RAW EXPERT

Nutritional training package

Natures Menu: Veterinary Division

2. Food production & legislation

Introduction

The production of food is often something we all take for granted. However, as pet owners are becoming more aware of what they feed their own human families, they are asking more questions of what goes into their pet's food and how it is made. Kibble, cans and pouches were first developed over 100 years ago and have become the backbone of the pet food industry. There is now an increased desire for 'natural' foods, fewer additives and less processing, alongside the more traditional requirements regarding nutritional balance, palatability and convenience.

Raw feeding is emerging in the pet food industry as a solution to all these concerns. While raw feeding and BARF (biologically appropriate raw food) diets have been around for many years, they have only more recently gained attention through increased media coverage and changing attitudes towards food. This development has also led to huge improvements in the way raw food is manufactured, with an emphasis on safety and nutritional balance, along with improved convenience. However, not all commercially produced raw food is the same and it is important to know what sets them apart and this often begins with legislation.

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Sourcing Ingredients

Sourcing the ingredients to manufacture a pet food is arguably one of the most important steps as inevitably you can only expect to get out the same quality you put in! There are a number of factors affecting how ingredients may be sourced and sometimes confusing labelling and clever marketing will intimidate even the savviest of pet owners. In this section we will break down the legislation, animal welfare issues and traceability to help gain a more critical eye for what really is going into pet food.

a) Legislation

Legislation is law produced by a governing body to aid in the regulation and authorisation of a particular process, e.g. pet food production. Legislation on animal feed originates from the European Union (EU) (rather than coming from the UK). However, following Brexit it is expected the UK will adopt and continue to follow current EU animal feed legislation, although moving forwards the UK will have the power to make further amendments separate from the EU.

The main principle of the legislation is centred on hygienic conditions for food production and a safe finished product, which is not harmful to animal or human health, with full traceability. In total, there are more than 50 pieces of legislation governing the manufacture of pet food, we will just run through the top five here:

1. **EU Regulation (EC) No 183/2005** ***Laying down requirements for feed hygiene***

This regulation sets out the operating standards to which **all** pet food manufacturers must comply. The regulation summarises the feed hygiene requirements in terms of:

- **facilities** and equipment
- **personnel**
- **production**
- **quality control** including Hazard Analysis Critical Control Points (HACCP - feed safety management system)
- **storage** and transport
- record-keeping including **traceability**
- **complaints** and product **recall**

2. **EU Regulation (EC) No 767/2009** ***on the placing on the market and use of feed***

This legislation covers matters such as:

- **safety** and marketing requirements
- stringent **labelling**, presentation and packaging requirements including analytical declarations
- manufacturer **responsibilities**
- **substantiation** of any claims, including nutritional claims
- prohibition on the **misleading** of purchasers
- prohibition on making **medicinal claims**

This Regulation also transposes EU provisions on undesirable substances and particular nutritional purposes - for example:

- the maximum levels of various **contaminants** allowable in pet food (for example, arsenic, lead, dioxins and certain pesticides)
- certain substances that must not be used in feed

3. **EU Regulation (EC) No 1831/2003** ***on additives for use in animal nutrition***

These controls relate to the additives (including vitamins, colourants, flavourings, and binders) authorised for use in animal feed and covers matters such as:

- categorisation of feed additives
- authorisation of feed additives
- labelling and packaging of feed additives
- provisions relating to a community register of additives

4. **EU Regulation (EC) No 1069/2009** ***laying down health rules as regards animal by-products and derived products not intended for human consumption***

This relates to **animal by-products** - for example, material of animal origin which are either deemed surplus to human consumption or are not normally consumed by people in the UK, and derived from animals inspected and passed as fit for human consumption prior to slaughter.

5. **EU Regulation (EC) No 142/2011** ***implementing Regulation (EC) No 1069/2009 and Directive 97/78/EC***

Annex XIII, chapter II gives a **restricted list of raw materials** which can be used in the preparation of raw pet foods specifically. It also sets the microbiological standards and **ZERO TOLERANCE** for **Salmonella** in raw pet foods.

FEDIAF and PFMA

In addition to official legislation governing pet food manufacture, the industry can sometimes also be described as self-regulated. This is because there are numerous additional guidelines which are adopted by some pet food manufacturers on a voluntary basis but are not independently audited. These guidelines exist alongside the legislation in a complementary manner.

In the UK, membership of the Pet Food Manufacturers Association (PFMA) indicates a pet food manufacturer has signed up to a range of industry standards which go above and beyond the basic legal requirements. The PFMA are the leading trade body for the UK pet food industry and have over 80 members (at the time of writing this includes 9 manufacturers of raw pet foods), which account for more than 90% of the total pet food market. PFMA are the UK representatives within FEDIAF (European Pet Food Industry Federation) who have members from 18 different countries across Europe and are the trade association representing the European pet food industry.

In 2017 the PFMA published new sector guidelines for the manufacture of commercial raw pet food. These guidelines promote best practice and were developed by members in conjunction with Defra, the Animal and Plant Health Agency (APHA), Public Health England (PHE) and the Food Standards Agency (FSA). The objectives of the new guidelines are:

- Improve safety, hygiene and nutrition of raw pet food made in the UK
- Summarise sector-specific regulatory requirements for raw pet food production
- Describe recommendations to achieve 'best practice' in raw pet food production
- Improve ease of compliance with EU regulation for current and emerging raw pet food manufacturers
- Liaise with regulators and enforcement bodies (Defra, APHA, FSA, FSS, Scottish Government and local authorities) to combine expertise and develop recommendations to maintain and raise standards

The document is designed with accessibility in mind and is colour coded to highlight legislative requirements, it features the following chapters and is free to download via the PFMA website:

1. Regulation and Approval
2. Plant Design and Maintenance
3. Sourcing Raw Materials
4. Handling Raw Materials
5. Production
6. HACCP and Quality Management
7. Protecting Public and Animal Health

Europe vs North America

One very important point to consider when reviewing raw foods and research publications is to look at whether they originate from Europe or North America as the regulations are significantly different, preventing any kind of fair and reasonable comparison. Recently the American Veterinary Medical Association (AVMA) published a controversial 'anti-raw statement' which advised against the feeding of any raw pet food due to the public health risk. The document only discusses the food safety and public health risk with no consideration of any other risks or indeed benefits – there must be a good reason for many people still choosing to feed raw to their beloved family pets in the face of such bad press!

In North America pet food manufacture is regulated by federal government and individual state laws, there is no harmonized legislation as in Europe so rules differ from state to state. The Association of American Feed Control Officials (AAFCO) establishes the nutritional standards for complete and balanced pet foods, and ***it is the pet food company's responsibility*** to formulate their products according to the appropriate AAFCO standard. However, AAFCO does not regulate, test, approve or certify pet foods in any way.

