⁵⁷⁵, Michaela Lohmann⁵⁷⁶, Michaela Lohmann⁵⁷⁷, Michaela Lohmann⁵⁷⁸, Michaela Lohmann⁵⁷⁹, Michaela Lohmann⁵⁸⁰, Michaela Lohmann⁵⁸¹, Michaela Lohmann⁵⁸², Michaela Lohmann⁵⁸³, Michaela Lohmann⁵⁸⁴, Michaela Lohmann⁵⁸⁵, Michaela Lohmann⁵⁸⁶, Michaela Lohmann⁵⁸⁷, Michaela Lohmann⁵⁸⁸, Michaela Lohmann⁵⁸⁹, Michaela Lohmann⁵⁹⁰, Michaela Lohmann⁵⁹¹, Michaela Lohmann⁵⁹², Michaela Lohmann⁵⁹³, Michaela Lohmann⁵⁹⁴, Michaela Lohmann⁵⁹⁵, Michaela Lohmann⁵⁹⁶, Michaela Lohmann⁵⁹⁷, Michaela Lohmann⁵⁹⁸, Michaela Lohmann⁵⁹⁹, Michaela Lohmann⁶⁰⁰, Michaela Lohmann⁶⁰¹, Michaela Lohmann⁶⁰², Michaela Lohmann⁶⁰³, Michaela Lohmann⁶⁰⁴, Michaela Lohmann⁶⁰⁵, Michaela Lohmann⁶⁰⁶, Michaela Lohmann⁶⁰⁷, Michaela Lohmann⁶⁰⁸, Michaela Lohmann⁶⁰⁹, Michaela Lohmann⁶¹⁰, Michaela Lohmann⁶¹¹, Michaela Lohmann⁶¹², Michaela Lohmann⁶¹³, Michaela Lohmann⁶¹⁴, Michaela Lohmann⁶¹⁵, Michaela Lohmann⁶¹⁶, Michaela Lohmann⁶¹⁷, Michaela Lohmann⁶¹⁸, Michaela Lohmann⁶¹⁹, Michaela Lohmann⁶²⁰, Michaela Lohmann⁶²¹, Michaela Lohmann⁶²², Michaela Lohmann⁶²³, Michaela Lohmann⁶²⁴, Michaela Lohmann⁶²⁵, Michaela Lohmann⁶²⁶, Michaela Lohmann⁶²⁷, Michaela Lohmann⁶²⁸, Michaela Lohmann⁶²⁹, Michaela Lohmann⁶³⁰, Michaela Lohmann⁶³¹, Michaela Lohmann⁶³², Michaela Lohmann⁶³³, Michaela Lohmann⁶³⁴, Michaela Lohmann⁶³⁵, Michaela Lohmann⁶³⁶, Michaela Lohmann⁶³⁷, Michaela Lohmann⁶³⁸, Michaela Lohmann⁶³⁹, Michaela Lohmann⁶⁴⁰, Michaela Lohmann⁶⁴¹, Michaela Lohmann⁶⁴², Michaela Lohmann⁶⁴³, Michaela Lohmann⁶⁴⁴, Michaela Lohmann⁶⁴⁵, Michaela Lohmann⁶⁴⁶, Michaela Lohmann⁶⁴⁷, Michaela Lohmann⁶⁴⁸, Michaela Lohmann⁶⁴⁹, Michaela Lohmann⁶⁵⁰, Michaela Lohmann⁶⁵¹, Michaela Lohmann⁶⁵², Michaela Lohmann⁶⁵³, Michaela Lohmann⁶⁵⁴, Michaela Lohmann⁶⁵⁵, Michaela Lohmann⁶⁵⁶, Michaela Lohmann⁶⁵⁷, Michaela Lohmann⁶⁵⁸, Michaela Lohmann⁶⁵⁹, Michaela Lohmann⁶⁶⁰, Michaela Lohmann⁶⁶¹, Michaela Lohmann⁶⁶², Michaela Lohmann⁶⁶³, Michaela Lohmann⁶⁶⁴, Michaela Lohmann⁶⁶⁵, Michaela Lohmann⁶⁶⁶, Michaela Lohmann⁶⁶⁷, Michaela Lohmann⁶⁶⁸, Michaela