

Probiotics: Choosing The Right One For Your Needs

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Abstract

This article reviews the recent changes in the field of probiotic therapy. Additionally, the bacterial strains found in probiotic supplements available on the Australian market will be highlighted. There is a specific focus on the research conducted on these strains and a summary of when each brand of supplement and probiotic food would best be utilised in clinical practice.

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Introduction

This article is a follow-up to a previous article discussing the probiotic strains found in Australian yoghurts and their respective characteristics⁽¹⁾. The focus of this article is to share some of the recent knowledge in this field, to reinforce some of the changes in theory and practice that this knowledge precipitates, and to review the probiotic strains found in major Australian supplements. The evidence that exists supporting the use of these strains is also reviewed. This allows for the prescription of particular supplements and fermented foods for specific applications.

Probiotic Characteristics

Probiotic organisms require certain characteristics to enable them to exert maximum therapeutic effects. These qualities are outlined in Table 1.

Table 1 Desirable Properties of Probiotics⁽²⁾

Probiotic Characteristics
Human origin
Gastric acid and bile salt stability
Adherence to intestinal mucosa
Colonisation of intestinal tract
Safety in food and documented clinical safety
Production of anti-microbial compounds
Antagonism against pathogenic organisms
Clinically documented and validated health effects
Adequate shelf life and stability during processing

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Some of these characteristics are considered almost essential for a probiotic to have therapeutic effects. These are:

- 1) gastric acid and bile salt stability;
- 2) an ability to adhere to the intestinal mucosa; and
- 3) an ability to colonise the intestinal tract (at least temporarily).

Before prescribing any probiotic supplement or food, it is imperative to ensure that the bacterial strains contained in the product have these three vital qualities. If not, it is wise to prescribe one that does.

Other vital characteristics include the ability to produce anti-microbial compounds and to directly antagonise more pathogenic organisms⁽³⁾. Additionally, the anti-microbial compounds produced should have selective activity, so that they inhibit the growth of pathogenic bacteria, but not beneficial species. For example, *Lactobacillus acidophilus* NCFM produces anti-microbial substances that inhibit the growth of some beneficial species of bacteria, including *L. fermentum*, *L. delbrueckii* ssp. *lactis*, and *L. delbrueckii* ssp. *bulgaricus*, whilst having no effect on pathogens⁽⁴⁾. Whereas *L. rhamnosus* GG⁽⁵⁾ and *L. johnsonii* La1⁽⁶⁾ produce compounds that only inhibit the growth of potentially pathogenic bacteria, not beneficial ones.

Another important probiotic characteristic, especially in dealing with conditions associated with dysbiosis, is the ability of the strain to beneficially alter the composition of the GIT flora when consumed — both reducing numbers of potentially pathogenic organisms and increasing numbers of beneficial organisms. This is a trait not found in all probiotic strains. For instance, ingestion of *L. rhamnosus* GG both reduces gastrointestinal populations of potential pathogens and enhances growth of beneficial bacterial species⁽⁷⁾.

Unfortunately, many commercially available probiotic supplements and yoghurts contain bacterial strains that do not exhibit these vital characteristics. If a probiotic strain does not exhibit these characteristics, then it will be nowhere near as effective as those that do. Hence there are some specific yoghurts and supplements that will be more effective probiotics than others.

Changes in Probiotic Nomenclature

There are some changes in probiotic nomenclature that should be noted in order to make better sense of the literature:

- *Lactobacillus bifidus* (often incorrectly referred to as 'bifidus') was renamed *Bifidobacterium bifidum* over 30 years ago⁽⁸⁾.
- Bacterial strains that were once classified as *Lactobacillus acidophilus* (commonly referred to as 'acidophilus') have now been divided into six species: *L. acidophilus*, *L. gasseri*, *L. amylovorus*, *L. gallinarum*, *L. crispatus*, and *L. johnsonii*⁽⁹⁾.
- The species *Lactobacillus bulgaricus* is now called *Lactobacillus delbrueckii* ssp *bulgaricus*⁽⁸⁾.
- Strains of bacteria once classified as *Lactobacillus casei* have been reclassified as strains of *Lactobacillus paracasei* (eg *L. paracasei* Shirota strain) or *Lactobacillus rhamnosus* (eg *L. rhamnosus* GG)⁽⁹⁾.
- Strains of *Lactobacillus sporogenes* have been renamed *Bacillus coagulans* — they are not true lactobacilli as they are spore-forming⁽¹⁰⁾.