This is in contrast to most of Europe who are governed, regulated, approved and tested under the same umbrella of EU legislation. The European Pet Food Industry Federation (FEDIAF) are Europe's equivalent of AAFCO, establishing the nutritional standards for pet food, however this is done in a fully co-ordinated and integrated manner with all appropriate EU legislation. The word 'complete', when used in relation to a pet food, has a legal definition in Regulation (EC) No. 767/2009 as follows: "a mixture of at least two feed materials which, by reason of its composition, is sufficient for a daily ration". A daily ration is then defined in Regulation (EC) No. 1831/2003 as: "the average total quantity of feedingstuffs…required daily by an animal of a given species, age category and yield, to satisfy all its needs"

In North America, raw pet foods are produced with little or no regulatory oversight by the state or federal governments. The American Veterinary Medical Association (AVMA) make the following statement to justify this complete lack of regulation:

> *"Bacteria are expected to be present in raw meat, so the presence of Salmonella or other bacteria in raw diets does not trigger the same regulatory process that applies to commercially made canned or kibble pet foods."*

The American Food and Drug Administration (FDA) were motivated by the increasing popularity of raw feeding among companion animals to publish *"Guidance for Industry on the Manufacture and Labeling of Raw Meat Foods for Companion and Captive Non-companion Carnivores and Omnivores"* but the guidance is **voluntary** and **not legally enforceable** by the FDA.

In an effort to improve on this lack of mandatory regulation the FDA have produced their new Food Safety Modernization Act (FSMA) which was signed into law from January 2011. The act enforces HACCP type controls throughout processing and production to minimise the public health risk from food-borne illness. This is most likely to be achieved through "test and hold" methods prior to distribution or through interventions along the manufacturing process to reduce risk of contamination. Some raw companies in the USA use a process called 'High Pressure Pasteurisation' (HPP), which claims to eliminate the contamination risk without altering the nutritional composition of the raw food. However, there is currently strong evidence to suggest HPP does not completely remove the microbial contamination of raw pet food.

> *According to Dr. James Marsden, professor of food safety and security at Kansas State University, the new FDA initiative will greatly improve the safety of food in the U.S. Marsden says that while raw pet diets pose special challenges, most, if not all of the processed (not raw) pet food recalls have been due to recontamination. So the entire pet food industry is looking not only at ways to eliminate pathogens during processing, but also at how to prevent recontamination of finished product before it is packaged.*

b) Animal Welfare

The Farm Animal Welfare Council (FAWC) was original created by the British Government in 1979 to safeguard and improve the welfare of animals within the constraints of an effective livestock industry in the UK. The welfare of an animal includes its physical and mental state, therefore good animal welfare implies both fitness and a sense of well-being. Any animal kept by man must, at least, be protected from **unnecessary suffering**.

The FIVE FREEDOMS were eventually established and are now a well-recognised pillar in animal welfare:

1. Freedom from Hunger and Thirst - by ready access to fresh water and a diet to maintain full health and vigour.

2. Freedom from Discomfort - by providing an appropriate environment including shelter and a comfortable resting area.

3. Freedom from Pain, Injury or Disease - by prevention or rapid diagnosis and treatment.

4. Freedom to Express Normal Behaviour - by providing sufficient space, proper facilities and company of the animal's own kind.

5. Freedom from Fear and Distress - by ensuring conditions and treatment which avoid mental suffering.

'Free range' livestock is defined as that which has had access to the outdoors to graze or forage for food. It is believed these animals are happier and livelier leading to a better-quality product. Raw pet

food manufacturers are able to include free range and even organic ingredients into their produce as ingredients are sourced at the same level as that used within the human food chain.

c) Traceability

Traceability is the ability to reconstruct the course taken by a foodstuff through the production, processing and distribution stages (as defined by FEDIAF – the European Pet Food Industry Federation). In pet food production this is usually achieved through **batch numbers** which give details on raw materials used and their source, when the product was made and by whom. This information is recorded daily and is monitored every three months by DEFRA in order to fulfil the licensing requirements to produce pet foods.

Why is traceability needed?

1. To protect animal and human health
2. To enable efficient withdrawal or recall of products
3. To provide information on quality problems
4. To comply with EU legislation

The majority of pet food manufacturers use category 3 animal by-products as the main protein source in their foods. These comprise materials passed fit for human consumption but not needed in the human food chain and can contain poorer quality protein sources such as feet, head, beaks, feathers and blood. They are often all grouped together and transported to the pet food manufacturers which limits the information available on these materials, such as how they were raised and slaughtered. For many pet owners these assurances are important and as we look for evidence of welfare assurance schemes and humane slaughter methods on our own foods, many people wish to have the same guarantees for the food they buy for their pets. As a raw food manufacturer Natures Menu cannot use many category 3 animal by-products for safety reasons, such as the gastro-intestinal tracts of chickens which pose a significant Salmonella risk. This means we can source our ingredients with welfare in mind and use various farm assurance schemes and free-range meats to ensure standards are maintained and traceability runs right back to the farm level.

d) Sustainability

Sustainability has become a growing concern in the pet food industry as a result of the global protein shortage. Animal by-products used in many pet foods have traditionally been a way to reduce wastage in the meat industry by utilising the materials not needed or wanted for the human food chain. Raw pet food can also be very effective in supporting this non-competitive relationship with the human food industry as long as the ingredients are sourced responsibly. Raw pet food makes use of ingredients

such as tripe, which is culturally unpopular as human food in the UK, as well as a variety of offal and bones which could otherwise have been seen as waste. The need to source more directly with farmers and growers also allows raw pet food manufacturers and their customers to support sustainable and environmentally friendly farming practices through their buying choices.