Lohmann⁶⁶⁹, Michaela Lohmann⁶⁷⁰, Michaela Lohmann⁶⁷¹, Michaela Lohmann⁶⁷², Michaela Lohmann⁶⁷³, Michaela Lohmann⁶⁷⁴, Michaela Lohmann⁶⁷⁵, Michaela Lohmann⁶⁷⁶, Michaela Lohmann⁶⁷⁷, Michaela Lohmann⁶⁷⁸, Michaela Lohmann⁶⁷⁹, Michaela Lohmann⁶⁸⁰, Michaela Lohmann⁶⁸¹, Michaela Lohmann⁶⁸², Michaela Lohmann⁶⁸³, Michaela Lohmann⁶⁸⁴, Michaela Lohmann⁶⁸⁵, Michaela Lohmann⁶⁸⁶, Michaela Lohmann⁶⁸⁷, Michaela Lohmann⁶⁸⁸, Michaela Lohmann⁶⁸⁹, Michaela Lohmann⁶⁹⁰, Michaela Lohmann⁶⁹¹, Michaela Lohmann⁶⁹², Michaela Lohmann⁶⁹³, Michaela Lohmann⁶⁹⁴, Michaela Lohmann⁶⁹⁵, Michaela Lohmann⁶⁹⁶, Michaela Lohmann⁶⁹⁷, Michaela Lohmann⁶⁹⁸, Michaela Lohmann⁶⁹⁹, Michaela Lohmann⁷⁰⁰, Michaela Lohmann⁷⁰¹, Michaela Lohmann⁷⁰², Michaela Lohmann⁷⁰³, Michaela Lohmann⁷⁰⁴, Michaela Lohmann⁷⁰⁵, Michaela Lohmann⁷⁰⁶, Michaela Lohmann⁷⁰⁷, Michaela Lohmann⁷⁰⁸, Michaela Lohmann⁷⁰⁹, Michaela Lohmann⁷¹⁰, Michaela Lohmann⁷¹¹, Michaela Lohmann⁷¹², Michaela Lohmann⁷¹³, Michaela Lohmann⁷¹⁴, Michaela Lohmann⁷¹⁵, Michaela Lohmann⁷¹⁶, Michaela Lohmann⁷¹⁷, Michaela Lohmann⁷¹⁸, Michaela Lohmann⁷¹⁹, Michaela Lohmann⁷²⁰, Michaela Lohmann⁷²¹, Michaela Lohmann⁷²², Michaela Lohmann⁷²³, Michaela Lohmann⁷²⁴, Michaela Lohmann⁷²⁵, Michaela Lohmann⁷²⁶, Michaela Lohmann⁷²⁷, Michaela Lohmann⁷²⁸, Michaela Lohmann⁷²⁹, Michaela Lohmann⁷³⁰, Michaela Lohmann⁷³¹, Michaela Lohmann⁷³², Michaela Lohmann⁷³³, Michaela Lohmann⁷³⁴, Michaela Lohmann⁷³⁵, Michaela Lohmann⁷³⁶, Michaela Lohmann⁷³⁷, Michaela Lohmann⁷³⁸, Michaela Lohmann⁷³⁹, Michaela Lohmann⁷⁴⁰, Michaela Lohmann⁷⁴¹, Michaela Lohmann⁷⁴², Michaela Lohmann⁷⁴³, Michaela Lohmann⁷⁴⁴, Michaela Lohmann⁷⁴⁵, Michaela Lohmann⁷⁴⁶, Michaela Lohmann⁷⁴⁷, Michaela Lohmann⁷⁴⁸, Michaela Lohmann⁷⁴⁹, Michaela Lohmann⁷⁵⁰, Michaela Lohmann⁷⁵¹, Michaela Lohmann⁷⁵², Michaela Lohmann⁷⁵³, Michaela Lohmann⁷⁵⁴, Michaela Lohmann⁷⁵⁵, Michaela Lohmann⁷⁵⁶, Michaela Lohmann⁷⁵⁷, Michaela Lohmann⁷⁵⁸, Michaela Lohmann⁷⁵⁹, Michaela Lohmann⁷⁶⁰, Michaela Lohmann⁷⁶¹, Michaela Lohmann⁷⁶², Michaela