

Probiotics and Disease: A Comprehensive Summary—Part 2, Commercially Produced Cultured and Fermented Foods Commonly Available in the United States

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Abstract

This article series provides a literature review of the disease-specific probiotic strains studied in published clinical trials in humans and animals. The goal of the series is to provide clinically useful tools. The table design allows for quick access to supportive data and will be helpful as a guide for both researchers and clinicians. The first article (part 1) focused on mental health and neurological conditions. This second article (part 2) explores cultured and fermented foods that are commonly available in the United States. Future articles will review conditions related to cardiometabolic and fatigue syndromes; ear, nose, throat, respiratory, and infectious

diseases; immune and dermatological conditions; cancer; gastrointestinal and genitourinary; followed by an article focused on probiotic supplements. This literature review is specific to disease conditions, probiotic classification, and individual strains. In part 1, we explored foods, brands, bacterial strains, and the number of organisms at end of production (in colony-forming units). In part 2, we investigate many of the commercially available cultured and fermented probiotic rich foods that are currently available in the United States. This summary can serve as a quick reference guide for recommending probiotic rich foods to patients.

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The purpose of this summary is to provide nutritionists and other medical practitioners with a reference guide for recommending health-promoting commercially produced cultured and fermented food products to patients. Research was conducted via grocery stores trips, company Web site reviews, personal communication with food company personnel, along with PubMed and EBSCO Research Premier searches. The lists contained herein are not exhaustive; however, they represent items that are commonly accessible to US consumers.

Foods Containing Live Active Cultures and Probiotic Foods

Cultured and fermented foods contain live active bacteria. One caveat is that pasteurization destroys bacteria; thus, for foods to retain their active cultures, foods must be pasteurized before fermentation.¹

In some, but not all cases, foods may be classified as a probiotic. Owing to the inconsistency of the internationally recognized definition of probiotic foods, this article uses the standards set forth by the International Scientific Association for Probiotics and Prebiotics (ISAPP). In accordance with the ISAPP definition, there must be viable scientific evidence to support the generalized benefit in human subjects, proof of viability/quantity of specific strains, and shelf-life viability. As such, the ISAPP classifies some traditionally probiotic foods, such as yogurt, not as probiotic but as fermented foods “containing live and active bacteria.” This delineation is due to the potential diversity and variability of strains found in such traditional cultured foods.²

Table 1 shows a variety of fermented foods containing live and active cultures that are prepared using specific bacteria. The foods listed herein are commercially produced and commonly available in the refrigerated sections of grocery and health food stores in the United States. Research shows that many of these foods have

health-promoting and medicinal qualities.³ Specific benefits range from improved immune system function, better gastrointestinal health, improved mood, and increased bone mineral density among those with osteoporosis.^{4,5} This detailed information can be found in

the Notes section in Table 1. Caution is advised for those with histamine sensitivity as fermented foods are high in histamine and may exacerbate symptoms of histamine intolerance.⁶

Table 1. Foods Commercially Available in the United States That Contain Specific Bacterial Cultures