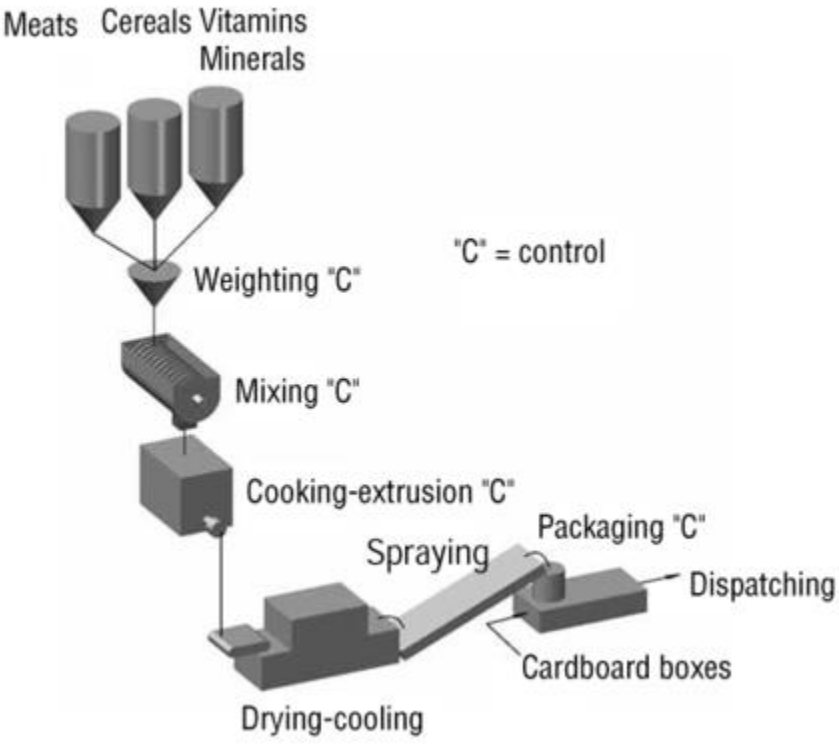
Types of pet food production

1. Kibble

Meat derivatives or meatmeal/bonemeal are among the most common ingredients found in dry kibble. They are highly variable in quality and can consist of ground up by-products and leftovers e.g. hooves, heads, fur and feathers. If the pet food label uses categories on their labels, such as 'meat and animal derivatives' or 'various sugars', the recipe can often change between batches, giving different protein types, depending on costs at source. The ingredients have often undergone a process called **rendering** which involves cooking to remove the water, fats and oils then grinding the residue into a powder.

Nearly all kibble products are made by a process called **extrusion**.

a) A mixed blend of meat meals, meat and bones meals, cereals, powders and supplements are all mixed in a dry powder format
b) Steam is injected into the mix to heat it and soften the product
c) Protein molecules are released which bind the product into a dough
d) The dough is forced under high pressure through a small grinding head to create the kibbles
e) The kibbles are then cooled and sprayed with oils to add palatability



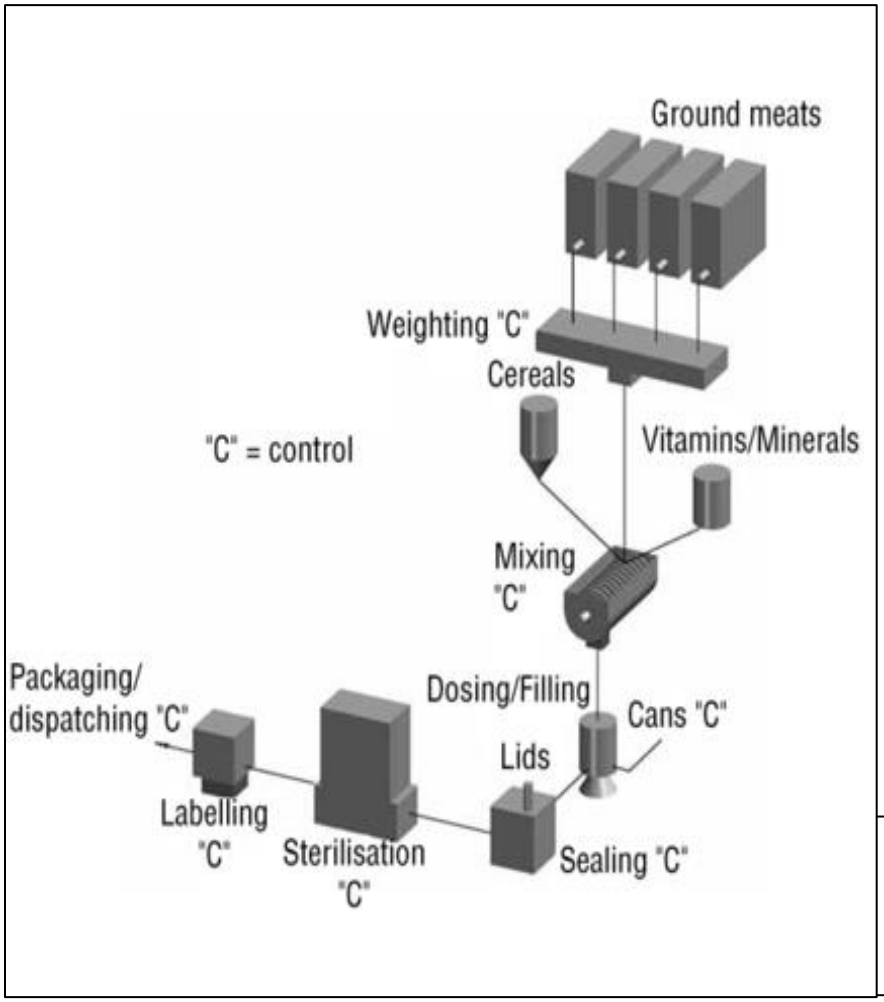
Production technique for dry foods

(Courtesy of FEDIAF)

2. Cans, trays and pouches

The most common method of producing canned pet foods is highly processed, with similar, and sometimes poor protein sources to kibble. The cooked/rendered ground meats are mixed with cereals and supplements before mixing and placing into cans. The often bland ingredients are formed to look like meaty chunks and bound together by gluten before being covered in flavoured jelly or gravy to provide the palatability and added nutrition. Ever wondered why cats almost always lick the jelly/gravy off first?

Once the cans are sealed they undergo sterilisation which legally requires temperatures in excess of 90ºC to kill pathogenic bacteria such as Salmonella. However new methods are emerging, through manufacturers such as Natures Menu Ltd, whereby high quality ingredients are sealed in raw and only gently steam-cooked once to ensure the nutrients are of the highest quality and remain undamaged.



Production technique for canned foods

(Courtesy of FEDIAF)

3. Frozen raw food

Possibly the simplest of all methods, frozen raw food offers nutrition that has been uncompromised by processing but has the potential to create a risk of food-borne disease and parasitism. Therefore, the controls put in place by the manufacturer to prevent these added risks must be heavily scrutinised to ensure both animal and human safety.

Fresh ingredients

Whole carcass is minced and mixed with other fresh ingredients

Product is formed into final shape

Product is frozen and packaged ready for dispatch

When producing frozen pet foods there is another added consideration to help ensure safety and that is within its distribution. It is imperative the food is not allowed to defrost and then re-freeze as this can allow micro-organisms within the food to multiply and cause the food to spoil. Therefore frozen pet food companies should take reasonable steps t o guarantee this will not happen, ideally delivery in temperature controlled vehicles.

4. Freeze Dried

Freeze drying, also known as lyophilisation or cryodessication, is a technique for **preserving** perishable foods and enabling easier storage and transport at room temperature. It relies on a chemical process called **sublimation** where under certain conditions water can transform directly from its solid form (ice crystals) to its gaseous form. In this form, through the use of a partial vacuum, the water may be easily removed from a product **without** altering the composition of the original foodstuff.

There are FOUR stages:

1. ***Pretreatment*** – Any method of treatment prior to freezing, may involve altering surface area or concentrating the product.
2. ***Freezing*** – Must be performed rapidly to avoid the formation of ice crystals which damage cell walls and result in poor nutritive content and poor texture.
3. ***Primary drying*** – Pressure is lowered, a partial vacuum applied and just enough heat is applied to cause the water to sublime (change from solid to gas). 95% of water is removed during this stage but it can be slow (several days) as too much heat risks altering the materials structure.
4. ***Secondary drying*** – Further low pressure and a little more heat now removes any unfrozen water bonded with the material. Water content is now 1-5%.

