# Pet probiotics

**Keelan McNamara BSc, research and development scientist, AnaBio Technologies, discusses the benefits of the growing pet-probiotic market**

Since 2010, global pet-food sales have increased by approximately 30%. This market is estimated to be worth $75bn USD (Euromonitor), with the US making up about 42%, followed by western Europe (27%). Pet populations are ever increasing, especially dogs and cats which have been companions and cohabitants with humans for thousands of years. Interest in the health and well-being of our pets is now on par with our own. These animals face similar lifestyle challenges as humans, with obesity in pets becoming more predominant.

A pet's digestive system, which is mainly responsible for breaking down and absorbing nutrients, is key for the physiology and well-being of the body. The digestive system in turn is dependent on the 'good' bacteria which colonise it. In fact, research indicates that 70% of a pet's immune system lies in the digestive tract. Therefore, a major part of the animal's health derives from the gut, which harbours a complex microbial community. Often, gastrointestinal (GI) disorders in animals can be linked to bacterial overgrowth and enterotoxins produced by pathogenic bacteria.

## WHAT IS A PROBIOTIC?

Probiotic bacteria, as defined by the World Health Organization (WHO) are: "Live microorganisms (bacteria or yeasts), which, when ingested or locally applied in sufficient numbers, confer one or more specified demonstrated health benefits for the host." Consumer awareness of probiotics for human health is well established, and knowledge of the benefits that probiotic products can have for companion animals is increasing. Probiotic supplements have been recommended for the treatment and prevention of a variety of conditions in different species, particularly for dogs and cats.

Commensal bacteria are present at various sites throughout an animal's GI system.

Adverse interventions such as stress and illness can reduce the natural levels of these commensal bacteria.

Probiotic supplementation can help restore and maintain their levels. Some probiotics produce antimicrobial substances like bacteriocins, which directly target other competing bacteria, including pathogenic species. Additionally, probiotics produce a variety of beneficial