Food Category	Specific Food	Brands Product Examples	Bacterial Strains	Number of Organisms at End of Production (CFU)	Notes
Fermented Dairy-free Beverages	Kvass	Zukay Live Foods			Kvass is a traditional fermented fruit and/or vegetable juice product from Eastern Europe. ⁷
		Veggie Kvass, Fruit Kvass	<i>L casei</i> , <i>L mesenteroides</i> (specifically <i>Ln mesenteroides</i> FUA 3086), <i>S cerevisiae</i> (yeast)	$7.3 \times 10^7/\text{mL} = 17.52$ billion/240 mL, $6.0 \times 10^7/\text{mL} = 14.4$ billion per 240 mL, $3.0 \times 10^7/\text{mL} = 7.2$ billion/240 mL	See Dlusskaya et al ⁸ (2008)
Fermented Dairy Alternatives	Almond Yogurt	Almond Dream			
		Nondairy Yogurt	<i>S thermophilus</i> , <i>B lactis</i> , ^a <i>L acidophilus</i> , <i>L rhamnosus</i> , <i>L casei</i> , <i>L delbrueckii</i> , <i>L lactis</i> , <i>L bulgaricus</i>	Not specified; contains live and active cultures, ^{a,b} at least 100 million CFU/g	
		Amande Cultured Almond Milk	<i>L acidophilus</i> , <i>L rhamnosus</i> , <i>L casei</i> , <i>L bulgaricus</i> , <i>S thermophilus</i> , <i>B bifidum</i> ^a	Not specified; contains live and active cultures, at least 100 million CFU/g	
		Kite Hill			
		Almond Milk Yogurt	<i>S thermophilus</i> , <i>L bulgaricus</i> , <i>L acidophilus</i> , <i>Bifidobacteria</i> ^a (species not specified)	Not specified; contains live and active cultures, at least 100 million CFU/g	
	Cashew Yogurt	Forager Project			
		Creamy, Dairy-free Cashew Yogurt	<i>L plantarum</i> LM, <i>L acidophilus</i> , <i>B bifidum</i> , <i>L bulgaricus</i> , <i>S thermophilus</i> , <i>L delbrueckii</i> LE	Not specified; contains live and active cultures, at least 100 million CFU/g	
	Coconut Milk Yogurt	Coconut Grove			
		Organic Cultured Coconut Milk	<i>S thermophilus</i> , <i>L bulgaricus</i> , <i>L acidophilus</i> , <i>Bifidobacterium</i> ^a (species not specified)	Not specified; contains live and active cultures, at least 100 million CFU/g	
		Trader Joe's			
		Cultured Coconut Milk	<i>L bulgaricus</i> , <i>S thermophilus</i> , <i>L rhamnosus</i> , <i>L acidophilus</i> , <i>B bifidum</i> ^a	Not specified; contains live and active cultures, at least 100 million CFU/g	
	Soy Yogurt	Springfield Creamery			

Table 1. (continued)

Food Category	Specific Food	Brands Product Examples	Bacterial Strains	Number of Organisms at End of Production (CFU)	Notes
		Nancy's Organic Cultured Soy	<i>L acidophilus</i> , <i>B lactis</i> , <i>L casei</i> , <i>L rhamnosus</i> , <i>L bulgaricus</i> , <i>S thermophilus</i>	Not specified; contains live cultures, at least 100 million CFU/g	
		Stonyfield Organic			
		O'Soy Soy Yogurt	<i>S thermophilus</i> , <i>L bulgaricus</i> , <i>L acidophilus</i> , <i>Bifidus</i> ^a (species not specified)	Not specified; contains live and active cultures, at least 100 million CFU/g	
Fermented Dairy Products					
	Lassi	Dahlicious			Lassi is a traditional Indian fermented cow's milk product that contains fruits or grains and a variety of medicinal herbs and spices. ⁹
		Cow's Milk Lassi	<i>S thermophiles</i> , <i>L acidophilus</i> , <i>B lactis</i> , ^a <i>L casei</i> , <i>P freudenreichii</i>	15 billion/240 mL	
	Yogurt	All Yogurt Containing "Live and Active Cultures"	<i>L bulgaricus</i> , <i>S thermophilus</i>	At least 100 million CFU/g	
	Cow's Milk Yogurt	Springfield Creamery			
		Nancy's Organic Yogurts	<i>L acidophilus</i> LA-5, <i>S thermophilus</i> , <i>L bulgaricus</i> , <i>L casei</i> , <i>L rhamnosus</i> , <i>B bifidum</i> ^a	56 billion CFU/225 g/ mL	
		Wallaby Yogurt Company			
	Goat's Milk Yogurt	Redwood Hill Farm			
		Goat Milk Yogurt	<i>B lactis</i> , ^a <i>S thermophilus</i> , <i>L acidophilus</i> , <i>L delbrueckii</i> sbps <i>lactis</i> , <i>L delbrueckii</i> sbps <i>bulgaricus</i>	Not specified; contains live and active cultures, ^b at least 100 million CFU/g	
	Sheep's Milk Yogurt	Bellwether Farms			
			<i>L bulgaricus</i> , <i>S thermophilus</i> , <i>L acidophilus</i> , <i>Bifidus</i> ^a (species not specified)	Not specified; contains active cultures, ^b at least 100 million CFU/g	
Probiotic Dairy Foods ^c	Cow's Milk Probiotic Yogurt	Dannon, Inc			

Table 1. (continued)

