Prebióticos, Probióticos e Fibras

Carolina Battistini

Doutoranda em Ciência dos Alimentos

28 de Maio de 2020

FoRC
FOOD RESEARCH CENTER
Centro de Pesquisa em Alimentos

- **Graduação em Engenharia de Alimentos**

“Desenvolvimento de bebida fermentada simbiótica com base em soja verde sabor melão”

Centro Universitário do Instituto Mauá de Tecnologia – Escola de Engenharia Mauá

- **Mestrado em Engenharia de Processos Químicos e Bioquímicos**

“Utilização de soja verde para a obtenção de bebida fermentada simbiótica”

Centro Universitário do Instituto Mauá de Tecnologia – Escola de Engenharia Mauá

Estágio de pesquisa no exterior no Centro de Biotecnologia e Química Fina da Universidade Católica Portuguesa, Porto, Portugal - Programa de Mobilidade Internacional Fórmula Santander

- **Doutorado em Ciência dos Alimentos**

“Aplicação de bagaço de malte em leite fermentado probiótico e avaliação do seu potencial funcional”

Orientadora: Profa. Dra. Susana Marta Isay Saad

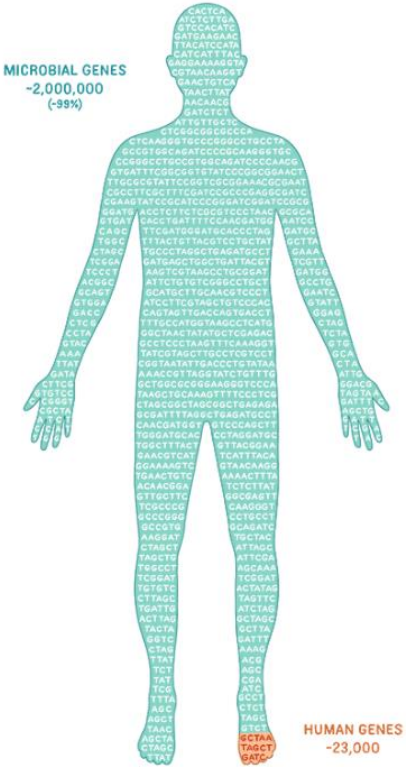
Faculdade de Ciências Farmacêuticas – Universidade de São Paulo (USP)

Doutorado Sanduíche: Department of Medicine - University of Illinois at Chicago – Chicago – IL – USA

Microbiota

An estimated 30 trillion cells in your body—less than a third—are human. The other 70-90% are bacterial and fungal.

by Gaby D'Allesandro / © AMNH

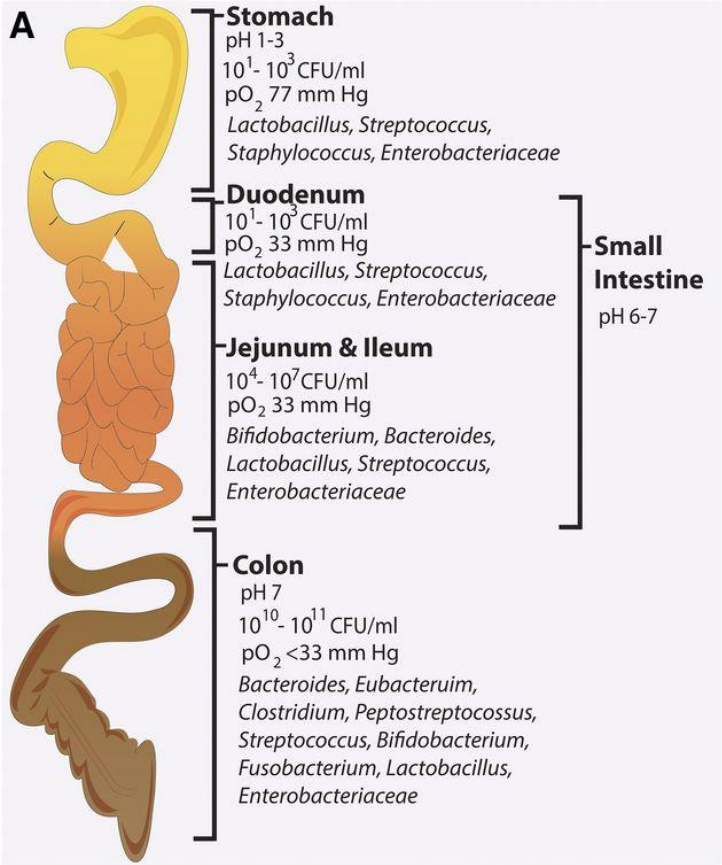


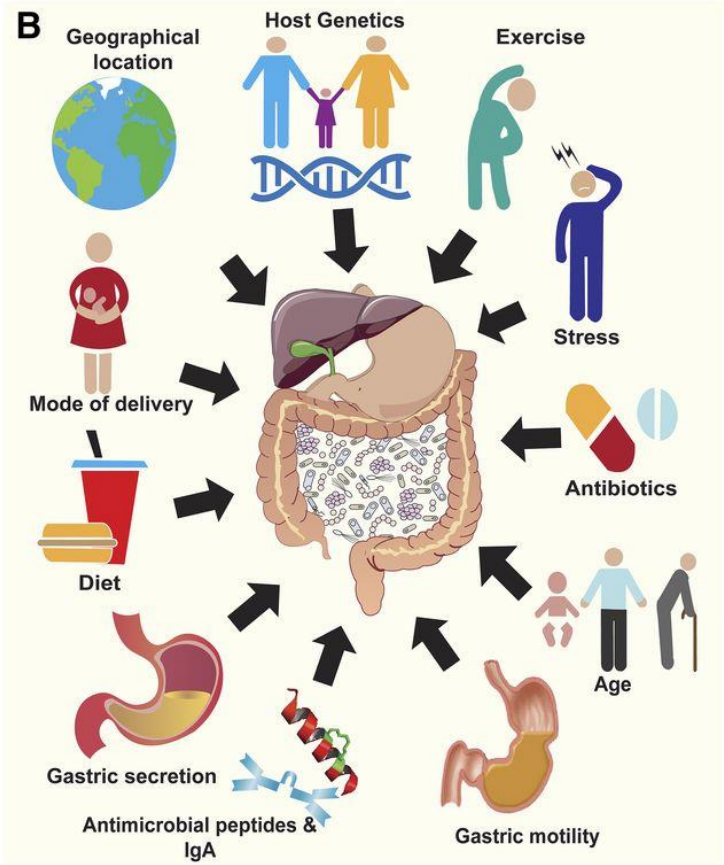
Ninety-nine percent of the unique genes in your body are bacterial. Only about one percent is human.

by Gaby D'Allesandro / © AMNH

https://www.amnh.org/explore/science-topics/microbiome-health/meet-your-microbiome

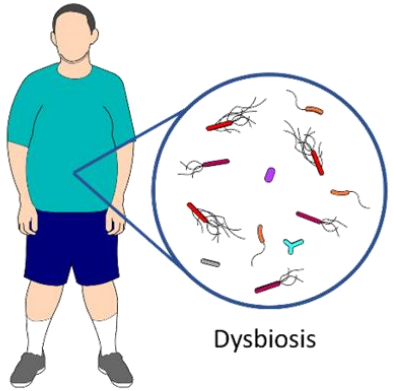
Microbiota





Clarke et al., *Pharmacological Reviews*, v. 71, n. 2, p. 198-224, 2019.

Microbiota

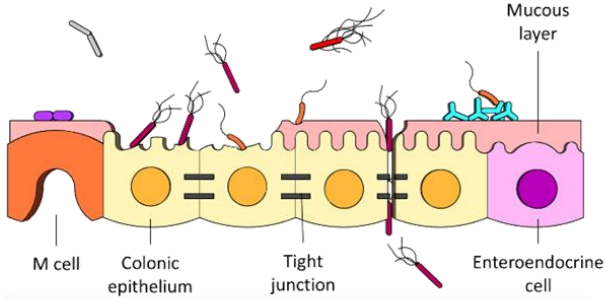


Intervenções da dieta!!!

Lifestyle
- Western diet (high sugar and fats)
- Low physical activity
- Smoking and alcohol abuse
- Sleep deprivation

Metabolic diseases
- Diabetes
- Cardiometabolic diseases
- Obesity
- Non-alcoholic fatty liver disease

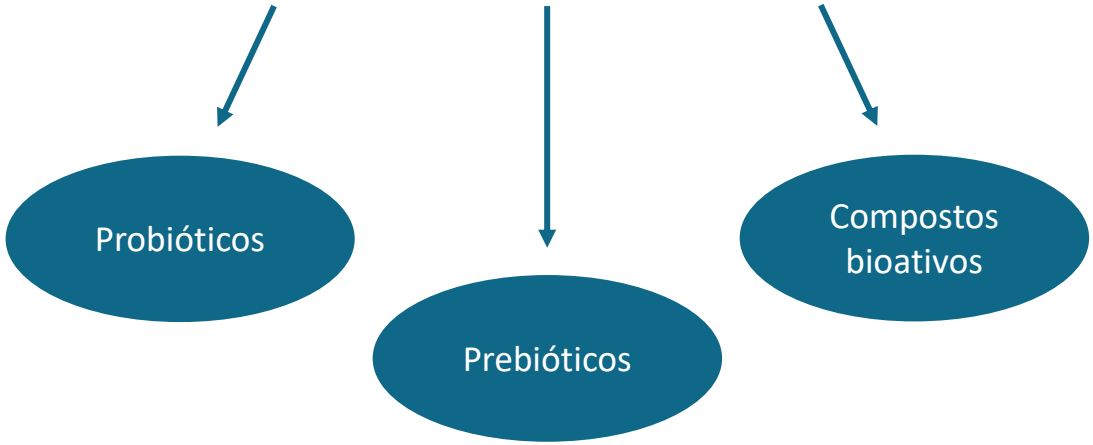
Dysbiosis
- ↓ Intestinal barrier integrity
- Dyslipidemia
- Insulin resistance
- ↑ circulating lipopolysaccharides
- ↑ energy harvesting
- ↓ Bifidobacterium spp.