The product is then packaged and sealed whereby the substantially lowered water content will inhibit the action of micro-organisms and enzymes that would ordinarily cause it to spoil or degrade. At room temperature these sealed products are often preserved for years. The main disadvantage of this technique is the current high costs involved, but over time it is becoming more widespread and affordable.

Labelling

Labelling of pet food is a **tightly regulated** facet of food production. It has an increasingly important function in **consumer communication** as pet owners are questioning diets more and more. With the free movement of goods within the EU it is also of utmost importance to have a standardised legislation to ensure consistency of consumer information and a level playing field within the European marketplace. FEDIAF have produced a Code of Good Labelling Practice for Pet Foods, to be used alongside EU legislation, to create a harmonised understanding. The code addresses the three basic functions of product communication:

a) Consumer information on product use
b) Control and enforcement
c) Marketing and retail

The following features of labelling are mandatory:

- Name and Product Description
- Composition (ingredients list)
- Analytical constituents (% nutrient levels)
- Information about additives
- Best Before Date, Batch Code
- The name of the producer/distributor and contact details for further info
- How to use the product (feeding instructions, storage)
- Weight and/or quantity statement
- All claims must be verifiable and substantiated
- Must not be misleading or ambiguous

It is important to make fair comparisons when looking at labels on different types of dog foods. The nutrient levels are often represented by percentages on an 'as fed' basis which does not account for the vast difference in moisture contents from wet to dry foods. In order to do this in a more representative way we can look at a feature known as 'dry matter basis'. This allows us to compare different types of foods fairly without being biased by the moisture content.

Calculating dry matter:

E.g. Dry Food A: **Protein** = 23% (Moisture = 10%)
Wet Food B: **Protein** = 10% (Moisture = 75%)

Initially the dry food looks to have the better protein content……

Total Dry Matter in A:
100% (total) -10% (moisture) = 90% (dry matter) → Total **protein** dry matter = (23/90) * 100 = **26%**
Total Dry Matter in B: 100% -75% = 25% → Total **protein** dry matter = (10/25) * 100 = **40%**

Once moisture is considered, wet food B is the real leader when it comes to protein!

Food-borne Illness

Food-borne illness describes any illness brought about by consumption of contaminated food, most commonly caused by micro-organisms such as Salmonella and Campylobacter. There is an immediate risk to the animal fed but also a significant **public health risk** to the pet's family and any immuno-compromised, young or elderly people in the vicinity, from contaminated bowls and surfaces. It is estimated around a million people in the UK suffer a food-borne illness each year, costing us nearly £1.5 billion.

All types of pet food are subject to monitoring as part of EU legislation. This is carried out in the United Kingdom by a division of DEFRA known as the Animal and Plant Health Agency (APHA) (formerly AHVLA). The frequency of testing is dependent on a number of factors:

1. Throughput of the plant
2. Length of time in operation
3. Results from previous samples

If the results are unsatisfactory, action must be taken. This action involves incineration of the affected batch and review of the Hazard Analysis and Critical Control Point (HACCP) plan which is in place to try and improve safety and prevent outbreaks of disease. The source of the problem is identified and necessary changes are made to the plan to allow continued manufacturing. Within some companies batch testing is carried out before distribution to reduce the risk to the customer ('test and hold' method). However, other manufacturers will have already dispatched before results are available and in the event of an unsatisfactory result have to issue a recall of all affected products.

A further government department known as the **Food Standards Agency** (FSA) have produced their food-borne diseases strategy with the objectives to reduce food-borne disease in the UK and improve public awareness. As little as 1% reduction in case numbers could mean 10,000 fewer cases and save the economy around £15 million per year. The priority pathogens identified for action in the latest report are Campylobacter, which causes the largest number of cases per year, and Listeria monocytogenes, which is responsible for the largest number of deaths. Salmonella and E.coli O157 also remain important pathogens and are closely monitored with a number of interventions in place, such as food hygiene programmes.

We shall now examine the main bacterial and viral foodborne pathogens of interest in more detail.

Campylobacter

Campylobacter is the most common cause of bacterial food poisoning in the UK, with case numbers having gradually risen since 2004. Some suggest this is partly due to better detection methods and increasing amounts of chicken being consumed, as around 80% of campylobacter food poisoning in the UK comes from contaminated poultry, especially chicken. Recent surveys suggest that as many as 65% of raw chickens at retail sale in the UK are contaminated with Campylobacter and one of the main ways to contract campylobacter is through cross-contamination. Washing raw chicken is not advised because it can spread campylobacter by splashing it onto hands, work surfaces, clothing and cooking equipment.

Campylobacter is also found in red meat, unpasteurised milk and untreated water. Although it does not normally grow in food, it can spread easily and has a low infective dose, so contact with a few bacteria can cause illness. This is especially significant for children under five, elderly people, or the immunosuppressed. However, most people who get ill recover quickly, but it can cause long-term and severe health problems in some.

Increased public awareness and good food hygiene practices at home, (such as chilling food at 5 degrees Celsius or below, cooking chicken thoroughly and avoiding cross contamination with ready-to-eat foods) are expected to reduce levels in the future.

There is no compulsory testing for Campylobacter in the production of raw pet food, however, Natures Menu Ltd conduct voluntary testing and, to date, have not had a positive case (in over 30 years of production). This is attributed to the vulnerability of poultry-derived Campylobacter strains to prolonged periods of freezing sustained during manufacture. Indeed, the European Food Safety Authority (EFSA) have recognised long-term freezing as a suitable control measure for Campylobacter contamination in broiler meat intended for human consumption. Freezing and the formation of ice crystals kills a large proportion of the Campylobacter present on meat, but a fraction of the population may survive or be sub-lethally injured. Based on current evidence, frozen storage for a few days will result in approximately 90% reduction in Campylobacter while frozen storage for 3 weeks results in approximately 99% reduction (EFSA, 2010). Due to this documented effect of freezing on Campylobacter, freezing of broiler meat has already been implemented as a successful control measure in several Scandinavian countries (Georgsson, et al., 2006; Hofshagen & Kruse, 2005; Rosenquist, et al., 2006). However, it is not typically used in chicken meat intended for human consumption in the UK, at present. It is important to remember that freezing is not 100% effective in killing Campylobacter, and so cannot be seen as a substitute for safe handling. However, it is still proven to significantly minimise the risk and so should be recommended as an effective and practical control measure.

Listeria monocytogenes

Listeria monocytogenes remains relatively rare in the UK but cases have nearly doubled since 2000 and each year it is responsible for more deaths than Salmonella and E.coli O157 combined. The cause of the increase is not clear, but it is thought to be associated with the susceptibility of particular individuals e.g. those over 60 and immunosuppressed people such as cancer patients on chemotherapy. Pregnant women are about 20 times more likely to get listeriosis than other healthy adults but the reason behind their increased susceptibility is currently unknown. It is also known to be carried asymptomatically by some healthy humans, animals and birds and *L. monocytogenes* is widespread in the environment, especially in soil and water, and it is still able to grow and multiply at low temperatures.