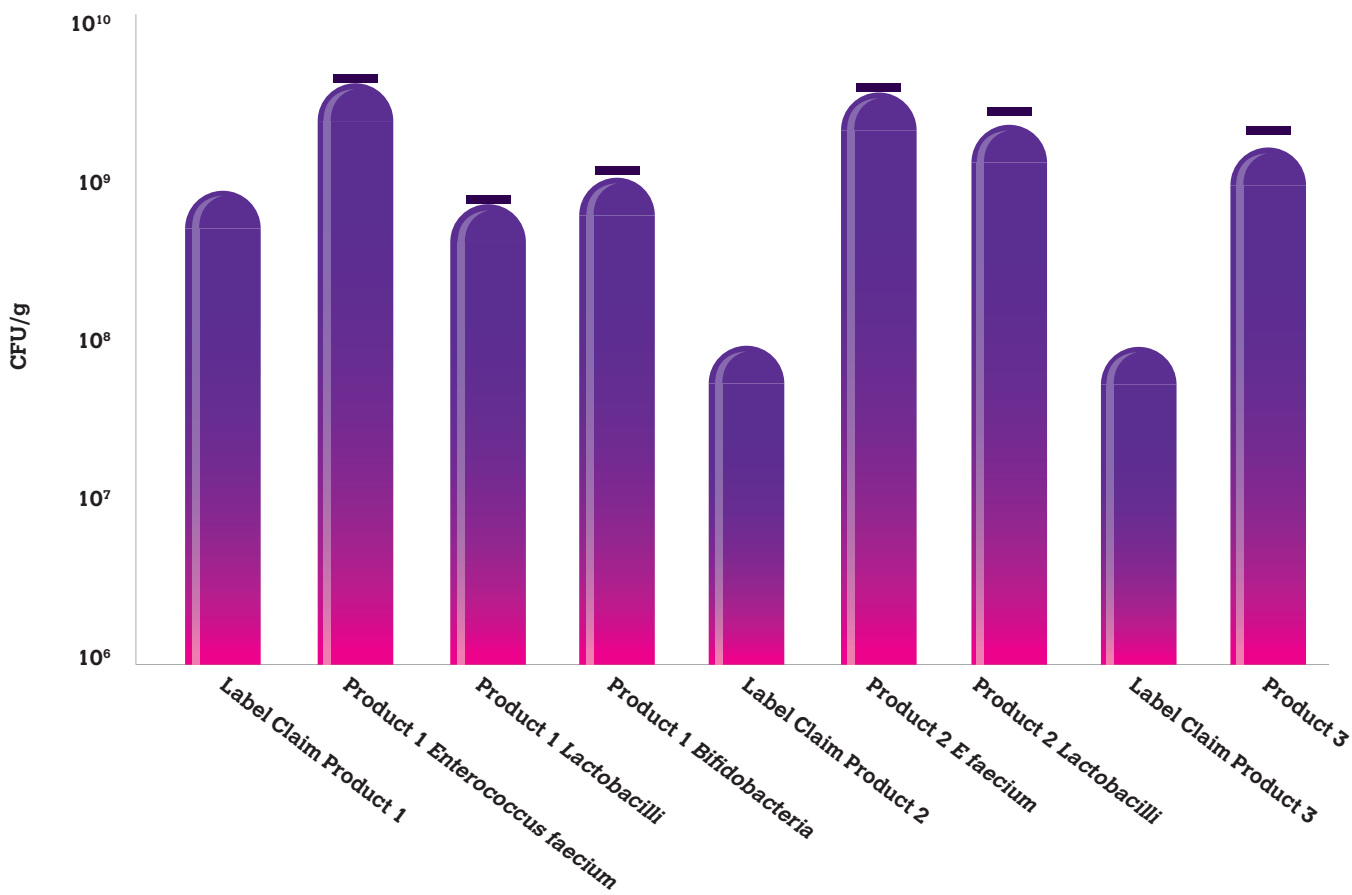


**Figure 1: Comparison of actual bacterial probiotic contents versus label claims in commercial pet foods.**

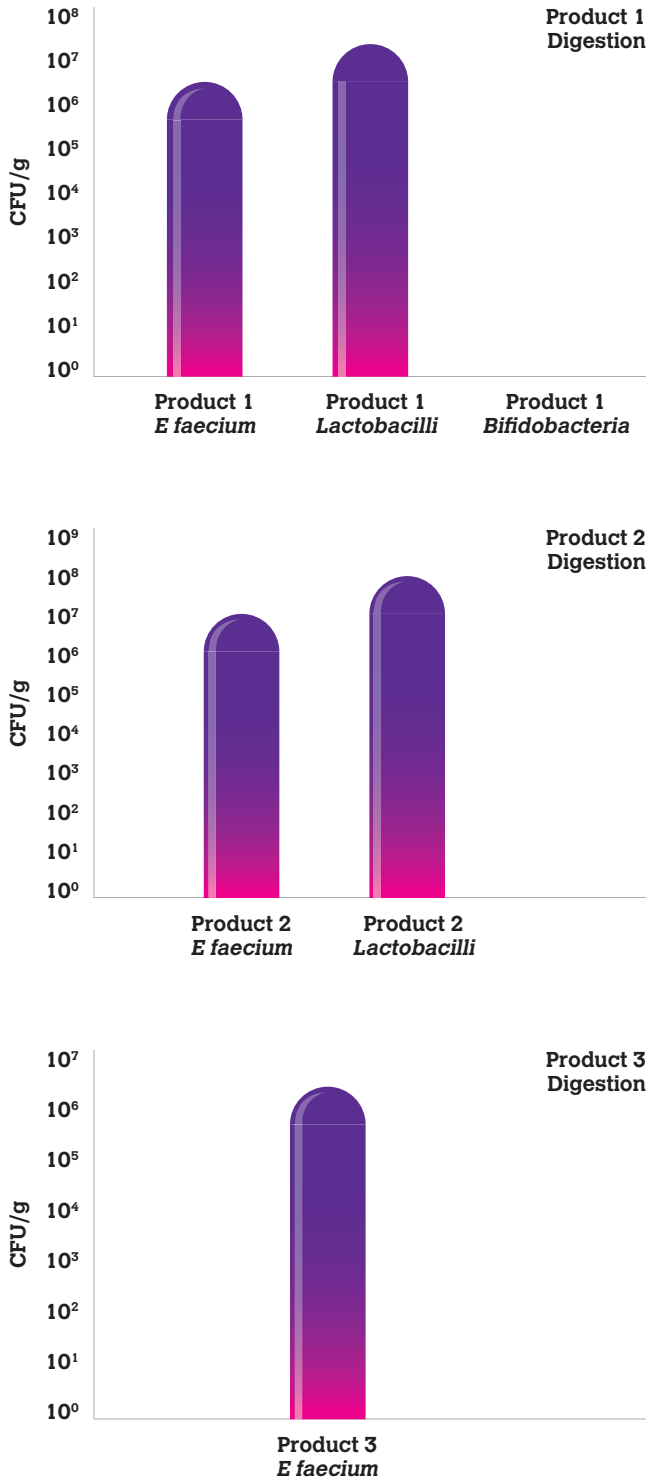


**Figure 2: Comparison of bacterial probiotic content after simulated *in vitro* digestion.**

compounds, such as lactic acid and hydrogen peroxide, and can competitively exclude microbial pathogens via adhesion to gut-binding sites. This competitive exclusion is recognised as a key benefit of probiotic-mediated, improved immune function.

As well as boosting the immune system, probiotics play a vital role in supporting digestion along with the assimilation of vitamins and minerals. *Lactobacillus* and *Bifidobacterium* strains are the most commonly used probiotics in pet food and feed. Other microorganisms, such as the yeast *Saccharnomyces cerevisiae* and *Bacillus* species, are also found in pet probiotics. The applications of probiotics with regards to pet health has increased gradually over the past decade. However, akin to human-probiotic products several uncertainties concerning microbiological viability and efficacy exist.

## SURVIVING THE STOMACH

The majority of probiotics grow at an optimal temperature of 37°C, but some strains, such as *Lactobacillus casei*, prefer 30°C. Travelling through the digestive system can be challenging for bacteria especially with regards to surviving the highly acidic environment of the stomach. In order to be able to say that probiotics exert a health benefit, they must remain alive, by first surviving ingestion and pass, still viable, through the stomach and populate the gut at relevant quantities to make a significant difference. The viability of these cells depends on pH, the length of time exposed to the acid and the species and strain used as (some microorganisms are more resistant to stomach