Strain Specificity of Actions and Qualities

As mentioned in my previous article, strains of bacteria can be likened to different breeds of dogs. All dogs belong to a single species ie *Canis familiaris*. Within this one species there is great diversity in size, shape, strength and other physical characteristics — ranging from the German Shepherd to the chihuahua. A similar division occurs within species of bacteria.

Within each species of bacteria there is a multitude of strains, some of which are resilient and strong, able to survive passage through the upper GIT and inhibit pathogenic bacteria. Whilst other strains within the same species may be unable to survive exposure to gastric acid or bile salts, nor limit the growth of pathogenic bacteria. It is also important to note that just because one strain of bacteria in a given species has a proven action does not mean that another strain will too. Furthermore, actions found in one strain of *L. rhamnosus* cannot be extrapolated to a strain of *L. acidophilus* or even another strain of *L. rhamnosus*. Actions and qualities are fundamentally strain specific⁽¹¹⁾. Even strains of bacteria within the same species can have significantly different actions, properties and characteristics.

Unfortunately, this strain specificity is not well known, leading to inaccurate extrapolations from the literature. For example, some supplement manufacturers will quote a study that utilised *L. rhamnosus* strain GG and then say that their probiotic supplement containing a strain of *L. acidophilus* will have the same effects. This is quite incorrect. This situation is somewhat analogous to the following scenario:

Both St John's wort and elecampane are medicinal herbs. Research has recently validated the efficacy of St John's wort in the management of mild to moderate depression. Because elecampane is another medicinal herb, it must also be useful in the treatment of mild to moderate depression.

This obviously isn't the case. The difference between the actions and qualities of particular strains of bacteria can be substantial (even within the same species), and is not unlike the differences between various medicinal herbs.

Thus it is very inaccurate and misleading to extrapolate results from research conducted on one bacterial strain to another. Unfortunately, this situation occurs far too commonly, especially at industry seminars. The bottom line is, if you want to achieve the same results as seen in a clinical trial, use the same bacterial strain.

Some supplement companies have actually gone so far as to alter the research abstracts included in their seminar manuals to change the identity of the strain that has been trialed. Thus making it appear as though their strain was used in the research.

Use of a different strain than what was utilised in the research may or may not produce therapeutic effects. Unless proven, one cannot assume that a given strain of *L. acidophilus*, *L. rhamnosus* or any other species of probiotic bacteria will even survive transit through the stomach and small intestine, let alone colonise the GIT or have specific therapeutic effects. They might, but unless proven it is impossible to know. Recent research has repeatedly demonstrated this strain specificity.

A number of recent clinical trials have investigated the use of *L. rhamnosus* strains in the prevention of recurrent urinary tract infections (UTIs). Each trial used a different strain of *L. rhamnosus*. *L. rhamnosus* GG⁽¹²⁾ and an unknown strain of *L. rhamnosus* (found in Gynophilus[®])⁽¹³⁾ failed to decrease rates of UTIs, whereas *L. rhamnosus* GR-1 (in conjunction with *L. fermentum* B-54) did decrease UTI recurrence rates^(14,15). *L. rhamnosus* GR-1 was found to have the capacity to colonise the urogenital area and inhibit the growth of uropathogens (i.e., *Escherichia coli*). Whereas the *L. rhamnosus* strain found in Gynophilus[®] was unable to colonise the urogenital region nor could it inhibit growth of uropathogens.