Food Category	Specific Food	Brands Product Examples	Bacterial Strains	Number of Organisms at End of Production (CFU)	Notes
		Activia, Activia Light, Activia Greek, Activia Fruit Fusion, Activia Dairy Drink	<i>B animalis lactis</i> DN-173 010/CNCM I-2494, ^a <i>S thermophilus</i> , <i>L bulgaricus</i> , <i>L lactis</i>	Not specified; contains live and active cultures, ^b at least 100 million CFU/g	Health Claim “Activia may help reduce the frequency of minor digestive issues like bloating, gas, discomfort and rumbling, when consumed twice per day for two weeks as part of a balanced diet and healthy lifestyle.” ¹⁰ Human Studies in Support of Activia • Improved bowel evacuation in women with constipation. ¹¹ • Improved gastrointestinal well- being and digestive symptoms among women without gastrointestinal disorders. ¹²
	Cow’s Milk Probiotic Beverages	Dannon			
		DanActive	<i>L bulgaricus</i> , <i>S thermophilus</i> , <i>L casei immunitas</i> (<i>L casei</i> DN-114001)	Not specified; contains live and active cultures, ^b at least 100 million CFU/g	Health Claim “DanActive helps support your immune system when consumed regularly as part of a balanced diet and healthy lifestyle.” ¹³ Studies in Support of Danactive • Improved immune response. ^{14,15}
		Yakult USA			
		Yakult, Yakult Light	<i>L casei shirota</i>	8 billion/80 mL	Health Claim “Drinking Yakult daily may help balance your digestive system.” ¹⁶ Human Studies in Support of Yakult • Preservation of diversity of gut microbiota and decreased abdominal dysfunction in the context of high-stress situations. ¹⁷ • Improved natural killer cell activity and increased anti- inflammatory cytokine production among elderly subjects. ¹⁸ • Immunomodulation in HIV- positive patients. ¹⁹ • Decreased duration of fever associated with norovirus. ²⁰ • Decreased incidence of hard, lumpy stool. ²¹ • Decreased frequency and duration of upper respiratory tract infections. ²² • Decreased cortisol secretion during times of stress. ²³

Table 1. (continued)

Food Category	Specific Food	Brands Product Examples	Bacterial Strains	Number of Organisms at End of Production (CFU)	Notes
	Cow's Milk Kefir				Human Studies in Support of Kefir <ul style="list-style-type: none"> • Anticariogenicity²⁴ • Attenuation of inflammatory process associated with athletic training.²⁵ • Improved outcomes in <i>H pylori</i> infection treatment.²⁶ • Improved regulation of emotions, modulation of sensory and task responses.²⁷ • Increased bone mineral density in patients with osteoporosis.²⁸ • Relief of constipation.²⁹
		Green Valley Organics			
		Lactose-Free Kefir	<i>L bulgaricus</i> , <i>L acidophilus</i> , <i>L casei</i> , <i>L rhamnosus</i> , <i>L lactis</i> , <i>L diacetylactis</i> , <i>S thermophilus</i> , <i>L cremoris</i> , <i>L cremoris</i> , <i>B bifidum</i> ^a	589.68 billion/240 mL	
		Springfield Creamery			
		Nancy's Organic Lowfat Plain Kefir	<i>B lactis</i> BB-12, <i>L acidophilus</i> LA-5, <i>L casei</i> , <i>L rhamnosus</i> LB3	Not specified; contains live and active cultures, ^b 233 billion live cultures/240 mL, 64 Billion live probiotic cultures cultures/240 mL	
	Goat's Milk Kefir	Redwood Hill Farm			
		Goat Milk Kefir	<i>B lactis</i> , ^a <i>S thermophiles</i> , <i>L casei</i> , <i>L rhamnosus</i> , <i>L acidophilus</i> , <i>L delbrueckii</i> sbsp <i>lactis</i> , <i>L delbrueckii</i> sbsp <i>bulgaricus</i> , <i>L lactis</i> sbsp <i>cremoris</i> , <i>L lactis</i> sbsp <i>lactis</i> , <i>L lactis</i> sbsp <i>lactis</i> biovar <i>diacerylactis</i> , <i>L mesenteroides</i> sbsp <i>cremoris</i>	589.68 billion/240 mL	
Probiotic Drinks (Dairy-free) ^c	Kombucha				Health Claims <ul style="list-style-type: none"> • "Bolsters your immunity."³⁰ • "Reinvigorating."³¹ • "Naturally Energizing."³¹ • "Restorative."³¹ Human Studies in Support of Kombucha <ul style="list-style-type: none"> • None found via PubMed search. • Lack of experimental evidence in human subjects had been noted.³²

Table 1. (continued)