Ballan et al., **Interactions of Probiotics and Prebiotics with the Gut Microbiota**, 2020, https://doi.org/10.1016/bs.pmbts.2020.03.008

Alimentos Funcionais

Além das propriedades nutricionais, devem conferir algum benefício a saúde do consumidor e, a quantidade recomentada deve ser compatível com uma dieta normal.



https://www.ncbi.nlm.nih.gov/mesh/?term=functional+food
http://www.inspection.gc.ca/food/requirements-and-guidance/labelling/industry/health-claims/eng/1392834838383/1392834887794?chap=8

Alimentos Funcionais

Alimentos

≠

Medicamentos

Promoção da saúde /
Redução do risco de doenças

Tratamento de doenças

Probióticos

“Microrganismos vivos que quando administrados em quantidades adequadas, conferem efeitos benéficos à saúde do hospedeiro” (FAO/WHO, 2002).

“Microrganismos vivos que administrados em quantidades adequadas, conferem um efeito benéfico ao hospedeiro” (Hill et al., 2014).

Somente bactérias podem ser classificadas como microrganismos probióticos

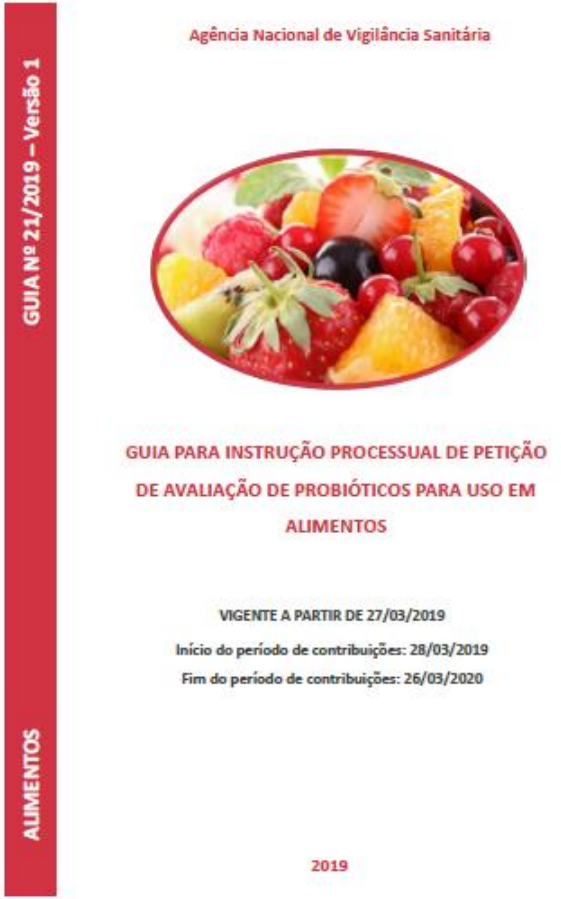
http://www.fao.org/3/a-a0512e.pdf

HILL *et al*. Nat Rev Gastro Hepat, v. 11, 2014

Probióticos

ANVISA → **RDC Nº 241, DE 26 DE JULHO DE 2018**

Requisitos para comprovação da segurança e dos benefícios à saúde dos probióticos para uso em alimentos



http://portal.anvisa.gov.br/documents/10181/3898888/RDC_241_2018_.pdf/941cda52-0657-46dd-af4b-47b4ee4335b7

Probióticos

- **Identidade**
  - Espécie (nomenclatura binomial). Ex.: *Lactobacillus rhamnosus*;
  - Linhagem. Ex.: *L. rhamnosus* LGG, *L. rhamnosus* GR-1;
  - Origem. Ex.: solo, microbiota intestinal, microbiota urogenital feminina, produtos lácteos, etc..
  - Depósito da linhagem em coleção de cultura internacionalmente reconhecida.

- **Segurança**
  - Histórico de uso seguro;
  - Ausência de fatores de virulência e patogenicidade para a saúde humana;
  - Ausência de resistência a antibióticos;
  - Susceptibilidade a, pelo menos, dois antibióticos.

Generally Recognized As Safe

Probióticos

Government of Canada | Gouvernement du Canada

Canada.ca | Services | Departments | Français

Canadian Food Inspection Agency

Canada

Search

About the CFIA | Food | Animals | Plants | Industry Guidance

Table of Acceptable Non-Strain Specific Claims for Probiotics

Eligible bacterial species [11] Latin name (acceptable nomenclature [12]) and synonym where applicable	Acceptable Non-Strain Specific Probiotic Claim for Food
• Bifidobacterium adolescentis • Bifidobacterium animalis subsp. Animalis • Bifidobacterium animalis subsp. lactis -synonym: B. lactis • Bifidobacterium bifidum • Bifidobacterium breve • Bifidobacterium longum subsp. infantis comb. nov. [13] • Bifidobacterium longum subsp. longum subsp. nov. [13] • Lactobacillus acidophilus • Lactobacillus casei • Lactobacillus fermentum • Lactobacillus gasseri • Lactobacillus johnsonii • Lactobacillus paracasei • Lactobacillus plantarum • Lactobacillus rhamnosus • Lactobacillus salivarius	Probiotic that naturally forms part of the gut flora. [14] Provides live microorganisms that naturally form part of the gut flora. [14] Probiotic that contributes to healthy gut flora. [14] Provides live microorganisms that contribute to healthy gut flora. [14]

ANVISA
RDC Nº 241, DE 26 DE JULHO DE 2018

Seção IV

Benefício dos probióticos

Art. 12. O benefício à saúde associado ao uso do probiótico deve estar claramente identificado e refletir da forma mais adequada o conjunto de evidências apresentadas.

Parágrafo único. Nos produtos adicionados de probióticos, o benefício deve ser comunicado por meio da alegação de propriedade funcional ou de saúde aprovada para a linhagem, exceto quando houver disposição em contrário em regulamento técnico específico.

Art. 13. O benefício alegado pode ter caráter geral ou específico, levando em consideração a totalidade e o nível das evidências disponíveis.

Art. 14. A comprovação do benefício para probióticos requer demonstração da sobrevivência às condições do trato digestório humano e evidência de efeito em humanos obtida por meio de estudos que:

I - sejam conduzidos com a linhagem do micro-organismo;

II - envolvam um grupo representativo da população de interesse ou cujos resultados possam ser extrapolados para aquela de interesse;

III - considerem a quantidade mínima sugerida para obtenção do benefício;

IV - avaliem desfechos relevantes para o benefício alegado; e

V - minimizem vieses e fatores de confundimento.

Parágrafo único. Em adição às evidências em humanos tratada no caput, podem ser apresentados outros tipos de estudos e referências que ajudem a explicar a plausibilidade biológica do efeito alegado.

Art. 15. Quando o benefício a ser comprovado estiver associado a uma mistura de linhagens, os estudos em humanos devem ser realizados com a mesma mistura a que se pretende demonstrar o efeito alegado.

Parágrafo único. A comprovação do benefício à saúde tratada no caput não é necessária para a associação de probióticos em que todas as linhagens utilizadas já tenham um benefício comprovado.

https://inspection.gc.ca/food/requirements-and-guidance/labelling/industry/health-claims/eng/1392834838383/1392834887794?chap=10
ANVISA, RDC Nº 241, DE 26 DE JULHO DE 2018. http://portal.anvisa.gov.br/documents/10181/3898888/RDC_241_2018_.pdf/941cda52-0657-46dd-af4b-47b4ee4335b7

Probióticos

LACTOBACILLUS

Ácido lático

BIFIDOBACTERIUM

Ácido lático
+
Ácido acético

***Bifidobacterium* não é BAL!!!**

Associação com cultura starter.
Ex. *Streptococcus thermophilus*

Menor tempo de fermentação

Next-generation Probiotics

Sensíveis ao oxigênio!