In vitro research using two closely-related strains of *B. bifidum* (CIDCA 5310 and 537) found that one strain (CIDCA 5310) inhibited enterocyte invasion by *Salmonella arizonae*, whereas the other had no effect⁽¹⁶⁾. The results of this research demonstrates the principle of strain specificity — that is, different bacterial strains (even within the same species) can have significantly different actions and therapeutic effects.

Supplement Quality

The quality of probiotic supplements depends upon two main factors:

- 1) the characteristics of the strains found in the supplement and
- 2) adequate viability, so that sufficient numbers of living bacteria are present at the point of consumption.

Bacterial strains used in probiotic supplements should demonstrate all the characteristics outlined in Table 1 and, ideally, supplements should also contain strains that have been clinically trialed.

Table 2A Choosing the Right Strain for Specific Therapeutic Applications

Therapeutic Application	Most Appropriate Probiotic Strain(s)	Most Appropriate Probiotic Food(s)	Most Appropriate Supplement(s)	References
Hypercholesterolaemia and cardiovascular disease	<i>Lactobacillus plantarum</i> 299v, <i>Bacillus coagulans</i> ATCC # 31284 ^β , <i>L. acidophilus</i> L1	Sauerkraut	Thorne (<i>Lactobacillus sporogenes</i>) ^β	(36–39)
Prevention of atopy	<i>L. rhamnosus</i> GG ^α	Vaalia ^α	Culturelle ^α	(24,25)
Eczema	<i>L. rhamnosus</i> GG ^α , <i>Bifidobacterium lactis</i> Bb12 ^β , <i>L. paracasei</i> Shirota ^δ	Vaalia ^{αβ} , Yoplus ^β , Yakult ^δ	Culturelle ^α , Blackmores ^β , Bio-Organics (<i>Ultra Megadophilus</i>) ^β , Natural Nutrition (<i>Mega Acidophilus capsules</i>) ^β , Nature's Own (<i>Double Strength Acidophilus</i>) ^β	(40–45)
Food allergies	<i>L. rhamnosus</i> GG ^α , <i>Bifidobacterium lactis</i> Bb12 ^β , <i>L. paracasei</i> Shirota ^δ	Vaalia ^{αβ} , Yoplus ^β , Yakult ^δ	Culturelle ^α , Blackmores ^β , Bio-Organics (<i>Ultra Megadophilus</i>) ^β , Natural Nutrition (<i>Mega Acidophilus capsules</i>) ^β , Nature's Own (<i>Double Strength Acidophilus</i>) ^β	(41–50)
Lowered immunity	<i>L. rhamnosus</i> GG ^α , <i>B. lactis</i> HN019 (DR10) ^α , <i>L. johnsonii</i> La1 ^β , <i>L. rhamnosus</i> HN001 (DR20) ^β , <i>L. acidophilus</i> LA5 ^α	Vaalia ^{αβ} , Nestle LC1 ^β , Mainland Inner-balance cheese ^δ , Yoplus ^α , Jalna (drinking yoghurt only) ^α	Culturelle ^α , Blis Bio Restore ^{αβ} , Blackmores ^α , Bio-Organics (<i>Ultra Megadophilus</i> or <i>Megadophilus</i>) ^α , Natural Nutrition (<i>Mega Acidophilus capsules</i>) ^α , Nature's Own (<i>Double Strength Acidophilus</i>) ^α	(51–61)
Antibiotic use (during and after)	<i>L. rhamnosus</i> GG ^α , <i>Saccharomyces cerevisiae</i> (Hansen CBS 5926), <i>L. acidophilus</i> LA5 ^α , <i>L. plantarum</i> 299v	Vaalia ^{αβ} , Yoplus ^β , Jalna (drinking yoghurt only) ^β , sauerkraut	Culturelle ^α , Blackmores ^β , Bio-Organics (<i>Ultra Megadophilus</i> or <i>Megadophilus</i>) ^β , Natural Nutrition (<i>Mega Acidophilus capsules</i>) ^β , Nature's Own (<i>Double Strength Acidophilus</i>) ^β	(62–73)