Food Category	Specific Food	Brands Product Examples	Bacterial Strains	Number of Organisms at End of Production (CFU)	Notes
		GT's Kombucha			
		Classic Kombucha, Classic Synergy	<i>Lactobacillus</i> (no species specified), <i>S boulardii</i>	1 billion/240 mL, 1 billion/240 mL	May contain over 0.5% alcohol.
		Enlightened Kombucha, Enlightened Synergy	<i>B coagulans</i> GBI-30 6086, <i>S boulardii</i>	1 billion/240 mL, 1 billion/240 mL	
		Kevita Kombucha			
		Masterbrew	<i>B coagulans</i> (LactoSporeMTCC 5826), <i>L rhamnosus</i>	Not specified, "Live probiotic"	Contains caffeine.
		Cleansing Probiotic Drink, Sparkling Probiotic Drink	Kevita Probiotic Culture: <i>B coagulans</i> GBI-30 6086, <i>L rhamnosus</i> , <i>L plantarum</i> , <i>L paracasei</i>	Not specified	Cleansing Probiotic Drink contains trace amounts of alcohol.
	Juice Drinks	NextFoods			
		GoodBelly By the Glass, GoodBelly Gluten Free By the Glass, Good Belly Plus Shot, GoodBelly Straight Shot, GoodBelly Supershot	<i>L plantarum</i> 299V	20 billion/240 mL, 20 billion/240 mL, 20 billion/81 mL, 20 billion/81 mL, 50 billion/81 mL	Health Claims "Promotes healthy digestion." ³³ Human Studies in Support of Drink Containing <i>Lactobacillus plantarum</i> 299V: <ul style="list-style-type: none"> • Decreased gastrointestinal permeability and inflammatory response following biliary drainage in patients with obstructive jaundice.³⁴ • Decreased gastrointestinal symptoms during antibiotic therapy.³⁵

Note: These foods are all refrigerated and not pasteurized after culturing.

^aViability of *Bifidobacterium* strains in yogurt has been shown to decline after 4 weeks in refrigerated (4°C) storage.³⁶

^bAccording to the National Yogurt Association, a yogurt that claims to contain "live and active cultures" must contain at least 100 million cultures per gram at the time of manufacture.¹ According to the International Scientific Association for Probiotics and Prebiotics,² the terms *live* and *active cultures* do not always imply probiotic activity; scientific evidence of general beneficial effect in humans and proof of viability of specific strains at the end of product shelf life are required for "probiotic" food classification.

^cAccording to the International Scientific Association for Probiotics and Prebiotics,² scientific evidence of general beneficial effect in humans and proof of viability of specific strains at the end of product shelf life are required for "probiotic" food classification.

Abbreviation: CFU, colony-forming unit.

Fermented Foods

Historically, fermented foods have been traditional staples for populations in all parts of the globe.³⁷ Fermenting food, often via lactic acid bacterial fermentation, enhances digestibility, improves nutrient content (eg, enhances B complex vitamins, increases vitamin A and K levels, decreases mineral-binding phytates) and is an effective means of biopreservation.^{38,38,39} Certain types of flora have been shown to be predominant in many foods; however, some geographic variation exists owing to traditions and cultural preferences.³⁷ Table 2 displays commercially produced refrigerated (with the exception of olives) fermented foods commonly found in grocery stores in the United States; this list is not exhaustive.

None of these foods would be officially classified as probiotics by the ISAPP² because they do not always

contain specific strains of bacteria in stated quantities. However, all of the foods listed contain beneficial live bacteria that have health-promoting qualities.³⁸ Caution is advised for those with histamine sensitivity as fermented foods are high in histamine and may exacerbate symptoms.⁶

There are many shelf-stable fermented foods available in the marketplace such as beer, chocolate, coffee, ginger beer, tamari soy sauce, and wine.³⁹ These shelf-stable foods have been excluded from this list because temperature fluctuations through time could alter the level of surviving live bacteria in the food product.⁴⁰ Cheeses, another category of fermented food, have also been excluded from this list. The purpose of the exclusion is due to the wide variety of cheese, all of which have their unique culture fingerprints.⁴¹