Bacteroides fragilis

Faecalibacterium prausnitzii

Bacteroides uniformis

Akkermansia muciniphila

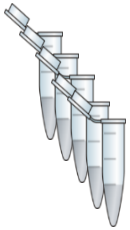
Eubacterium hallii

Clostridium spp. (cluster IV and XIVA)

El Hage et al., *Front Microbiol*, v. 8, article n° 1889, 2017

Viabilidade

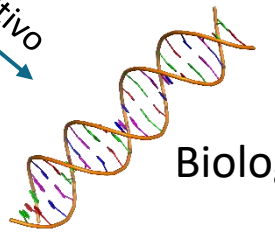
Método dependente de cultivo



Diluição seriada

Semeadura em ágar seletivo

Método independente de cultivo

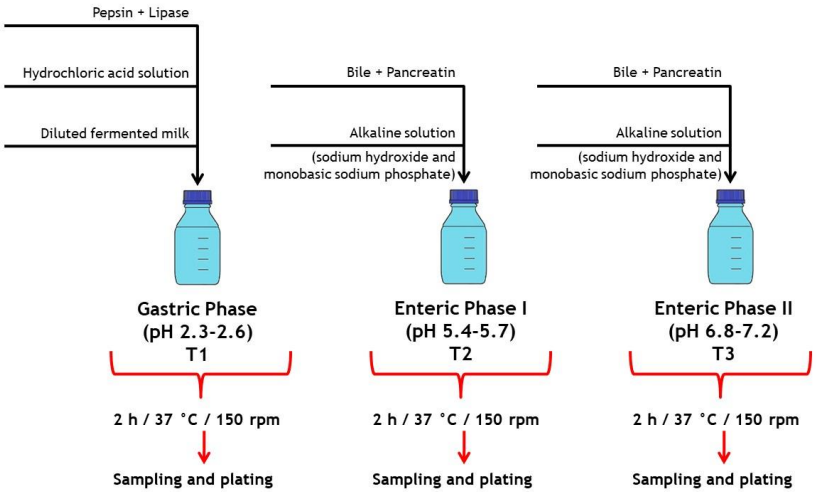


Biologia Molecular → qPCR

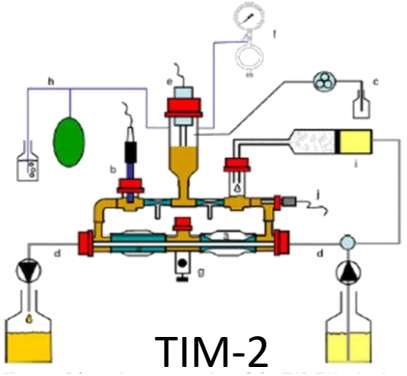
UFC/g ou mL

Simulação do trato gastrointestinal *in vitro*

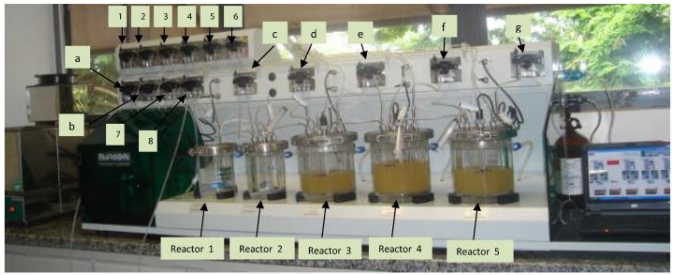
➢ Modelo estático:



➢ Modelos dinâmicos:



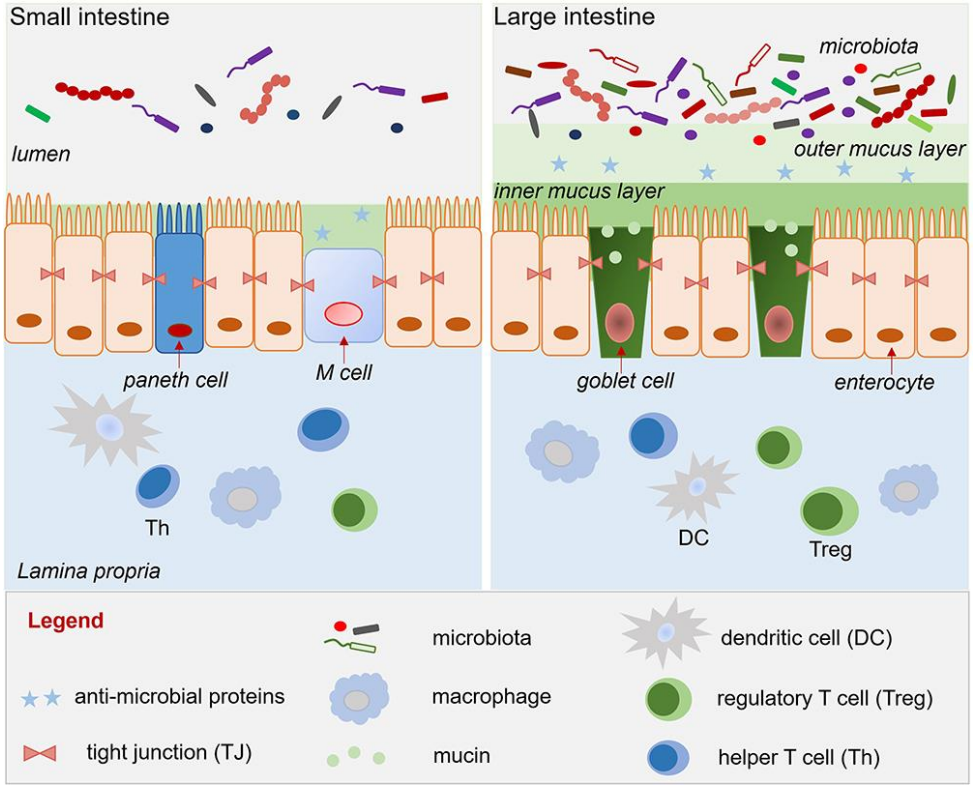
TIM-2

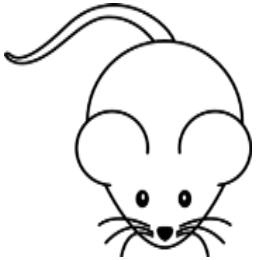


SHIME®

Bedani *et al*. Food Microbiol, v. 34, p. 382-389, 2013.
Rehman *et al*. BMC Microbiology, v. 12, n.47, 2012.
Bianchi *et al*. Food Res Int, v. 64, 2014.

Simulação dos efeitos na saúde: modelos *in vitro* e *in vivo*





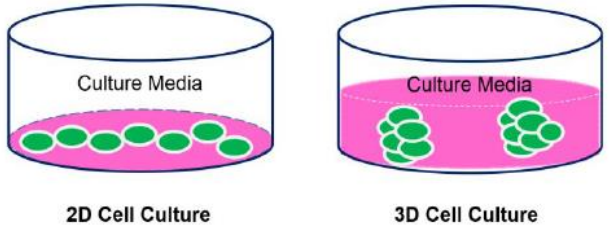


Figure 1-1 Schematic illustration of typical 2D and 3D cell culture formats.

Yang C & Merlin D, International Journal of Nanomedicine, v. 14, p. 8875-8889, 2014.

Yang. Y., An Advance Digital Electrical Impedance Tomography System for Biomedical Imaging, 2018, https://www.researchgate.net/publication/324745992_Advanced_digital_electrical_impedance_tomography_system_for_biomedical_imaging

Probióticos

- ✓ Benefícios são específicos para cada cepa;
- ✓ Sobrevivência ao trato gastrointestinal humano;
- ✓ Viabilidade ao longo da vida de prateleira;
- ✓ Dose mínima sugerida para conferir o benefício.

Beneficial Microbes, 2017; 8(2): 143-151

Wageningen Academic Publishers

A review of dose-responses of probiotics in human studies

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Received: 8 August 2016 / Accepted: 12 October 2016

REVIEW ARTICLE

Abstract

The probiotic definition requires the administration of an 'adequate amount' in order to obtain a health benefit. What that amount should be is not indicated. Here, an overview is given of studies that investigated the dose-response relation of probiotics in human interventions. Studies were divided in; meta-analyses, meta-analyses on specific probiotic strains, and studies testing two or more doses of a probiotic (combination) in the same study. Meta-analyses on the effect of probiotics on antibiotic associated diarrhoea (AAD) suggest a dose-response effect; for *Clostridium difficile*-associated diarrhoea on the other hand no dose-response was observed. For other end-points; such as necrotising enterocolitis, prevention of atopic dermatitis and slow intestinal transit, no dose-response relation was identified in meta-analyses. For prophylaxis in colorectal cancer and relief of irritable bowel syndrome, no dose-response relation was determined. However, for blood pressure, a meta-analysis observed that higher doses (greater than 10^{11} cfu) were more effective than lower doses. Meta-analyses of specific strains suggest a break-point for effectiveness of *Lactobacillus rhamnosus* GG in the treatment of acute gastroenteritis in children; no dose-response was observed for two other probiotics assessed. Studies comparing two or more doses indicate that faecal recovery and risk reduction of AAD follow a positive dose-response relationship. Other end-points such as immune markers, general health, and bowel function did not exhibit clear dose-response relations. For AAD, the findings are very compelling; both meta-analyses and dedicated dose-response studies observe a positive correlation between dose and AAD risk. These findings do not allow for extrapolation, but suggest that studying higher doses for this end-point would be worthwhile. The lack of a clear dose-response for other end-points, does not mean it does not exist; present data does just not allow drawing any conclusions.

Keywords: *Lactobacillus, Bifidobacterium,* antibiotic associated diarrhoea, dose-response

Fibras alimentares

NCBI Resources How To

MeSH MeSH Search

Limits Advanced

Dietary Fiber

The remnants of plant cell walls that are resistant to digestion by the alimentary enzymes of man. It comprises various polysaccharides and lignins.