The most appropriate probiotic strain(s) to use for a variety of clinical applications. Probiotic strains are listed in decreasing order of appropriateness. For instance, strains listed first generally have the most evidence supporting their use in that condition. (Note: Table 2A highlights only those strains widely discussed in the peer-reviewed literature). The superscripted Greek lettering next to each strain is used to designate which food(s) and supplement(s) contains this strain. For example, *L. rhamnosus* GG is found in both Vaalia yoghurt and Culturelle supplements and *L. acidophilus* LA5 is found in both Vaalia and Yoplus yoghurts, Jalna drinking yoghurt and a number of different supplements.

Viability at the point of consumption depends upon a number of factors such as a proper environment during manufacturing, transport and storage, as well as the 'hardiness' of the strain. Many strains of lactobacilli and bifidobacteria do not respond well to freeze-drying (lyophilization) or spray drying, and excessive temperatures during storage or packaging can dramatically reduce bacterial survival. Typically, refrigeration is necessary during storage and ideally during transport, unless shown otherwise⁽¹⁷⁾.

Some manufacturers utilise enteric coatings on their capsules and tablets in an attempt to improve survival through the acidic medium of the stomach. This practice does appear to enhance survival through the upper GIT, although enteric coatings are not a necessity if the strain has demonstrated satisfactory tolerance to gastric acid⁽¹⁸⁾.

With so many probiotic products currently on the market, it can be difficult to sort through different manufacturer's claims of superiority. By choosing a supplement that contains bacterial strains with proven characteristics and clinical efficacy, according to the dosage recommendations discussed below, one will select supplements with the best chance of producing therapeutic results.

Unfortunately, probiotic supplements generally contain far fewer bacteria than the quantity stated on the label and many also contain bacterial contaminants. Market-basket surveys conducted throughout the world have consistently found few

probiotic supplements that contain what they are labelled as containing^(19–22). So until such time as an independent market-basket survey is conducted assessing Australian probiotic supplements, practitioners will never know if they are prescribing exactly what they believe they are. Thus it is important for clinicians to only prescribe brands that utilise stringent quality control measures during and after their manufacturing processes, and those that guarantee the number of live bacteria in their products until the expiry date. This will not assure that the supplement will contain what it says it does, but it does make it more likely. The recent debacle with Pan Pharmaceuticals has highlighted the fact that what is stated on the label is not necessarily what is in the product.

Probiotic Strains Available in Australia

The author approached a number of probiotic supplement manufacturers in order to ascertain which bacterial strains each supplement contained. Those that contain bacterial strains that have been widely discussed in the peer-reviewed literature are outlined in Tables 2A, 2B and 2C along with their therapeutic uses.

There were two common responses from companies whose supplements are not listed in Tables 2A, 2B or 2C. These were:

- did not know which bacterial strain(s) their supplements contained, or

Table 2B Choosing the Right Strain for Specific Therapeutic Applications

Therapeutic Application	Most Appropriate Probiotic Strain(s)	Most Appropriate Probiotic Food(s)	Most Appropriate Supplement(s)	References
Non-steroidal anti-inflammatory drug use/Erosive gastritis	<i>L. rhamnosus</i> GG ^α	Vaalial ^α	Culturelle ^α	(74)
Intestinal hyperpermeability	<i>L. rhamnosus</i> GG ^α , <i>S. cerevisiae</i> (Hansen CBS 5926)	Vaalial ^α , sauerkraut	Culturelle ^α	(42, 43, 75, 76)
Gastroenteritis	<i>L. rhamnosus</i> GG ^α , <i>L. reuteri</i> MM53, <i>L. paracasei</i> CRL431 ^β , <i>L. acidophilus</i> CRL730, <i>L. johnsonii</i> La1 ^φ , <i>B. lactis</i> Bb12 ^κ , <i>L. plantarum</i> 299v, <i>L. paracasei</i> Shirota ^τ	Vaalial ^{ακ} , Yoplus ^{δκ} , Nestle LC1 ^φ , Yakult ^τ , sauerkraut	Culturelle ^α , Blackmores ^κ , Bio-Organics (<i>Ultra Megadophilus</i>) ^κ , Natural Nutrition (<i>Mega Acidophilus capsules</i>) ^κ , Nature's Own (<i>Double Strength Acidophilus</i>) ^κ	(26, 27, 34, 77—85)
Giardia infection	<i>L. johnsonii</i> La1 ^α , <i>L. plantarum</i> 299v, <i>L. rhamnosus</i> GG ^δ	Nestle LC1 ^α , Vaalial ^δ , sauerkraut	Culturelle ^δ	(77, 86, 87)
Intestinal dysbiosis	<i>L. rhamnosus</i> GG ^α , <i>L. johnsonii</i> La1 ^β , <i>L. plantarum</i> 299v, <i>L. paracasei</i> Shirota ^φ , <i>Propionibacterium freudenreichii</i> HA-101 and HA-102 ^φ	Vaalial ^α , Nestle LC1 ^β , Yakult ^φ , sauerkraut	Culturelle ^α , Bioceuticals (Symbiotique) ^φ	(5—, 23, 65, 66, 88—91)
Lactose intolerance	<i>L. acidophilus</i> NCFM ^α , <i>L. johnsonii</i> La1 ^β , <i>L. acidophilus</i> LA5 ^δ	Nestle LC1 ^β , Vaalial ^δ , Yoplus ^δ , Jalna (drinking yoghurt only) ^δ	Metagenics (<i>Ultra Flora +/- DF, Ultra Flora Plus</i> or <i>Ultradophilus</i>) ^α , Blackmores ^δ , Bio-Organics (<i>Ultra Megadophilus</i> or <i>Megadophilus</i>) ^δ , Natural Nutrition (<i>Mega Acidophilus capsules</i>) ^δ , Nature's Own (<i>Double Strength Acidophilus</i>) ^δ	(28, 92—95)
Peptic ulcer disease/Nonerosive gastritis	<i>L. johnsonii</i> La1 ^α , <i>L. acidophilus</i> LB, <i>L. acidophilus</i> strain NAS ^δ , <i>L. acidophilus</i> DDS-1 ^φ , <i>L. rhamnosus</i> GG ^φ	Nestle LC1 ^α , Vaalial ^φ	Natren (<i>Trenev Trio, DFA, or Natradophilus</i>) ^{φφ} , Culturelle ^φ	(51, 96—99)
Irritable bowel syndrome	<i>L. plantarum</i> 299v, VSL # 3 ^β	Sauerkraut	VSL # 3 ^β	(100—102)

The most appropriate probiotic strain(s) to use for a variety of clinical applications. Probiotic strains are listed in decreasing order of appropriateness. For instance, strains listed first generally have the most evidence supporting their use in that condition. (Note: Table 2B highlights only those strains widely discussed in the peer-reviewed literature). The superscripted Greek lettering next to each strain is used to designate which food(s) and supplement(s) contains this strain. For example, *L. rhamnosus* GG is found in both Vaalial yoghurt and Culturelle supplements and *L. acidophilus* LA5 is found in both Vaalial and Yoplus yoghurts, Jalna drinking yoghurt and a number of different supplements.

- they used a 'secret' strain of which they would tell the author little regarding both characteristics and clinical efficacy.

Practitioners should always ask suppliers of probiotics to produce evidence from peer-reviewed literature to substantiate the therapeutic claims made about their probiotic supplements. As some probiotic suppliers could not tell the author which bacterial strain(s) is used in their supplements, practitioners must be aware that some supplements may contain the cheapest bacterial strains available, not necessarily the most therapeutic ones.