Table 2. Common Fermented Foods Commercially Available in the United States

Food Category	Specific Food	Brands Product Examples	Prominent Bacterial Strains Present at End of Fermentation	Notes
Soy	Miso	Marukome, Miso Master	Various lactic acid bacteria (primarily <i>Lactococci</i> and <i>Enterococci</i>) ⁴²	Miso, a traditional Japanese food, is a fermented soybean paste. ^{42,43} Other beans or grains may be used to make miso. ⁴³
	Tempeh	Lightlife, Tofurky, West Soy	<i>R oligosporus</i> (mold), <i>R oryzae</i> (mold) ⁴³	Tempeh, a traditional Indonesian food, is a fermented soybean cake; it is high in protein. ^{37,49} Grains such as rice or barley are sometimes added to tempeh. ⁴⁹
Vegetables	Kimchi	King's, Ozuké, Seoul, Wildbrine, Pickled Planet	<i>Lactobacillus plantarum</i> , <i>L mesenteroides</i> , <i>W koreensis</i> , ⁴⁴ <i>L plantarum</i> , <i>L brevis</i>	Kimchi, a traditional Korean food, is fermented cabbage, traditionally made with radish, garlic, red pepper, green onion, ginger and salt. ³⁷ Ozuké brand kimchi is available at grocery stores in the central United States. ⁵⁰ Ozuké brand kimchi contains 88 million CFU/g (M. King, personal communication, October 7, 2016). Mara King is the Chief Operating Officer of Esoteric Food Company.
	Pickled Beets	Ozuké, PureLiving, Wildbrine	Lactic acid bacteria (M. King, personal communication, October 7, 2016), specifically <i>L plantarum</i> , <i>L brevis</i> (C. Glab, personal communication, July 11, 2016)	Ozuké brand fermented beets are available at grocery stores in the Central United States. ⁵⁰ Ozuké brand fermented beets contain 10 million CFU/g. (M. King, personal communication, October 7, 2016). Mara King is the Chief Operating Officer of Esoteric Food Company. Christopher Glab is the owner of Wildbrine.
	Pickled Cucumbers	Bubbies, Real Pickles, Pickled Planet	<i>Lactobacillus</i> , <i>Pediococcus</i> , <i>Leuconostoc</i> (species not specified) ⁴⁵ <i>L plantarum</i> <i>L brevis</i>	Real Pickles are available in the North Eastern United States. ⁵¹

Table 2. (continued)

Food Category	Specific Food	Brands Product Examples	Prominent Bacterial Strains Present at End of Fermentation	Notes
	Pickled Ginger	Wildbrine	<i>L. plantarum</i> <i>L. brevis</i> (C. Glab, personal communication, July 11, 2016)	Christopher Glab is the owner of Wildbrine.
	Sauerkraut	Bubbies, Farmhouse Culture, PureLiving, Wildbrine, Pickled Planet	<i>L. mesenteroides</i> , <i>L. plantarum</i> , <i>P. pentosaceus</i> , <i>L. brevis</i> , ⁴⁶ <i>L. plantarum</i> <i>L. brevis</i> (C. Glab, personal communication, July 11, 2016) <i>L. plantarum</i> <i>L. brevis</i>	Sauerkraut, fermented cabbage, is a traditional German food. ⁴³ Christopher Glab is the owner of Wildbrine.
Other	Fermented Juice	Farmhouse Culture, Gut Shot, Wildbrine	None specified, <i>L. plantarum</i> , <i>L. brevis</i> (C. Glab, personal communication, July 11, 2016)	Christopher Glab is the owner of Wildbrine.
	Black (Kalamata) Olives (Greek, in glass jars)	DeLallo, Mezzetta	<i>L. pentosus</i> , <i>L. mesenteroides</i> ⁴⁷	
	Green Olives (Greek and Spanish, in glass jars)	Trader Joe's, Mezzetta	<i>L. plantarum</i> , <i>L. pentosus</i> ^{47,48}	
	Salad Dressings	Zukay	None specified	Zukay salad dressing flavors include Carrot Ginger, Cucumber Mint, and Tomato Olive.
	Pickled Beans	Pickled Planet	<i>L. plantarum</i> , <i>L. brevis</i>	
	Salsa	Wildbrine	<i>L. plantarum</i> , <i>L. brevis</i> (C. Glab, personal communication, July 11, 2016)	Christopher Glab is the owner of Wildbrine.

Note: No specific starter cultures added, and no specific CFUs reported.

Abbreviation: CFU, colony-forming unit.

Conclusion

A variety of commercially produced cultured and fermented foods, requiring refrigeration, are available in the US marketplace. Consuming products by their respective expiration dates will ensure the presence of live and active cultures in the food(s).⁵² The purpose of this review was to inform patients and practitioners about specific strains of bacteria and corresponding food(s) that may benefit or harm their well-being.

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