It is of most concern in chilled, ready-to-eat foods, rather than in raw produce, and can contaminate a variety of foods (before or after cooking) such as:

- Ready-to-eat processed meat e.g. hotdogs and deli meat such as pâté
- Raw vegetables
- Prepared or stored salads, including coleslaw and fresh fruit salad
- Melons
- Unpasteurised milk and milk products e.g. soft cheeses
- Ready-to-eat smoked seafood and raw seafood (there is evidence to suggest that low-level Listeria contamination is common in this particular food-type)

Reducing the risk of listeria during food preparation includes washing fruit and vegetables thoroughly, keeping chilled ready-to-eat foods below 5 degrees Celsius and cooking or reheating foods until they are piping hot throughout.

It is important to note dogs and cats rarely get listeriosis and they usually don't show signs of disease. One reference mentions only six reported cases in dogs from 1947 to 2000, and the dogs showed a wide range of symptoms (Laikko, et al., 2004). Control of human cases is centred on the commission of new research to better understand the risks and increasing public awareness.

Salmonella

Salmonella bacteria typically live in animal and human intestines and are shed through faeces. Humans become infected most frequently through contaminated water or food.
Common sources of *Salmonella* infection would include:

- Raw/undercooked meat and poultry
- Raw/undercooked eggs and related products
- Raw/unpasteurised milk/dairy products
- Raw fruits and vegetables

A survey by the FSA in 2008 found a consistently low Salmonella prevalence of around 5-6% in fresh chicken at retail in the human food chain. Young children, the elderly and immunocompromised are the groups at greatest risk of Salmonella infection. Reducing risk of infection in individuals involves similar methods to those discussed for Campylobacter and Listeria.

Cases of Salmonella have declined consistently since 2000 and DEFRA hopes this trend is set to continue with the implementation of a number of current and future control programmes. However, it remains an important pathogen and is subject to close monitoring of cases and outbreaks, with action to be taken if the situation worsens. As previously mentioned, DEFRA currently has a zero tolerance of Salmonella in raw pet food and commits to ongoing monitoring to uphold this.

E.coli

E.coli is a normal inhabitant of the gastrointestinal tract in dogs, cats and humans. It is ubiquitous in nature, with many strains being completely harmless commensal flora of the gut. Most cases of foodborne illness are caused by a strain known as E. coli O157 (enterotoxigenic E. coli). Incidence of human infections with **E.coli O157** has fluctuated since 2000 but it remains relatively rare compared to Campylobacter and Salmonella.

It remains an important human pathogen after causing a number of large and serious food-borne outbreaks. As with many other pathogens it poses a particular risk to the very young and very old, but the risk can be easily minimised through hygienic practices in the home, avoiding contaminated water sources and washing fruit and vegetables thoroughly.

Clostridium perfringens

Clostridium perfringens is usually a mild and self-limiting illness, which is suspected to be underreported in the human population. It is more commonly found in cooked foods like beef and poultry rather than raw foods, and is also present in the environment, such as in soil. It requires a large infective dose to cause illness, as it commonly occurs as a commensal in the healthy human and animal gut (up to 85% of healthy dogs in some studies). Foodborne outbreaks are usually due to the poor temperature control and storage of bulk meat dishes.

Foodborne viruses

Foodborne viruses account for an estimated 18% of the UK's food poisoning incidents – a significant proportion. Viruses rely on the cellular organelles of hosts to multiply, so will not reproduce on food. However, they have a very low infective dose, are often hardy in extreme conditions and some can survive and remain infectious in foods and the environment for prolonged periods.

Norovirus is the most frequent cause of gastrointestinal infection in the UK. Outbreaks are often reported in residential institutions, hospitals and cruise ships. Foodborne outbreaks have frequently been attributed to the consumption of oysters, however contamination by infected food handlers could also play a role.

Hepatitis A is another significant worldwide viral pathogen that can potentially be present in raw food. However, it most commonly occurs in the developing world in conditions of poor sanitation and over-crowding. The illness is usually caught in childhood, with many cases being asymptomatic. Following infection, lifelong immunity results. Food-borne outbreaks are common, and ingestion of shellfish cultivated in polluted water is associated with a high risk of infection. It can be prevented by vaccination, good hygiene, and sanitation.

Hepatitis E Virus can infect both humans and animals, although in humans the clinical signs are usually mild and self-limiting. However, immunosuppressed people seem particularly at risk. Whilst it most commonly spreads through contact with the faeces or vomit of an infected person, there is now some evidence to suggest that the infection may also be linked to undercooked pork and pork products, with a recent survey within pig abattoirs finding that nearly 6% of pigs had hepatitis E virus in their blood.

Thorough cooking of pork products, along with good household hygiene practices are advised to limit the risk of disease contraction. The FSA has also commissioned further work to understand how much heat is required and for how long in order to remove hepatitis E in food, as currently there is uncertainty on how effective different cooking practices are at eliminating the virus.

In conclusion, the risk of food-borne illness to both pets and their owners must be a serious consideration for any person choosing to feed raw pet food. While it carries no greater risk than handling fresh raw produce intended for humans, pet owners must be dedicated to good hygiene practices in the home and fully aware of potential sources of contamination. Additional risks to

children, the elderly, pregnant women and the immuno-suppressed should be fully evaluated and all possible precautions taken to minimise the risks.

It is also important to remember that processed foods are not free from the risks associated with food-borne illnesses and hygiene in the home is crucial to keeping everyone safe. Using a DEFRA-registered raw food manufacturer who is professionally and hygienically preparing meals with appropriate microbiological controls will significantly reduce the risks.

Current Thoughts on RAW feeding

The ever-increasing popularity and interest in raw feeding is undeniable. As veterinary professionals it is our duty to provide accurate and responsible advice at all times. In this tough economic climate, we cannot risk alienating and potentially losing clients who choose to feed raw through our own lack of familiarity and reluctance to consider this as an option. Instead we should be feeling comfortable and confident, armed with the best available information, to openly and actively discuss the best and safest ways to raw feed in the interest of the individual pet and owner. It is also important to recognise raw feeding will not be right for everyone and safety is only achievable through education.

Raw feeding has been dividing opinions in the veterinary world for many years and will likely continue to do so for many years to come. However, keeping abreast of the most current research, new products and evolving recommendations is what many of us love about our challenging jobs. In this section we hope to address current research as well as start to unravel many of the myths surrounding raw food.