Other companies used strains sourced from the Institut Rosell-Lallemand. There appears to be little information published in the English medical literature on these strains. Yet some of these strains appear to have been the subject of some research that has been released solely at conferences and/or in Eastern European medical journals. Thus the author was unable to review the rigour and clinical importance of the research done on these strains. Interested readers can visit the Institut Rosell-Lallemand website (www.lallemand.com/HNAH/eng/Abstracts.shtm) and self-assess the literature.

Bioceuticals uses *L. rhamnosus* HA-111, *L. acidophilus* HA-122, *L. casei* HA-108, *B. longum* HA-135 and *B. bifidum* HA-132 in their ProDophilus supplement and *L. rhamnosus* HA-111, *B. bifidum* HA-132, *B. longum* HA-135 and *Propionibacterium freudenreichii* strains HA-101 and HA-102 in Symbiotique. No research has been published at time of compiling this article for these strains, except for the two *P. freudenreichii* strains which is highlighted in Table 2B⁽²³⁾.

Metagenics will soon release Probex, a probiotic supplement containing *L. plantarum* strain 299v. This strain has been the subject of a substantial amount of research and its main therapeutic uses are highlighted in Tables 2A, 2B and 2C. Probex is not listed in the *Most Appropriate Supplement(s)* columns tables 2A, 2B or 2C as these were compiled prior to the release of Probex.

Choosing the Right Strain for the Job

To achieve successful and reproducible clinical outcomes, it is important to use the exact probiotic strain that has been proven to have the specific therapeutic action that is desired. For example, two trials have demonstrated that *L. rhamnosus* GG can prevent the development of atopy if consumed during pregnancy and the early months of breast-feeding^(24,25). Other strains of *L. rhamnosus* cannot be assumed to act in a similar manner, nor can strains of *L. acidophilus* (despite what their manufacturers may claim). It is best practice to use the exact strain used in the research, as other strains, even closely-related ones, may not have the same effects.

The canine analogy is also useful in looking at the strain-specific nature of probiotic actions. For instance, Labradors make excellent seeing-eye dogs, but not guard dogs. Kelpies make much better cattle dogs than Scottish terriers. That is not to say that a Labrador or Scottish terrier is not a 'good' or useful breed of dog, what it does say is that they may not be the best breed available for some tasks. In a similar fashion, different strains of bacteria have specific strengths, weaknesses and therapeutic applications. As more research is conducted on each strain, it will become clearer which strain is best suited