acid). In an attempt to compare label claims with actual concentrations of probiotic bacteria, three commercially available pet-probiotic products were analysed. These products were enumerated as per industry standards and differentiating media were used as two of the three products contained a mixture of species. The values found on the labels were in line with the results found in the laboratory testing. It is apparent from Figure 1 that the products were 'overdosed' with bacteria in order to ensure a concentration as indicated by the labelling. This overdosing process is used by some manufacturers in an effort to offset losses experienced during storage prior to consumption and consumption itself. Overdosing of probiotics is an expensive process as in most cases it requires the addition of 10-1,000 times the amount of probiotics. Indeed, an effective stabilisation process, such as microencapsulation could offset the requirement for this overdosing.

While investigation of the product concentrations indicated that the probiotic concentrations were at or over the indicated amount, as the bacteria must migrate to the lower gut to be effective. A simulated digest was performed on each product, in an effort to analyse the amount of viable cells that actually reach their site of action. This method was adapted from the well-established INFOGEST digestion model (modified to more closely resemble the GIT of a dog).

There is a clear imbalance after digestion between the cultures *E faecium*, (being the predominant species following in vitro digestion), *Bifobacterium* and *Lactobacillus*, with only 0.0001% of *Bifobacterium* strain surviving. Considering that the threshold for humans is $10^6$-$10^7$ CFU/g of a product, these numbers are far too limited for the probiotics to establish in the gut and elicit a beneficial health affect.