Clinical Research

Clinical research is always dependent on funding and this is no truer than within companion animal nutrition. The current veterinary pet food market is dominated by huge companies able to regularly fund large research projects in order to bring credibility and science to their foods. However, it pays to be cautious and maintain a critical eye when looking at such research as it is not always as unbiased as it may first seem. Raw food companies hold a small but significant portion of the market and continue to grow very rapidly but up until this point funding to research raw food specifically, has been lacking.

Natures Menu Ltd, the largest raw food producer in Europe, have committed funding needed to finally begin to provide the credibility needed within the veterinary profession. Data collection is currently underway for a number of projects so watch this space!

Raw Feeding and Public Health

Much of the research that has been carried out on raw feeding in recent years has involved the possible public health implications. This section addresses the most common topics covered by this research.

Does handling raw pet food pose an unacceptable public health risk?

This is a current hot topic and much of the academic research in the area of raw feeding has looked at different aspects of this question. The simple answer to the question is 'No' but that comes with some additional caveats to bear in mind.

It is key to ensure any raw feeder is sourcing their ingredients from trusted and responsible producers and are fully aware of the basic hygiene requirements when handling raw meat in the home. In essence, raw pet food should be handled in the same way as if it was raw meat intended to be cooked for human consumption. Raw pet food is of course not sterile, whether it's bought from the supermarket or from a reputable raw pet food manufacturer. Several studies (Baede et al, 2017; Bojanic et al, 2017; Finley et al, 2008; Fredriksson-Ahomaa et al, 2017; Lenz et al, 2009; Mehlenbacher et al, 2012; Nemser et al, 2014; Nilsson et al, 2015; Strohmeyer et al, 2006; Van Bree et al, 2018) have detected various pathogens present on raw meat intended to be used as commercial raw pet food (see earlier in chapter for information on the most common ones), but this shouldn't come as a surprise, as these would also be present on meat intended for human consumption as well.

A recent study of owner perceptions of acquiring infections through raw pet food (Anturaniemi et al., 2019) suggested that from the 16,475 raw feeding households surveyed from 81 different countries, 0.2% reported suspecting having had a transmission of pathogen from raw pet food to a human family member during the time that raw feeding had been used in the household. Of these cases, only in three cases was the same pathogen found in the human sample and the raw pet food (0.02% of all data). Therefore, it appears that the risk of transmission of pathogens from raw pet food to human is very low, but this relies on good hygiene standards being maintained.

An important point to remember is that EU legislation has a zero tolerance to Salmonella in raw pet food manufactured in the UK. This is actually stricter than with meat intended for human consumption, where certain serotypes of Salmonella are permitted, as the intention is this meat will be cooked. Some manufacturers, such as Natures Menu Ltd, also elect to voluntarily test for further causes of food-borne illness, such as Campylobacter. UK pet food manufacturers are regulated and monitored by a division of DEFRA and must have in place HACCP plans to form interventions during production to minimise any contamination risks. The recently published PFMA Guidelines for the Manufacture of Raw Food in the UK (which can be freely downloaded from pfma.org.uk) also contains a

wealth of additional information that PFMA members should follow to produce a responsible and safe product for consumers and their pets.

Will my raw-fed pet shed more bacteria into the environment?

This has been another area of recent academic research over the last few years. Concerns come from the theory that raw-fed animals consume bacteria from raw meat and whilst it may not make them ill, it could contaminate the environment through faecal and saliva shedding and pose a zoonotic risk. A recent internal study by Natures Menu (Towler, 2016) compared a group of raw and non-raw fed dogs to see if there was a higher risk of salivary Salmonella in dogs fed a raw diet. This study found that raw fed dogs posed no greater risk compared to non-raw fed dogs. In fact, the only case of salivary Salmonella detected in the study was from a non-raw fed dog. More information on this study can be found in Module 4 of the Raw Consultant. Lenz et al., (2009) compared vacuum cleaner waste from households with raw fed dogs to non-raw fed dogs for Salmonella detection and found no significant difference between the two.

There are some studies (Finley et al, 2007; Joffe and Schlesinger, 2002; Lefebvre et al, 2008; Lenz et al, 2009) which have demonstrated faecal bacterial shedding is increased by raw feeding. However, we must also remember that poor hygiene standards when handling dog faeces for disposal will increase pathogen risk, regardless of the diet the dog has been fed.

Campylobacter is the pathogen of biggest zoonotic concern (see section on foodborne illness earlier) however, the faecal shedding of Campylobacter is relatively common in all dogs.

Two studies (Bojanic et al, 2017; Fredriksson-Ahomaa et al, 2017) have shown no significant difference in the Campylobacter faecal shedding of raw and non-raw fed animals and the most common species of Campylobacter isolated in dog faeces in several studies (Bojanic et al, 2017; Fredriksson-Ahomaa et al, 2017; Leonard et al, 2011; Parsons, et al., 2010; Procter et al, 2014; Westgarth et al, 2009) was Campylobacter upsaliensis, which is thought to very rarely cause clinical disease in humans.

It is also even questionable whether Campylobacter can survive in the natural environment in faeces, as it requires quite specific conditions to do so (Bojanic et al, 2017; Strohmeyer et al, 2006).

Overall the relationship between consuming contaminated meat and the consequential bacterial faecal shedding by animals is currently not well understood and more research is required. However, what is certain is that good hygiene practices when handling pets and disposing of waste (as one would do regardless of the diet being fed) will definitely help minimise potential risk.

Does raw feeding contribute to the problem of antibiotic-resistance?

Several studies (Chengappa et al, 1993; Finley et al, 2007; Finley et al, 2008; Lefebvre et al, 2008; Morley et al, 2006; Nilsson et al, 2015; Strohmeyer et al, 2006; Van Bree et al, 2018; Nüesch-Inderbinen et al, 2019) have demonstrated the presence of antibiotic-resistant bacteria in raw diets and the potential for increased exposure to such bacteria could be a public health concern. The bacteria identified is usually E. coli or Salmonella.

Some studies (Baede et al, 2017; Lefebvre et al, 2008; Schmidt et al, 2015; Wedley et al, 2017) have also demonstrated that the consumption of raw meat-based diets by dogs or cats is a significant risk factor in the shedding of antibiotic resistant E. coli in faeces.

It is assumed that animals become colonised with these bacteria from eating contaminated raw food. The concern is that these bacteria may then remain in the gut after ingestion, establishing themselves as permanent residents of the gut flora. However, there is some evidence in the literature to suggest that such a theory is unlikely to occur (Baede et al, 2017).

We must also remember that just because a bacterium is antibiotic-resistant, this does not necessarily mean it is pathogenic. Many humans, dogs and other mammals carry commensal antibiotic-resistant bacteria as part of the normal gut flora, which do no harm.

It is possible that transient colonisation of the human gut with antibiotic-resistant bacteria from dogs, may allow gene transfer from these bacteria, to bacteria adapted to the human gut. This would result in prolonged colonisation of the human gut with resistant bacteria.

There have been studies that showed that when antibiotic-resistant E. coli was sampled in known human carriers, identical strains were also detected in dogs from the same household, to a limited extent. However, direction of transmission (from humans to dogs or vice-versa), can be difficult to ascertain.