Year introduced: 1982(1977)

bvs DeCS biblioteca virtual em saúde Descritores em Ciências da Saúde

Organização Pan-Americana da Saúde | Organização Mundial da Saúde Américas | BIREME

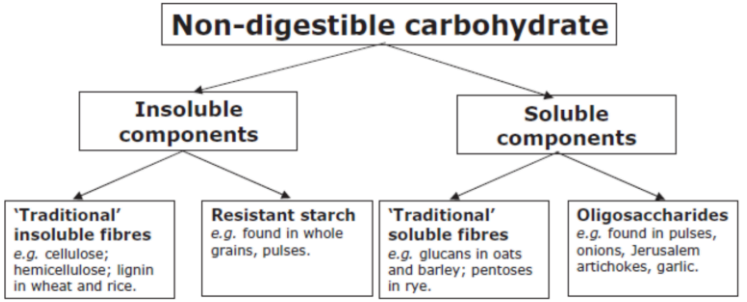
Descritor *Inglês*:	**Dietary Fiber**
Descritor *Espanhol*:	**Fibras de la Dieta**
Descritor *Português*:	**Fibras na Dieta**
Sinônimos *Português*:	Alimento Pouco Digerível Fibra Alimentar Fibra Dietética Fibra na Dieta Fibras Alimentares Fibras Dietéticas Substâncias não Digeríveis da Alimentação
Categoria:	D09.301.416 G07.203.300.400 J02.500.400 SP6.006.017.013.004
Definição *Português*:	1. Resíduos das paredes celulares das plantas que são resistentes à digestão pelas enzimas digestivas do homem. São compostas por vários polissacarídeos e ligninas. 2. Resíduos de paredes celulares e tecidos de sustentação de vegetais. Desempenham funções importantes no organismo, relacionadas ao metabolismo de lipídios e carboidratos e na fisiologia do trato gastrintestinal, além de assegurar absorção mais lenta dos nutrientes e promover sensação de saciedade. (Fonte: Pourchet-Campos, 1998)

NCBI, https://www.ncbi.nlm.nih.gov/mesh/68004043

Bilbioteca Virtual em Saúde, Descritores em Ciências da Saúde, http://decs.bvs.br/

Fibras alimentares

- Melhora no funcionamento intestinal;
- Redução dos níveis de colesterol;
- Controle do índice glicêmico;
- Promovem a saciedade;
- Menor risco de desenvolvimento de câncer do trato gastrointestinal.



Ministério da Saúde
↓
Consumo mínimo recomendado
25 g/dia

Fiber: Daily recommendations for adults

	Age 50 or younger	Age 51 or older
Men	38 grams	30 grams
Women	25 grams	21 grams

Institute of Medicine

Guia alimentar para a população brasileira : promovendo a alimentação saudável, Ministério da Saúde, 2008, http://bvsms.saude.gov.br/bvs/publicacoes/guia_alimentar_populacao_brasileira_2008.pdf

Lunn & Buttriss, British Nutrition Foundation, Nutrition Bulletin, v. 32, p. 21-64, 2007

Rubert et al., Trends in Endocrinology & Metabolism, in press, 2020, https://doi.org/10.1016/j.tem.2020.02.004

https://www.mayoclinic.org/healthy-lifestyle/nutrition-and-healthy-eating/in-depth/fiber/art-20043983

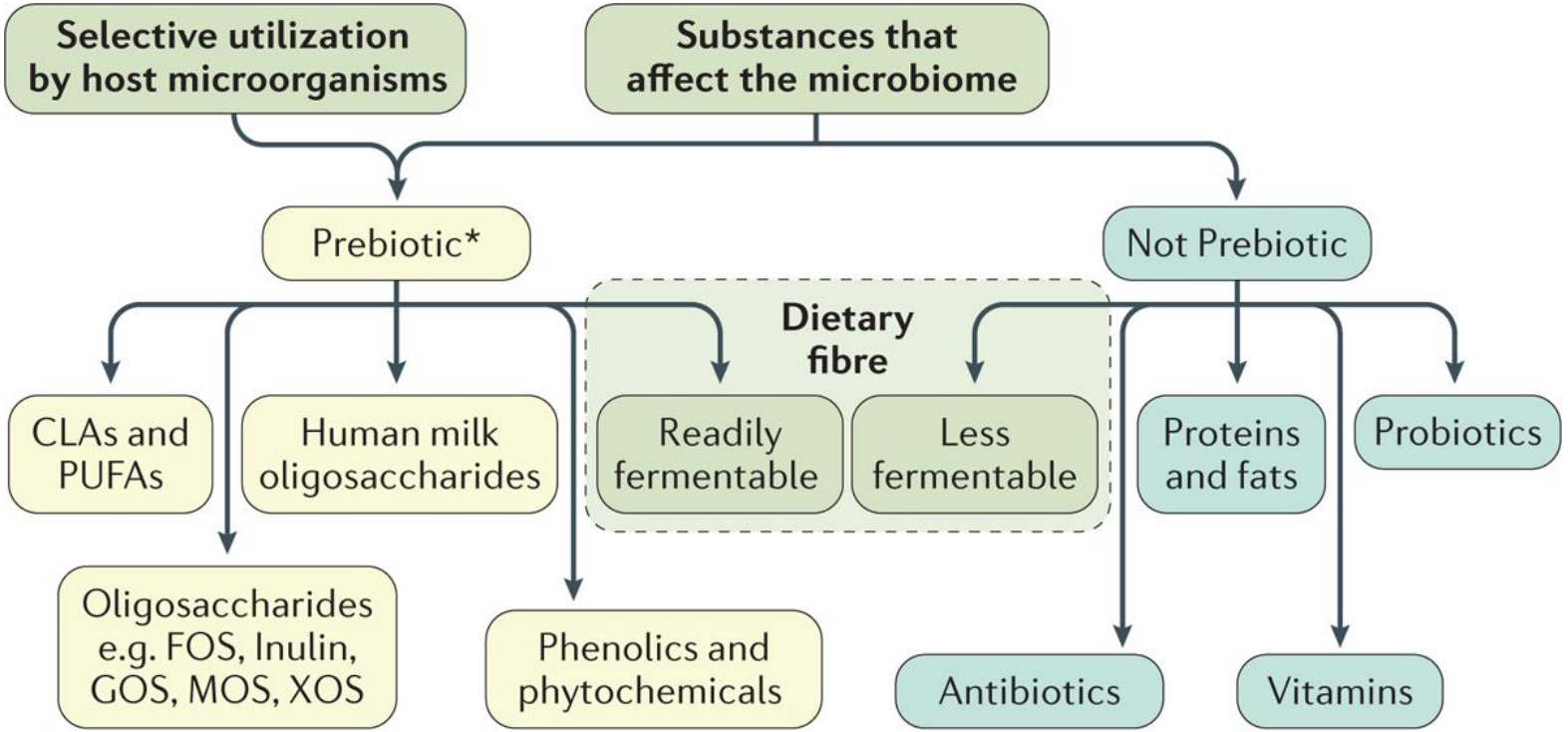
Prebioticos

“ingredientes seletivamente ferementáveis que resultem em modificações específicas na composição e/ou atividade da microbiota gastrointestinal, conferindo benefícioas à saúde do hospedeitos’’ (GIBSON et al., 2010)

“substrato que é seletivamente utilizado pelos microrganismos do hospedeiro, conferindo benefícios à saúde” (GIBSON et al., 2017)

Gibson et al., *Food Science and Technology Bulletin: Functional Foods*, v. 7, January, p. 1–19, 2010.
Gibson et al., *Nature Reviews Gastroenterology & Hepatology*, v. 14,p. 491-502, 2017.

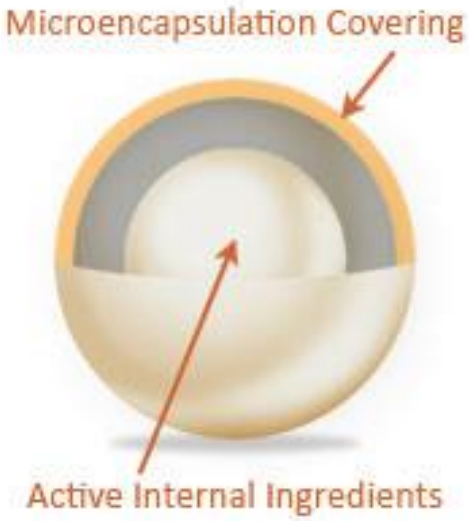
Prebioticos



Gibson et al., *Nature Reviews Gastroenterology & Hepatology*, v. 14,p. 491-502, 2017.

Prebioticos

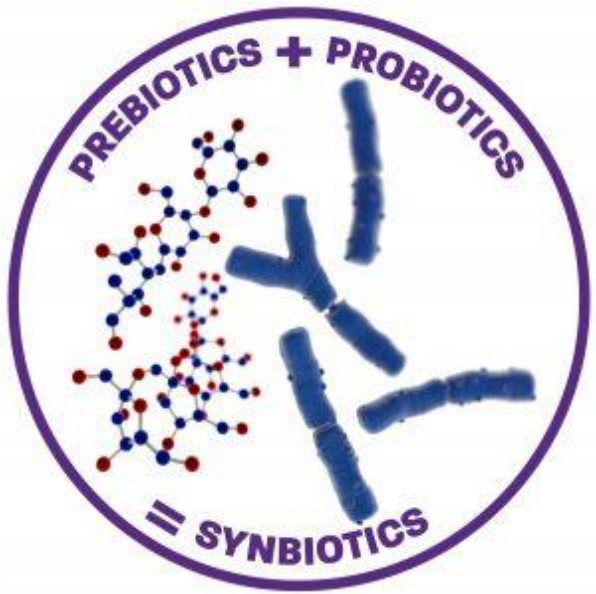
- Estimular a produção de metabólitos benéficos à saúde - SCFA;
- Maior velocidade de acidificação;
- Microencapsulação;
- Segurança;
- Dose adequada;
- Consumidor alvo.