A high pH buffering capacity has also been observed in some of these products, which may be caused by the addition of calcium carbonate, a very popular buffer used

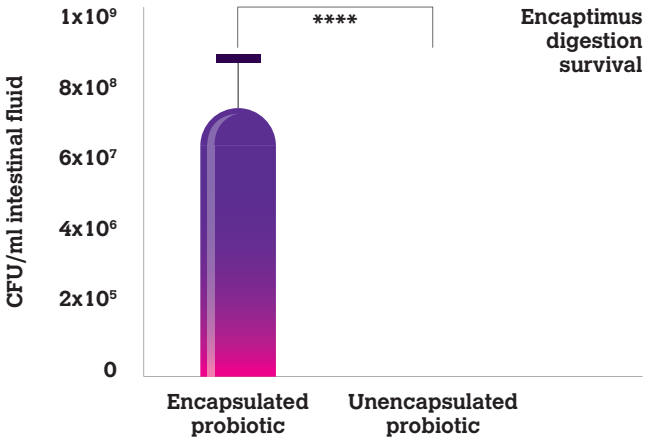


**Figure 3: Comparison of bacterial probiotic content after microencapsulation.**

to help neutralise stomach acid.
A potential side-effect of bicarbonate supplementation is the possibility of gastro-intestinal problems including stomach pain, nausea and vomiting. Overall, the actual content of the products was not accurately represented by the label description when digestion is considered.
One method of protecting probiotics from the stomach acid is microencapsulation which is done by enveloping these bacteria in a matrix having a special protective enteric coating. Microencapsulation is an exciting new field of research that has emerged and developed rapidly in the past decade. Based on this technology, a wide range of microorganisms have been immobilied within a semipermeable material that modulate the delivery of cells. Microencapsulation stabilise cells, enhancing their viability and stability during production, storage and ingestion. Therefore, micro-encapsulation may help probiotics to get where they need to go to elicit a beneficial health effect, this is especially important for many commercial dog and cat probiotic.
To validate the advantages that micro-encapsulation has to offer for probiotics, in terms of protection during digestion, a simulated digestion was performed on an unencapsulated and microencapsulated commercial strain of *Bifobacterium*. The graph in Figure 3, shows that microencapsulation efficiently increases probiotic viability during passage through the acidic-enzymatic-bile conditions of the gastrointestinal tract, with the encapsulated probiotic showing a full survival ($10^8$CFU/ml of intestinal fluid), while all the free cells were destroyed. Microencapsulation can noticeably improve the viability of probiotic microorganisms due to its protective effects against detrimental environmental factors such as high acidity, low pH, molecular oxygen (anaerobic microorganisms), heat processing (drying) and increased shelf life. Microencapsulation may also significantly reduce the need to overdose products with excess culture as 100% of the probiotic reaches the gut.

## REGULATIONS

When manufacturing nutritional supplements for pet's, compliance with legislation is important.

Probiotics in pet foods and feeds are considered as food supplements, so there are no regulations regarding what can be classified as a probiotic. A number of studies have reported that the quality control among probiotics supplements intended for animal use is poor, with several products tested either not containing the probiotics, or number of cells stated on the label (Weese & Arroyo, 2003). Therefore, there seems to be a great difference in the quality of probiotic pet food. Probiotics improve general health and well-being in animals. The rationale for adding probiotics to pet foods seems well justified. However, it remains important to be aware of the quality of the product.

## CONCLUSION

Overall, commercial pet-food sales are forecast to continue to grow substantially in the next five years. A growing pet population and an increase in the demand for prepared pet foods all play a role in the pet-food market growth. Providing a proper care and nutritionally-balanced diet to companion animals is recognised as a part of the duty of pet owners to maintain the health and well-being of their pets. Pet products that claim to contain probiotics appear to contain very low numbers of viable cells. Whether this is related to failure to survive processing or poor viability during storage is unclear. To improve the survival rates of probiotic microorganisms, microencapsulation is considered to be a promising process. To fulfil many demands of a successful probiotic encapsulation, this technique can be applied to increase cell viability during processing, storage, ingestion and digestion to ensure a targeted delivery of probiotics to the gut.
In conclusion, microencapsulation is of great interest since it could allow a wider application of probiotics in the pet-food market. Probiotics, in general, are very sensitive to certain environmental conditions. Thus, providing probiotics with protection against such conditions is crucial for the development of new probiotic foods.