Table 2C Choosing the Right Strain for Specific Therapeutic Applications

Therapeutic Application	Most Appropriate Probiotic Strain(s)	Most Appropriate Probiotic Food(s)	Most Appropriate Supplement(s)	References
Radiation-induced diarrhoea	VSL # 3 ^α , <i>L. acidophilus</i> NCFB 1748	sauerkraut	VSL # 3 ^α	(103,104)
Traveller's diarrhoea	<i>L. rhamnosus</i> GG ^α , <i>B. lactis</i> Bb12 ^β , <i>L. acidophilus</i> LA5 ^δ , <i>S. cerevisiae</i> (Hansen CBS 5926), <i>L. plantarum</i> 299v	Vaalial ^{αβδ} , Yoplus ^{βδ} , Jalna (drinking yoghurt only) ^δ , sauerkraut	Culturelle ^α , Blackmores ^{βδ} , Bio-Organics (<i>Ultra Megadophilus</i> or <i>Megadophilus</i>) ^{βδ} , Natural Nutrition (<i>Mega Acidophilus capsules</i>) ^{βδ} , Nature's Own (<i>Double Strength Acidophilus</i>) ^{βδ}	(77, 84, 105—107)
Crohn's disease	<i>L. rhamnosus</i> GG ^α , <i>S. cerevisiae</i> (Hansen CBS 5926)	Vaalial ^α	Culturelle ^α	(108—111)
Ulcerative colitis	<i>Escherichia coli</i> strain Nissle 1917, VSL # 3 ^β , <i>L. plantarum</i> 299	sauerkraut	VSL # 3 ^β	(112—116)
Prevention of colon cancer	<i>L. rhamnosus</i> GG ^α , <i>L. acidophilus</i> NCFM ^β , <i>L. paracasei</i> Shirota ^α , <i>L. acidophilus</i> DDS-1 ^δ , <i>L. acidophilus</i> Delvo Pro LA1, <i>L. delbrueckii</i> ssp. <i>bulgaricus</i> strain LB-51 ^κ	Vaalial ^α , Yakult ^δ	Culturelle ^α , Metagenics (<i>Ultra Flora +/- DF</i> , <i>Ultra Flora Plus</i> or <i>Ultradophilus</i>) ^β , Natren (<i>DFA</i> , <i>Natradophilus</i> , <i>Trenev Trio</i> , or <i>Bulgaricum IB</i>) ^{φκ}	(117—122)
Urinary tract infection	<i>L. rhamnosus</i> GR-1, <i>L. fermentum</i> B-54, <i>L. fermentum</i> RC-14, <i>L. acidophilus</i> NCFM ^α	None available	Metagenics (<i>Ultra Flora +/- DF</i> , <i>Ultra Flora Plus</i> , or <i>Ultradophilus</i>) ^α	(14, 15, 123—128)
Vaginal candidiasis (thrush)	<i>L. acidophilus</i> LA5 ^α , <i>L. acidophilus</i> strain NAS ^β , <i>L. rhamnosus</i> GG ^δ , <i>L. rhamnosus</i> GR-1, <i>L. fermentum</i> RC-14, <i>L. acidophilus</i> NCFM ^φ	Vaalial ^{αδ} , Yoplus ^α , Jalna (drinking yoghurt only) ^α	Blackmores ^α , Bio-Organics (<i>Ultra Megadophilus</i> or <i>Megadophilus</i>) ^α , Natural Nutrition (<i>Mega Acidophilus capsules</i>) ^α , Nature's Own (<i>Double Strength Acidophilus</i>) ^α , Natren (<i>Trenev Trio</i>) ^β , Culturelle ^δ , Metagenics (<i>Ultra Flora +/- DF</i> , <i>Ultra Flora Plus</i> or <i>Ultradophilus</i>) ^φ	(129—134)

The most appropriate probiotic strain(s) to use for a variety of clinical applications. Probiotic strains are listed in decreasing order of appropriateness. For instance, strains listed first generally have the most evidence supporting their use in that condition. (Note: Table 2C highlights only those strains widely discussed in the peer-reviewed literature). The superscripted Greek lettering next to each strain is used to designate which food(s) and supplement(s) contains this strain. For example, *L. rhamnosus* GG is found in both Vaalia yoghurt and Culturelle supplements and *L. acidophilus* LA5 is found in both Vaalia and Yoplus yoghurts, Jalna drinking yoghurt and a number of different supplements.

for specific health conditions. Enough research has now been conducted, however, that for most applications, specific strains can be recommended.

Even a strain that has a proven effect in one area may not be the best strain for another application. *L. rhamnosus* GG, for example, has been shown to be useful in the treatment of viral gastroenteritis^(26,27) however it doesn't appear of any benefit in the prevention of urinary tract infections⁽¹²⁾. Another example *L. acidophilus* NCFM may be useful in the management of lactose intolerance⁽²⁸⁾, but appears ineffective in the treatment of irritable bowel syndrome⁽²⁹⁾.

Tables 2A, 2B and 2C outline the most appropriate probiotic strains available for some common health conditions and the foods and supplements where they can be found. If it is not possible to locate and utilise the specific strains delineated in Tables 2A, 2B and 2C, the best option is to use an alternative bacterial strain within the same species, that possesses the essential characteristics outlined in Table 1. Some of the strains listed are not easily available in Australia at this point in time (these can be recognised by their lack of adjacent superscripted Greek lettering). However, some of these strains may become available in the near future and others can be purchased relatively easily over the Internet. The foods listed in Tables 2A, 2B and 2C all contain sufficient quantities of viable bacteria to generate therapeutic effects. Please note that sauerkraut refers to traditionally prepared, unpasteurised sauerkraut, not the canned/bottled variety commonly found on supermarket shelves.