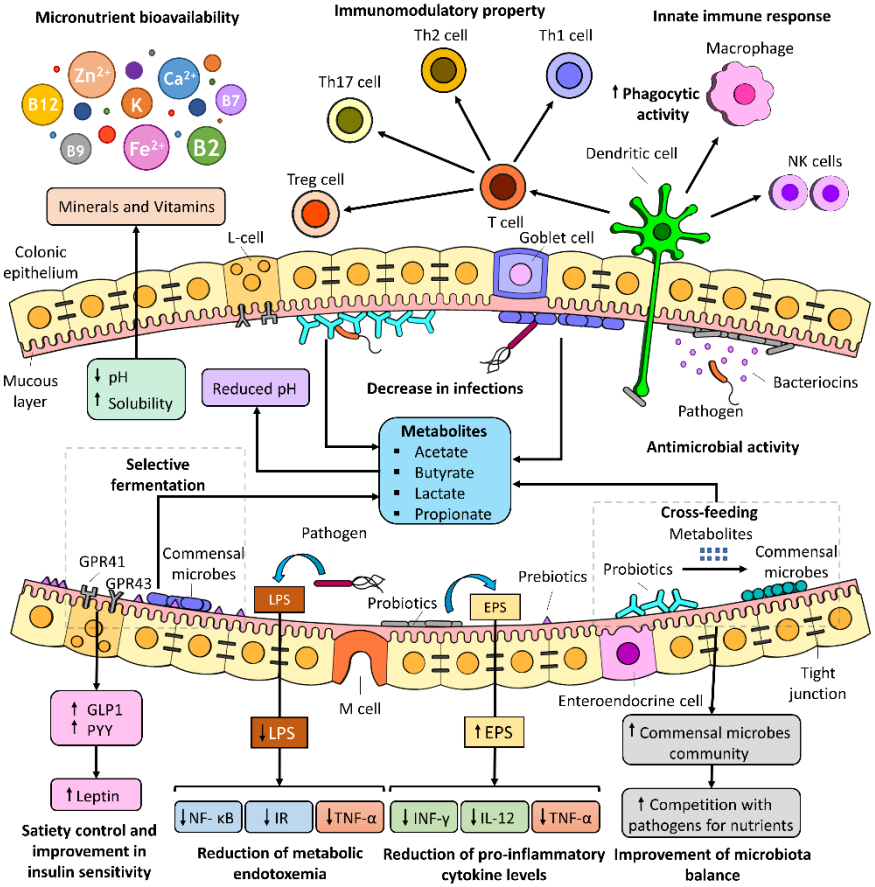
Gibson et al., *Nature Reviews Gastroenterology & Hepatology*, v. 14,p. 491-502, 2017.
Xavier dos Santos et al., LWT – Food Science and Technology, v. 99, p. 404-410, 2019.
Oliveira et al., LWT – Food Science and Technology, v. 42, p. 1015-1021, 2009.

Simbióticos

- Efeito sinérgico;
- Vantagem competitiva;
- Resistência ao stress GI.

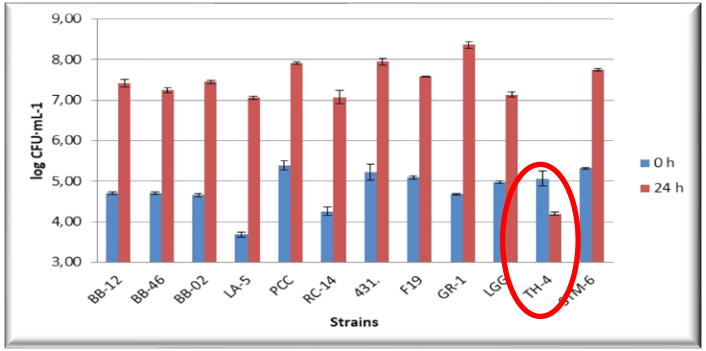


Mecanismos de ação

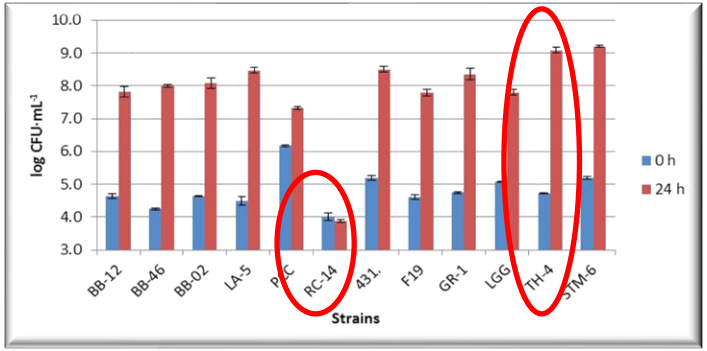


Ballan et al., **Interactions of Probiotics and Prebiotics with the Gut Microbiota**, 2020, https://doi.org/10.1016/bs.pmbts.2020.03.008

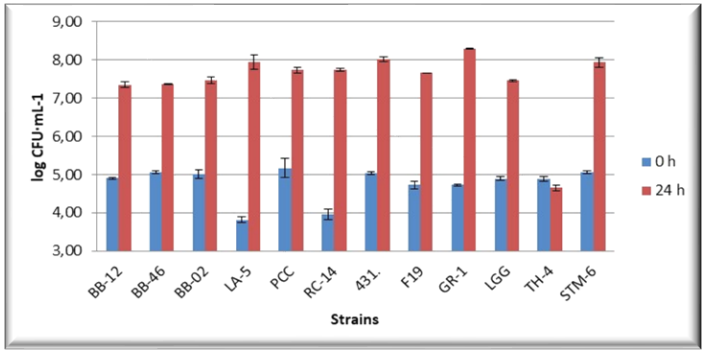
Aplicações



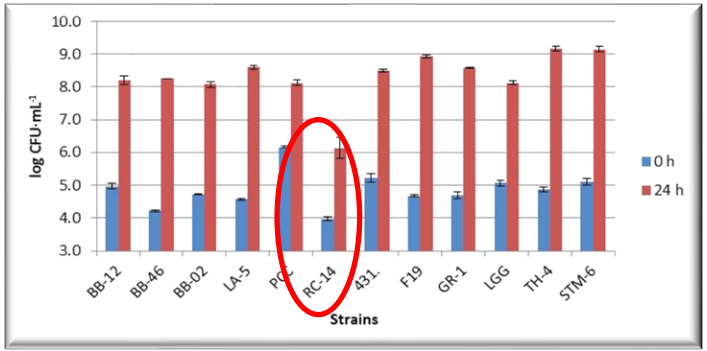
Probiotic and starter strains populations in phenol red MRS broth without BSG.



Probiotic and starter strains populations in UHT skimmed milk without BSG.



Probiotic and starter strains populations in phenol red MRS broth with 1% of BSG.



Probiotic and starter strains populations in UHT skimmed milk with 1% BSG.

Aplicações

BRAZILIAN JOURNAL OF MICROBIOLOGY 49 (2018) 303–309

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http://www.bjmicrobiol.com.br/

Food Microbiology

Development and characterization of an innovative synbiotic fermented beverage based on vegetable soybean

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fermentation of soymilk. In the present study, the reduction of raffinose and stachyose was 39.5% and 28.5%, respectively (Fig. 1). The short fermentation time in our study

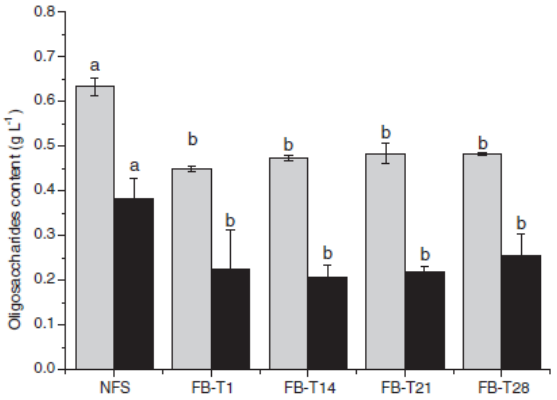

Fig. 1 – Oligosaccharides content, stachyose (grey bars) and raffinose (black bars), in the non-fermented soymilk (NFS) and in the soymilk fermented beverages (FB) during the storage period (T1, T14, T21 and T28). For each oligosaccharide, means with different letters are significantly different ($p < 0.05$).