Lohmann⁷⁶³, Michaela Lohmann⁷⁶⁴, Michaela Lohmann⁷⁶⁵, Michaela Lohmann⁷⁶⁶, Michaela Lohmann⁷⁶⁷, Michaela Lohmann⁷⁶⁸, Michaela Lohmann⁷⁶⁹, Michaela Lohmann⁷⁷⁰, Michaela Lohmann⁷⁷¹, Michaela Lohmann⁷⁷², Michaela Lohmann⁷⁷³, Michaela Lohmann⁷⁷⁴, Michaela Lohmann⁷⁷⁵, Michaela Lohmann⁷⁷⁶, Michaela Lohmann⁷⁷⁷, Michaela Lohmann⁷⁷⁸, Michaela Lohmann⁷⁷⁹, Michaela Lohmann⁷⁸⁰, Michaela Lohmann⁷⁸¹, Michaela Lohmann⁷⁸², Michaela Lohmann⁷⁸³, Michaela Lohmann⁷⁸⁴, Michaela Lohmann⁷⁸⁵, Michaela Lohmann⁷⁸⁶, Michaela Lohmann⁷⁸⁷, Michaela Lohmann⁷⁸⁸, Michaela Lohmann⁷⁸⁹, Michaela Lohmann⁷⁹⁰, Michaela Lohmann⁷⁹¹, Michaela Lohmann⁷⁹², Michaela Lohmann⁷⁹³, Michaela Lohmann⁷⁹⁴, Michaela Lohmann⁷⁹⁵, Michaela Lohmann⁷⁹⁶, Michaela Lohmann⁷⁹⁷, Michaela Lohmann⁷⁹⁸, Michaela Lohmann⁷⁹⁹, Michaela Lohmann⁸⁰⁰, Michaela Lohmann⁸⁰¹, Michaela Lohmann⁸⁰², Michaela Lohmann⁸⁰³, Michaela Lohmann⁸⁰⁴, Michaela Lohmann⁸⁰⁵, Michaela Lohmann⁸⁰⁶, Michaela Lohmann⁸⁰⁷, Michaela Lohmann⁸⁰⁸, Michaela Lohmann⁸⁰⁹, Michaela Lohmann⁸¹⁰, Michaela Lohmann⁸¹¹, Michaela Lohmann⁸¹², Michaela Lohmann⁸¹³, Michaela Lohmann⁸¹⁴, Michaela Lohmann⁸¹⁵, Michaela Lohmann⁸¹⁶, Michaela Lohmann⁸¹⁷, Michaela Lohmann⁸¹⁸, Michaela Lohmann⁸¹⁹, Michaela

结论

HMO促进健康

- > 母乳低聚糖有效促进双歧杆菌生长，并显示了与一些特定双歧杆菌菌株的共生特性
- > 母乳低聚糖主动预防病原微生物和病毒的侵害，维护肠道微生态平衡



HMO应用广泛

- > 各欧美国家和地区陆续上市含HMO的婴儿配方粉，并获得市场认可
- > 除了婴儿配方粉，HMO作为优质功能性低聚糖，还可以广泛应用于其他领域



杜邦为您提供

- > 杜邦CARE4U系列HMO产品纯度高，粉体质量优异
- > 杜邦益生菌平台搭配HMO的应用，将成为市场热点
- > 杜邦3FL将于2020年初推出商业化产品

IT'S WHAT'S INSIDE.

DuPont Nutrition & Health, a DowDuPont Specialty Products Division business, combines in-depth knowledge of food and nutrition with current research and expert science to deliver unmatched value to the food, beverage, pharmaceutical and dietary supplement industries. We are innovative solvers, drawing on deep consumer insights and a broad product portfolio to help our customers turn challenges into high-value business opportunities. More information is available at www.food.dupont.com.