Nilsson et al, (2015) suggest that the overall risk of the spread of antibiotic-resistant bacteria from raw pet food diets to humans is probably low, but this relies on good hygiene being maintained when handling products.

Another important point to remember is that ***all*** raw meat, including that intended for human consumption, poses a risk in having antibiotic-resistant bacteria present on it, and it could also potentially spread from animals to humans through the food chain.

Putting this topic in a wider context then, the bigger questions to consider are, why is the bacteria on the raw meat in the first place, and secondly, why is it specifically antibiotic-resistant bacteria?

It is likely that bacteria are on the meat in the first place due to inferior food production systems, with lower hygiene standards and inadequate sourcing and handling of raw materials, all leading to increased levels of contamination. The responsible sourcing of raw materials and vendor assurance

schemes, along with thorough analysis of the production line and HACCP implementation to minimise the potential for raw product contamination, can go a significant way in ensuring meat is handled and processed adequately. Natures Menu do all of these things as standard.

The answer to the second question, as to why this is specifically antibiotic-resistant bacteria present on the raw meat, is more complex and goes beyond the scope of raw feeding alone.

A significant contributor to antibiotic-resistance in animals, is the large amounts of antimicrobial drugs used in food production animals worldwide, (Overdevest et al, 2011) which leads to selection pressures that facilitate and favour the emergence of resistant bacteria. Some direct action is now being taken in the UK to try and reduce the likelihood of serious problems in the future. Agricultural sectors have demonstrated a considerable reduction in their overall antibiotic usage in food production animals over the last couple of years, but the equine and small animal sectors still have work to do (Kernot, 2017). The global scale of the problem is also evident, as some reports suggest in the USA antibiotic usage is five times higher in food animals than in the UK (Limb, 2018) and a recent EFSA Summary Report (EFSA, 2017) showed levels of antibiotic resistance can differ significantly from one EU country to another. A global initiative to reduce antibiotic usage and have better food production systems in place which prioritise higher welfare over relying on the overuse of drugs, are what is required to stop this issue becoming one of the major world health problems of the 21st century.

Whilst the initiatives as outlined above are of course important, a recent study has also questioned the likelihood of humans acquiring antibiotic-resistant bacteria from raw meat sources in the first place. The large study, published in the 'Lancet: Infectious Diseases' (Day et al., 2019), stated that in the case of extended-spectrum beta-lactamase producing E coli isolates (ESBL-E coli), 11% of the thousands of routinely collected human faecal samples in the study contained ESBL-E.coli and 65% of retail chicken samples also contained them.

However, the researchers interpreted from the data collected that *non-human* reservoirs, (such as meat and sewage), made little contribution to invasive human disease, and that prevention of the spread of resistant lineages amongst humans is more vital than interventions aiming to target food or livestock, as they found little evidence of crossover between strains from humans, chickens and cattle. In fact, the likeliest route of transmission was directly from human to human via the orofecal route. Therefore, good personal hygiene and the washing of hands after going to the toilet, seemed the most vital factor in tackling the spread of antibiotic-resistance in the case of ESBL-E. coli, rather than interventions that sought to target food or livestock.

On a smaller scale, studies that investigate the risk factors for carriage of antibiotic-resistant bacteria in domestic pets are currently very limited and more research is warranted. However, it seems clear that the presence of resistant bacteria on raw meat, (the fundamental issue when considering this

topic in relation to raw feeding), is a global and multifactorial problem which extends far beyond the scope of raw feeding alone.

Potential Benefits of Raw Feeding

Most of mainland Europe are already very supportive of raw feeding, where you will find raw food in many veterinary practices as a viable, recognised feeding choice. A recently published article from the University of Helsinki, Finland, with a large sample size of 632 dog owners (Hielm-Bjorkman, 2014), found evidence of a range of perceived health benefits. While the study acknowledges its own limitations, there is certainly a case for further in depth and structured follow up.

In this section we will attempt to highlight, with supportive research, the array of potential benefits seen in raw fed dogs. This is by no means an exhaustive list but will hopefully begin to clarify some common benefits important from a veterinary viewpoint. Subsequently we will unravel some of the myths surrounding raw feeding and shed light on some of the concerns shared by many pet owners and veterinary professionals.

We will discuss these commonly reported benefits in more detail below:

- ✓ Enhanced nutrition
- ✓ Better behaviour
- ✓ Superior digestibility
- ✓ Improved dental health
- ✓ Help for anal glands/firmer faeces
- ✓ Healthy appetites
- ✓ Healthier body condition

Enhanced Nutrition

The Ellen Dierenfield report (Dierenfeld et al, 2002) confirms that whole prey, as long as the soft tissues and some bones are consumed, meet all the nutrient requirements of carnivores, and at the same time enhance and positively influence behaviour. The report also suggests wild sourced prey are likely to be more nutrient dense than farmed prey. Consumption of whole prey increases intake of raw animal-derived fermentative substances which may **enhance** gut health, **stimulate** growth of microbial commensals and **optimise** immune function (Plantiga et al, 2011). In contrast, as a result of eating heat-treated, largely plant-derived processed foods, animals suffer tooth decay, dental pathologies, muscle atrophy and poor health (Bond and Linburg, 1990).

It is hugely important to get nutritional balance right from the start. Even the smaller inaccuracies, while not causing an apparent issue in the short-term, will have a cumulative effect over the lifetime of the pet.

Better Behaviour

Improvements in behaviour are linked to raw diets meeting the psychological needs of a dog as well as the nutritional ones. Many domestic cats still choose to hunt prey and consume the raw carcass whole. We must ask ourselves are we actually neglecting one of the five freedoms of animal welfare – *"freedom to express normal behaviour"* by preventing our pets from chewing on bones and raw food. Improvements in behaviour inevitably lead on to improved relationships with our pets and the formation of a stronger bond.

Recent studies have also demonstrated the benefits of omega-3 fatty acids for both improving trainability in puppies (Kelley, et al., 2004) and cognition in seniors (Pan Y, et al., 2018). While these delicate fatty acids often become rancid as a result of oxygen exposure in dry foods, raw foods are fresh and frozen which preserves these essential nutrients far more effectively.

Superior Digestibility

Multiple studies demonstrate greater digestibility of raw meat diets when compared to rendered or extruded animal by-products used in kibbles and canned foods (Sandri et al., 2016; Bermingham et al, 2017). One study showed raw food to be nearly 15% more digestible (Crissey, et al., 1997). This benefit can be particularly significant to those dogs and cats who suffer chronic and inflammatory gastro-intestinal and pancreatic disorders. The increased digestibility enables them to gain more nutrition despite their less efficient gastrointestinal tract and aids in the formation of firmer faeces alongside helping improve the microbiota. Another study (Anderson et al, 2018) showed results consistent with a premium kibble diet having a pro-inflammatory effect on the subject and a raw meat diet having an anti-inflammatory effect, as plasma IgA concentrations were significantly lower in raw-fed dogs compared to non-raw fed dogs. In human adults, increased IgA concentrations are correlated with ageing, heavy drinking, obesity and metabolic syndrome. Whether the increase in IgA in kibble-fed dogs is an indicator of low-level inflammation, associated with sub-optimal health in humans, remains unknown at this stage, but it certainly seems possible.