Aplicações

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International Journal of Food Microbiology

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Passion fruit by-product and fructooligosaccharides stimulate the growth and folate production by starter and probiotic cultures in fermented soymilk

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daily recommended intake of folates is 400 µg for a normal adult. One portion (100 mL) of the fermented soymilk supplemented with PF + FOS prepared with the co-culture TH-4 + LGG would contribute to approximately 45% RDA for adults, being not only an innovative

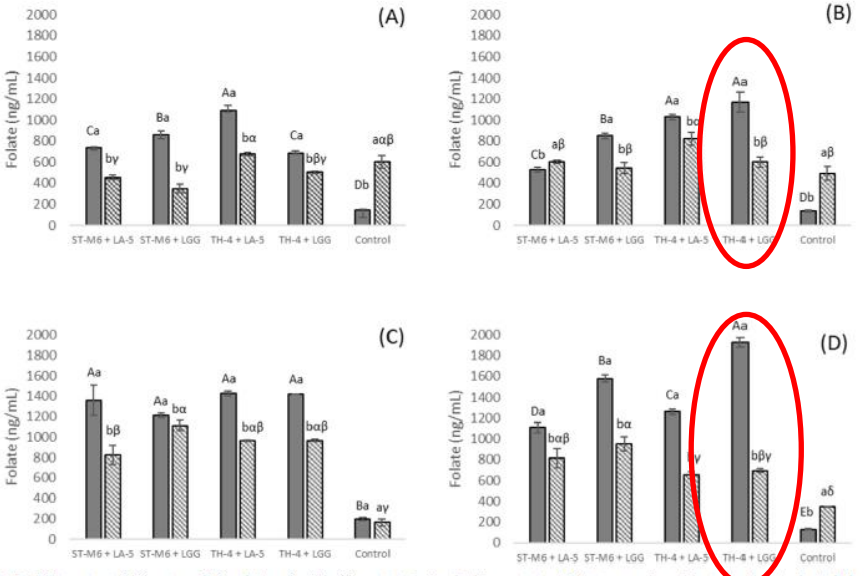

Fig. 2. . Total folate content of different soymilk formulations after 24 h of fermentation by *Lactobacillus* spp. strains with *Streptococcus thermophilus* strains. Traditional microbiological assay (grey bars); Tri-enzymatic treatment (textured bars). [A,B] Different capital letters denote significant differences between traditional microbiological assay results ($P < 0.05$). [α,β] Different Greek letters denote significant differences between tri-enzymatic extraction results ($P < 0.05$). [a,b]Different small letters denote significant differences between traditional microbiological assay and tri-enzymatic extraction results ($P < 0.05$). (A) Soymilk, (B) Soymilk supplemented with 1% (w/v) of passion fruit by-product, (C) Soymilk supplemented with 1% (w/v) of fructooligosaccharides, (D) Soymilk supplemented with 0.5% (w/v) of passion fruit by-product and 0.5% (w/v) of fructooligosaccharides. See item 2.1 for description of strains.

Aplicações

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In vitro gastrointestinal resistance of *Lactobacillus acidophilus* La-5 and *Bifidobacterium animalis* Bb-12 in soy and/or milk-based synbiotic apple ice creams

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The present study showed that the viability of *L. acidophilus* La-5 and *B. animalis* Bb-12 in all synbiotic apple ice cream formulations tested was satisfactory until the 84th day of frozen storage, with populations of around 7.5 to 8.5 log CFU/g, showing that the ice cream formulations are good matrices for carrying and delivering the probiotic microorganisms. Using the PMA-qPCR technique, we demonstrated that La-5 and

when compared to the milk-based counterpart. Most importantly, the ice cream mixtures containing soy extract and/or WPI + inulin may expand the range of synbiotic products for individuals with varying degrees of lactose intolerance or lactose sensitiveness. It is necessary to

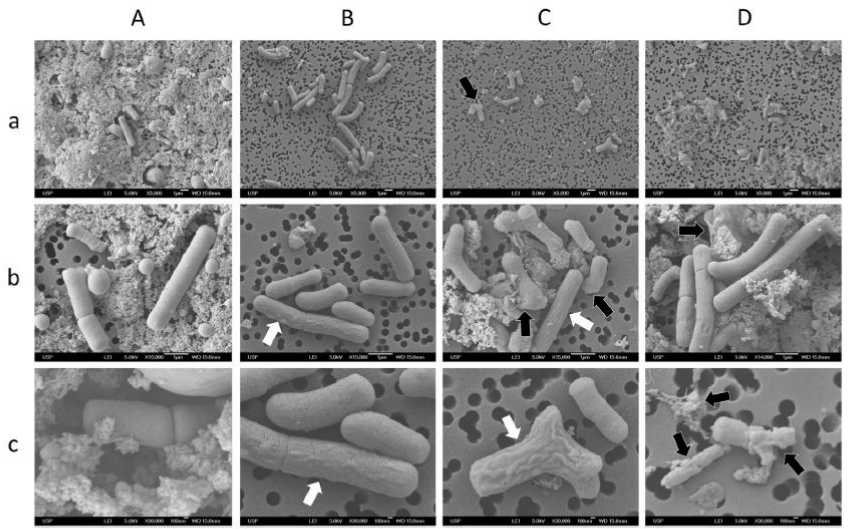

Fig. 3. Scanning electron microscopy showing morphological changes in *L. acidophilus* La-5 and *B. animalis* Bb-12 cells throughout the *in vitro* simulated digestion of ice cream samples. Representative photographs were obtained at different magnifications a, b, and c (×5000, ×15000, and 30,000, respectively). Images were acquired in the following order, A: Initial phase with no enzymes addition; B: 2 h of incubation in the gastric phase (pH 2.4–2.9 in the presence of pepsin and lipase); C: 4 h of incubation in the enteric phase I (pH 4.8–5.6 in the presence of bile and pancreatin; and D: after 6 h of incubation in the enteric phase II (pH 6.4–6.9 in the presence of bile and pancreatin). White arrows indicate surface protrusions of the cell wall/capsule; black arrows indicate cell membrane clumping and damage.

Aplicações

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journal homepage: www.elsevier.com/locate/lwt

Tropical fruit pulps decreased probiotic survival to *in vitro* gastrointestinal stress in synbiotic soy yoghurt with okara during storage

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during the 28 days of storage and the addition of fruit pulps and essences did not affect the viability of both probiotic microorganisms. However, the incorporation of fruit pulps and flavours decreased *L. acidophilus* La-5 and *B. animalis* Bb-12 survival significantly to simulated gastrointestinal stress. Acceptability was higher for mango soy yoghurt, but this difference was significant only at 21 days of storage. Therefore, the somehow improved acceptability of SY through the addition of tropical fruits pulps (and here observed for mango pulp) might lead to a reduction in the probiotic strains functionality. Further studies are necessary to

Table 5
Acceptability scores (mean ± SD of 50 observations) of overall likeness obtained for the different synbiotic soy yoghurts with okara during refrigerated storage (4 ± 1 °C).

Time (days)	Products		
	SYC	SYM	SYG
7	5.32 ± 1.83^{Aa}	5.72 ± 1.81^{Aa}	5.02 ± 1.91^{Aa}
14	4.98 ± 1.92^{Aa}	5.28 ± 1.88^{Aa}	4.96 ± 1.82^{Aa}
21	4.44 ± 2.23^{Ba}	5.82 ± 1.57^{Aa}	4.76 ± 2.03^{Ba}

^{A,B}Within a row, different superscript capital letters denote significant differences between formulations ($p < 0.05$); ^{a,b}Within a column, different lowercase superscript letters denote significant differences between storage periods ($p < 0.05$). SYC: control soy yoghurt (SY); SYM: SY with mango pulp and essence; SYG: SY with guava pulp and essence.

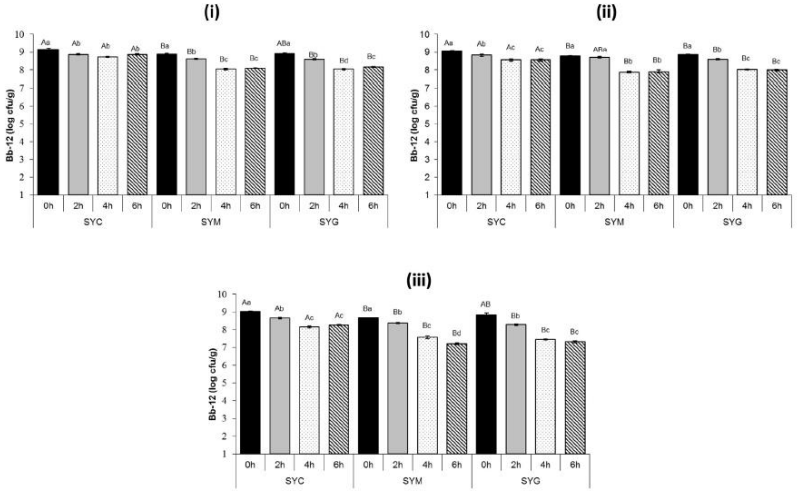

Fig. 2. Survival of *B. animalis* Bb-12 (log cfu/g) in synbiotic soy yoghurts with okara during storage for 1, 14, and 28 days (i–iii, respectively) before (0 h) and during exposure to *in vitro* simulated gastric (2 h) and enteric (4 and 6 h) conditions. For the same storage period, $^{A-C}$Different superscript capital letters denote significant differences between formulations for the same sampling period of the *in vitro* assay ($p < 0.05$); $^{a-d}$Different superscript lowercase letters denote significant differences between different sampling periods of the *in vitro* assay for the same formulation ($p < 0.05$). SYC: control soy yoghurt (SY); SYM: SY with mango pulp and essence; SYG: SY with guava pulp and essence.

Aplicações

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RESEARCH ARTICLE

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Impact of combining acerola by-product with a probiotic strain on a gut microbiome model

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ABSTRACT

In this study, we first investigated the survival of three probiotic strains, individually and combined with acerola by-product during simulated gastrointestinal conditions. Next, we investigated the effects of acerola by-product combined with *Bifidobacterium longum* BB-46 on a gut microbiota model (SHIME®). Chemical composition, total phenolic compounds, antioxidant activity of the acerola by-product and microbial counts, denaturing gradient gel electrophoresis (DGGE), ammonium ions (NH_4^+) and short-chain fatty acids (SCFAs) analysis of the SHIME® samples were performed. Acerola by-product revealed high protein and fibre, reduced lipid contents, and showed to be an excellent source of total phenolic compounds with high *in vitro* antioxidant activity. A decreased amount of NH_4^+ in the ascending colon and an increase ($p < .05$) in SCFAs were observed in the three regions of colon during treatment with BB-46 and acerola by-product. BB-46 combined with acerola by-product showed positive effects on the gut microbiota metabolism in SHIME® model.