Dosage

Supplements are best consumed with meals in order to take advantage of the increased alkalinity of the stomach environment (which equates to greater bacterial survival)⁽³⁰⁾. A dosage of 10⁸ bacteria per sitting is commonly mentioned in the probiotic literature as the minimum quantity of bacteria needed to generate therapeutic effects^(31,32). And there have been a handful of studies that have demonstrated therapeutic effects utilising 10⁷—10⁸ viable bacteria/dose^(33,34). However, most of the successful probiotic research has utilised >10⁹ bacteria/dose.

The minimum number of probiotic bacteria needed to achieve therapeutic effects appears to be somewhat strain dependent, in that for some strains 10⁷ bacteria is a sufficient quantity to produce beneficial effects⁽³⁴⁾, whilst for other strains, 10⁹ viable bacteria is needed⁽³⁵⁾. This situation, unfortunately, makes it hard to give firm dosage recommendations, as the minimum effective dosage appears to differ by strain. Thus it is best practice to ensure that supplements contain bacteria in concentrations of at least 10⁹ bacteria/dose, unless research has demonstrated that the specific strain contained in the supplement is effective in smaller amounts. If a formulation contains multiple strains, each strain must be present in amounts >10⁹, as dosages of less than 10⁹ living bacteria may not produce therapeutic effects.

Dosage: Supplements versus Yoghurts

Many readers have probably seen recent television commercials stating that one capsule of a particular brand of probiotic

supplement has comparable numbers of live bacteria as >20 tubs of yoghurt. On the surface this would appear to be correct, if the only thing that mattered when taking a probiotic product was the number of viable bacteria found in the product. The medium in which the bacteria are contained, however, plays a substantial role in determining the number of viable bacteria that reach the small and large intestine intact. For example, research has shown that administration of 10^8 bacteria in a milk-base gives greater faecal colonisation than 10^{10} given as a lyophilised supplement⁽³⁵⁾.

Thus it appears that up to 100 times less live bacteria can be given in a dairy-base to achieve similar faecal colonisation as a supplement. So the dose superiority of probiotic supplements put forth by their manufacturers is not as clear-cut as it appears. Even if this were not the case, the fact remains that that some brands of yoghurt contain sufficient quantities of probiotic bacteria to produce therapeutic effects⁽¹⁾.

Conclusion

The area of probiotics is a rapidly advancing field and each year hundreds of more papers are published. The information presented in this article is only a snapshot of the current state of affairs. Over time, some of the information presented in this article will be superseded as new research comes to light and probiotic supplements are reformulated.

Supplement manufacturers should be continuously updating and improving their products — hopefully using the best researched probiotic strains available rather than the cheapest. As the strain specificity of probiotic actions has not been known until relatively recently, some supplement manufacturers have chosen the cheapest or most shelf-stable strains of ‘acidophilus’ they could purchase, rather than the most therapeutic.

When practitioners start demanding that manufacturers utilise the most therapeutic strains available, manufacturers will be forced to change the strains they use in their products. Thus it is imperative for practitioners to keep up-to-date regarding the specific strains used by each manufacturer and the research done on these strains.

The days of prescribing any brand of ‘acidophilus’ for GIT or systemic complaints are long gone. It is imperative that we as a profession advance our practices in step with advancing knowledge. Fortunately, the majority of probiotic strains with a substantial research base are readily available in Australia. The information presented in this article allows practitioners to easily implement best practice in this field.

Prescribing probiotic supplements in the same fashion as done in the past may still produce results. However, implementation of newer ideas and practices should substantially enhance efficacy. This, undoubtedly, will improve clinical outcomes and client satisfaction.

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