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KEYWORDS
Probiotic; SHIME®; acerola by-product; phenolic compounds; human gut microbiota

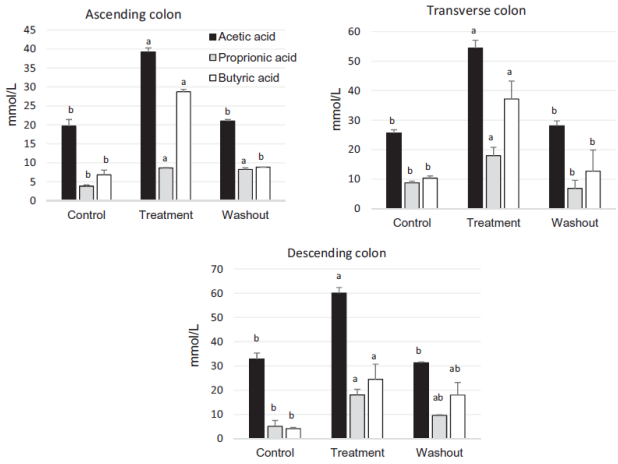

Figure 5. Metabolic activity of short-chain fatty acid (SCFA): acetic, propionic, and butyric acids in different vessels that simulate the ascending (colon vessel 3), transverse (colon vessel 4), and descending (colon vessel 5) colons as a result of treatment with the acerola by product + *Bifidobacterium longum* BB-46. Different letters represent a significant difference ($p < .05$) between different phases (control, treatment, and washout) for the same SCFA.

Table 2. NH_4^+ production (mmol/L) in different vessels that simulate the ascending (colon vessel 3), transverse (colon vessel 4), and descending (colon vessel 5) colons as a result of treatment with the acerola by product + *Bifidobacterium longum* BB-46.

	Ascending colon	Transverse colon	Descending colon
Control period	25.16 ± 0.88^{A}	27.39 ± 1.69^{A}	24.77 ± 0.75^{A}
Treatment period	16.40 ± 4.80^{B}	25.82 ± 2.00^{A}	25.77 ± 1.49^{A}
Washout period	23.70 ± 9.40^{AB}	38.17 ± 5.82^{B}	40.33 ± 2.07^{B}

Different letters in the same column represent a significant difference ($p < .05$) between different periods of the experiment for the same vessel.

Aplicações

Impact of Acerola (*Malpighia emarginata* DC) Byproduct and Probiotic Strains on Technological and Sensory Features of Fermented Soy Beverages

Antonio Diogo Silva Vieira, Vanessa Biscola, Marcela Albuquerque Cavalcanti de Albuquerque, Raquel Bedani, and Susana Marta Isay Saad

Abstract: Ten probiotic cultures were screened for the ability to hydrolyze soy proteins and bile salt deconjugation (BSD) to select one lactobacilli and one bifidobacteria strain to produce fermented soy beverages (FSBs) containing acerola byproduct (ABP). Next, the effect of the strains and the ABP on the technological and sensory characteristics of these beverages was evaluated during refrigerated storage for up to 28 days. None of the tested strains presented any proteolytic activity against soy proteins. Among the probiotic strains, the best BSD activities were observed for *Lactobacillus acidophilus* LA-5 and *Bifidobacterium longum* BB-46, which were further employed, individually or combined, to produce FSB supplemented or not with ABP, using *Streptococcus thermophilus* TH-4 as a starter, and the effect of these strains and ABP on the technological and sensory acceptability of FSB was evaluated. The probiotic strains did not influence FBS texture parameters, but ABP increased firmness in the ready product. BB-46 increased acidity, therefore decreasing acceptance, whereas the presence of LA-5 and/or ABP increased acceptance, even though the appearance was negatively affected by ABP after 21 days of storage. Thus, the presence of LA-5 and ABP contributed for the sensory acceptance of the FSBs without affecting their technological features.

Keywords: acerola byproduct, bile salt hydrolyses, fermented soy products, probiotic, sensory acceptability

Practical Application: *Lactobacillus acidophilus* LA-5, *Bifidobacterium longum* BB-46, and/or acerola byproduct (ABP) were applied in the production of fermented soy beverages (FSBs). Principal components analysis was used to evaluate the formulations of the 2^3 factorial design and the sensory attributes and the effect of storage independently and covariance was the matrix type used for mapping purposes. LA-5 and ABP contributed for the sensory acceptance of FSB, without affecting their technological features, and could be used by food processing companies after scaling up, also reducing the environmental impact by decreasing discarding byproducts, which are sources of bioactive compounds.

doi: 10.1111/1750-3841.14939

Aplicações

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Food Research International

journal homepage: www.elsevier.com/locate/foodres

Influence of daily consumption of synbiotic soy-based product supplemented with okara soybean by-product on risk factors for cardiovascular diseases

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A significant decrease in LDL-C and LDL-C to HDL-C ratio was observed in volunteers who consumed the synbiotic soy product after 8 weeks of study. These results suggest limited lipid-lowering effects of synbiotic soy-based product supplemented with okara in normocholesterolemic men.

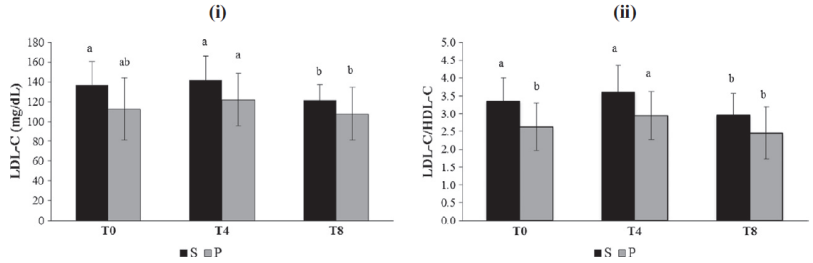

Fig. 1. Values of LDL-C (i) and LDL-C to HDL-C ratio (ii) throughout 8 weeks of intervention. Values are mean ± SD. [a,b] Different superscript lowercase letters denote significant differences between different sampling periods for the same study group ($p < 0.05$). T_0: baseline; T_4: 4 weeks of daily consumption of soy-based products; T_8: 8 weeks of daily consumption of soy-based products. LDL-C: low density lipoprotein cholesterol; LDL-C/HDL-C: LDL-cholesterol to HDL-cholesterol ratio. Group S: individuals who consumed the synbiotic soy-based product; Group P: individuals who consumed placebo (non-fermented soy-based product).

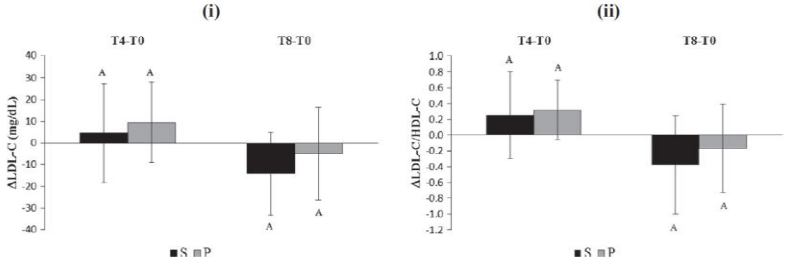

Fig. 2. Comparison between study groups for LDL-C (i) and LDL-C to HDL-C ratio (ii) after 4 and 8 weeks of intervention (changes from baseline). Values are mean. [A] Different superscript capital letters denote significant differences between groups for the same sampling period of the study ($p < 0.05$). T_0: baseline; T_4: 4 weeks of daily consumption of soy-based products; T_8: 8 weeks of daily consumption of soy-based products. Δ: changes from baseline ($T_4–T_0$ or $T_8–T_0$). LDL-C: low density lipoprotein cholesterol; LDL-C/HDL-C: LDL-cholesterol to HDL-cholesterol ratio. Group S: individuals who consumed the synbiotic soy-based product; Group P: individuals who consumed placebo (non-fermented soy-based product).

Aplicações

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SCIENTIFIC REPORTS

OPEN

Quinoa whole grain diet compromises the changes of gut microbiota and colonic colitis induced by dextran Sulfate sodium in C57BL/6 mice

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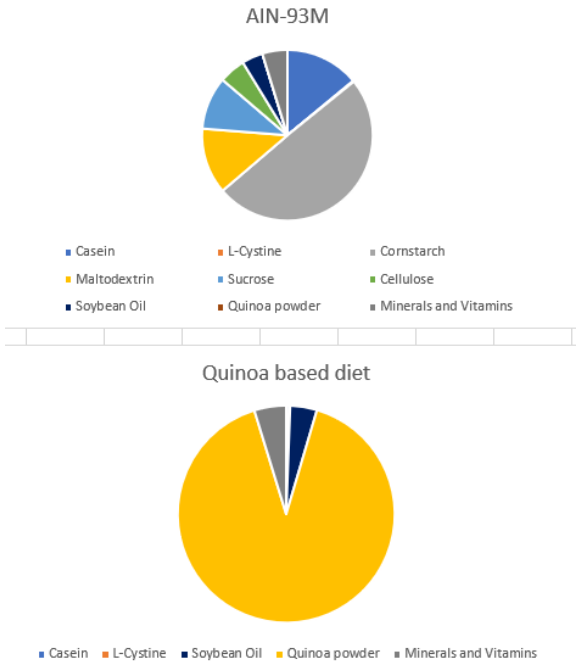
Published online: 08 October 2018

Wei Liu[1,2,3], Yu Zhang[1], Bin Qiu[2], Shoujin Fan[4], Hanfeng Ding[1,4] & Zhenhua Liu[3]

A plethora of evidence highlights that the dysbiosis of gut microbiota is a critical factor for inflammatory bowel disease (IBD). Both *in vivo* and *in vitro* studies have demonstrated that quinoa possesses potential prebiotic effects. The present study aims to examine the potential in using quinoa to ameliorate the dysbiosis and colitis induced by dextran sodium sulfate (DSS). A total of 40 C57BL/6 mice were fed either an AIN-93M diet or a quinoa-based diet, separately. Colitis was induced for 10 animals/dietary group with a 5-days exposure to 2.5% DSS. The clinical symptoms were monitored every other day, and the gut microbiota was characterized by 16S rRNA gene sequencing. The results indicated that consumption of quinoa lessened clinical symptoms as indicated by the reduced disease activity index and the degree of histological damage ($P < 0.05$). As expected, the DSS treatment induced significant dysbiosis of gut microbiota in mice on an AIN-93M diet. However, compared to mice fed the AIN-93M diet, the consumption of quinoa alleviated the DSS-induced dysbiosis remarkably, as indicated by increased species richness and diversity, decreased abnormal expansion of phylum *Proteobacteria*, and decreased overgrowth of genera *Escherichia/Shigella* and *Peptoclostridium* ($P < 0.05$). The relative abundances of *Firmicutes* and *Bacteroidetes* were less altered in mice fed with quinoa comparing to those mice fed the AIN-93M diet. In summary, the consumption of quinoa suppressed the dysbiosis of gut microbiota and alleviated clinical symptoms induced by DSS, indicating the potential to utilize quinoa as a dietary approach to improve intestinal health.



Aplicações

VITAMIN D RECEPTOR CONTRIBUTES TO THE HEALTH BENEFITS OF PROBIOTIC CONSUMPTION

Carolina Battistini [1] - Yong-guo Zhang [2] - Ishita Chatterjee [2] - Rong Lu [2] - Jilei Zhang [2] - Susana M I Saad [1] - Jun Sun [2]

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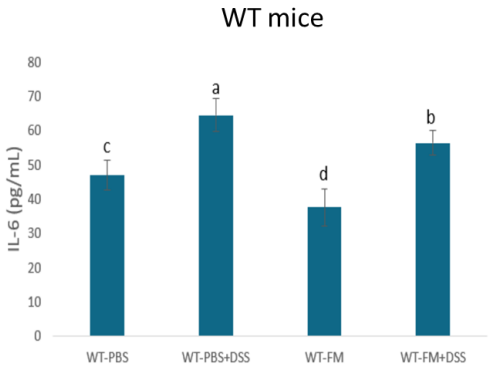
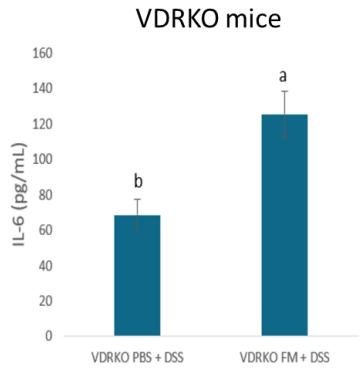
The probiotic FM produced with the co-culture *Streptococcus thermophilus* TH-4 and *Lactobacillus paracasei* subsp. *paracasei* F19 presented a promising anti-inflammatory potential against DSS induced colitis in mice, but VDR expression is needed. Therefore, enhancing VDR levels may contribute to potential health benefits driven by probiotic consumption.

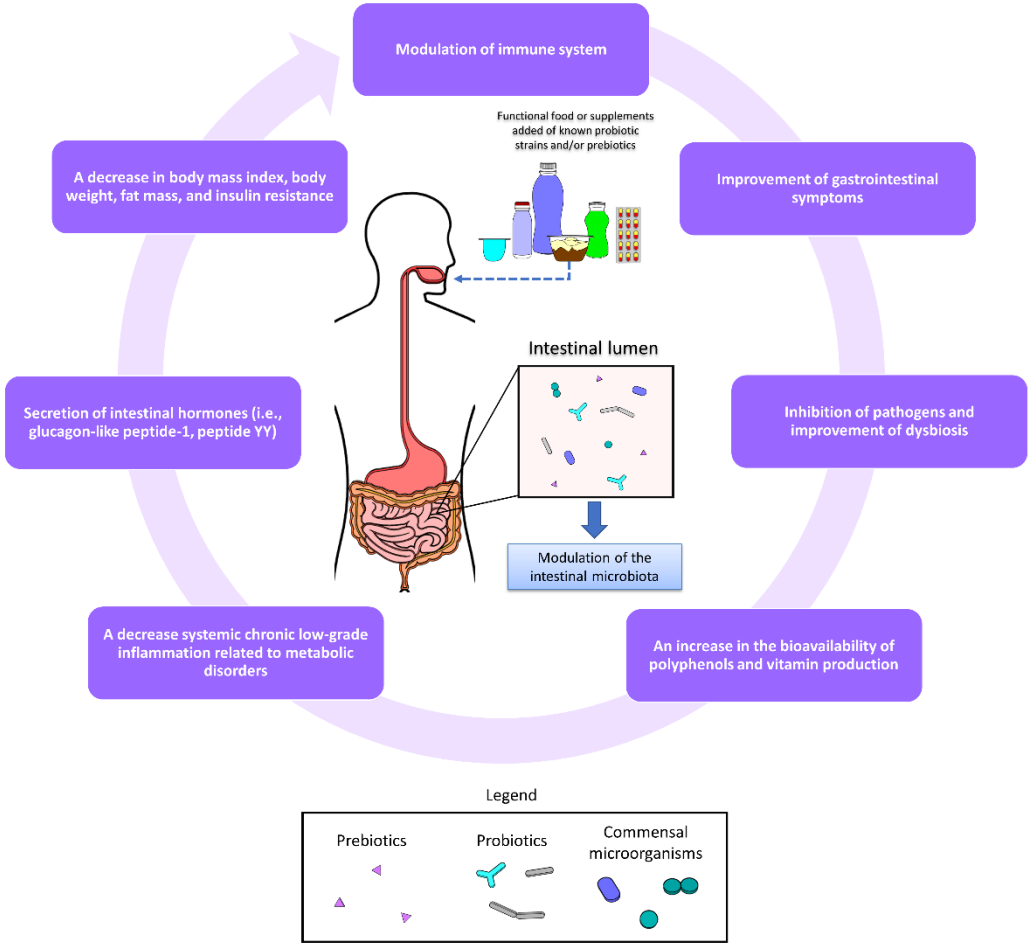
Inflammatory response of Probiotic Fermented Milk





* ELISA Kit (Mouse IL6)

Conclusões



Ballan et al., **Interactions of Probiotics and Prebiotics with the Gut Microbiota**, 2020, https://doi.org/10.1016/bs.pmbts.2020.03.008

Conclusões

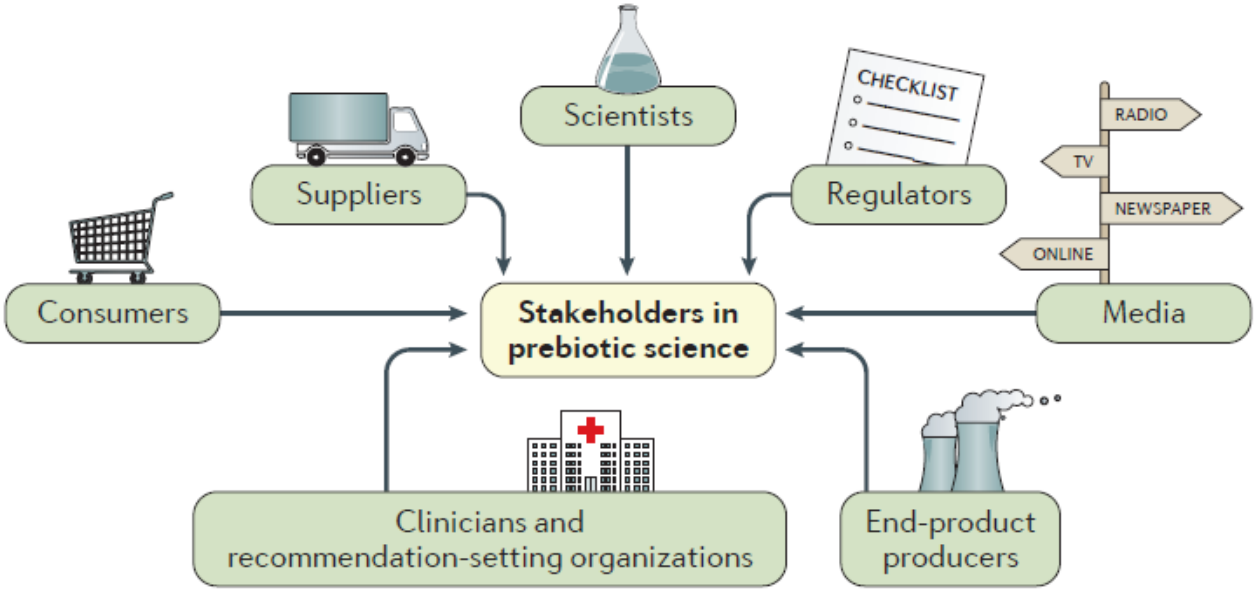


Figure 2 | **Stakeholders with an interest in prebiotic science.**

Gibson et al., *Nature Reviews Gastroenterology & Hepatology*, v. 14,p. 491-502, 2017.

Obrigada!!!

Contatos

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