Improved Dental Health

The opportunity to chew appropriate raw meaty bones as part of a raw diet has anecdotally been associated with greater dental health for a long time. A recent Australian study (Marx et al, 2016) used image integration software on a group of beagles to assess calculus coverage on the teeth, after giving each dog a daily piece of bovine femur to chew. The study found that after only 12 days, calculus had reduced on average by over 80% for the dogs in the study.

A study carried out by Writtle University, in association with Natures Menu, which compared the dental health of a group of raw-fed dogs with a group of non-raw fed dogs, also found that the raw fed dogs had a significantly lower average calculus score. More information on this study can be found in Module 4 of the Raw Consultant.

The emphasis must always be on the appropriate use of bones, to avoid the dental damage and gastro-intestinal issues caused by using bones of an incorrect size or density. Cooked bones should never be fed.

The mechanical action of chewing produces a compression and expansion of the periodontal ligament space around the teeth which, in turn, promotes formation of a dense fibrous suspensory structure by increasing both circulation and fibroblastic activity. The width of the periodontal ligament, a measure of its health, is directly related to the intensity of the mastication function (Fagan and Edwards, 2009). A common misconception is the ability of dry foods to reduce plaque and calculus; however, as the pet bites down into a typical kibble it shatters and crumbles, providing no mechanical cleaning function (Logan et al, 2010).

The dramatic difference in food formation, represented by commercial dog and cat foods, compared with the natural prey of wild canids and felids is often implicated as a significant cause of the degree of periodontal disease diagnosed in domestic dogs and cats. One researcher examined 1,157 wild canid skulls and reported that periodontal disease as suggested by alveolar bone destruction was present in only 2% of specimens, compared with today's prevalence, ranging from 60% to over 80%.

It is also important to consider the balance of micronutrients in a diet when looking at dental health. Diets that fail to meet the FEDIAF guidelines may be deficient in micronutrients such as vitamins C and E, which have a protective antioxidant function. Vitamins A, D and some B vitamins have also been associated with gingival disease.

Many veterinarians have noticed the superior dental health of those cats who hunt and consume their prey on a regular basis compared to those indoor cats, often pedigrees, raised solely on processed foods. Feline odontoclastic resorptive lesions (FORLs) are a particular concern and their aetiology

remains unproven in the seventy years since their discovery. Retrospective studies of zoological collections of feline skulls showed a low prevalence of FORLs before the 1960s compared to their current prevalence (Reiter et al, 2005). It leaves us to wonder could this correlate at all with the steady increase in use of processed foods for domestic cats during this time.

Help for Anal Glands

The transit times for raw foods compared to highly processed kibble foods are known to be different and hence the mixing of these is not advised due to their different digestive requirements. Raw food is generally digested more efficiently, forming firmer, drier and less odorous faeces (Bermingham et al, 2017). This is advantageous in aiding pets predisposed to anal gland problems by chronic diarrhoea (Van duijkeren, 1995), allowing natural expression of the glands when passing firmer faeces. It also makes it easier for responsible owners to clean up after their pets, reducing the public health risks in communal areas from the animal faeces. In addition, raw food also has no need for the added indigestible fibres and filler material (often incorporated into dry food to aid satiety) as the higher protein content leaves a fuller feeling. As a result there is often far less faeces produced as more of the food is digested and utilised by the body with less waste.

Healthy Appetites

With a higher palatability and greater psychological satisfaction, it is no wonder better appetites are commonly reported on raw fed pets. It is well known that kibble undergoes substantial expansion in the stomach, leaving a lasting full feeling, which suits some insatiable pets but can leave others missing meals due to a persistent bloated feeling. In one study looking at captive cheetahs fed a carcass-based diet there were improved appetites, longer periods spent feeding and greater possessiveness of food. Cats in particular can often require a level of persistence with their initial transition onto raw as they are commonly very suspicious of new things but once converted they will rarely choose to return to processed foods.

Healthier Body Condition Score

Dry processed diets, with low protein:carbohydrate ratios have been linked to obesity in cats. Emerging evidence suggests that microbiota (formerly known as gut flora) are critical to the development of obesity (Bermingham et al, 2017) and shifts in the faecal microbiota may be as a result of an increased carbohydrate load entering the large intestine. In humans and rodents, a clear association between

microbiota and diseases such as diabetes and obesity have been demonstrated. One study (Coelho et al, 2018) found that overweight or obese dogs experienced the largest compositional shift in their gut microbiome compared to lean dogs, when fed a high-protein diet. This is consistent with a view that the microbiome of obese dogs resides in a less stable state, compared to microbiomes of healthy, lean dogs.

Another study (Sandri et al, 2017) of a small group of Boxer dogs, found that compared to a commercial extruded diet, a raw diet produces a greater biodiversity of the gut microbiome, which leads to a more balanced growth of bacterial communities and a positive change in the readouts of healthy gut functions. They stated that the lower biodiversity of intestinal microbiome found in kibble diets, is associated with a higher microbial fitness, which is detrimental for host fitness and in humans and mice has been shown to lead to unhealthy eating behaviour and obesity. It is also thought to contribute to increased flatulence for pets on processed foods compared to those on raw diets.

Unravelling the Myths

Can raw feeding be appropriately nutritionally balanced and complete?

Yes.

However, in order to ensure this is achieved in every meal the suggested method would be to choose a complete, commercially produced and reliable raw food that has done all the hard work for you! To determine if a UK commercially produced raw food meets the appropriate standards in nutrition you should check for membership to the Pet Food Manufacturers Association (PFMA) who are the UK representatives of FEDIAF. FEDIAF set their nutritional standards in line with current EU legislation. Home-made raw diets take a wealth of knowledge to execute effectively and should not be undertaken by a novice in raw food. In a European study (Dilitzer et al, 2011) that evaluated 95 homemade raw meat–based diets being fed to dogs, 60% had major nutritional imbalances.

Is it dangerous to feed bones?

Not if done appropriately. The possible risks from pets chewing bones should be kept in context. A retrospective study (Hayes, 2009) examined 208 1st opinion cases of gastrointestinal foreign bodies requiring surgical removal and found that only 3 cases (1.4%) were caused by pieces of bone. The study also did not specify the type of bone and whether it was raw or cooked.

We would always advise appropriate choice of bones from reliable sources for individuals, full supervision (at least initially) and training. NEVER feed cooked bones.

Is raw feeding for everyone?

No.

While it suits a huge proportion of cats and dogs there are some individuals for who raw feeding is not the best choice. For example, vegetarian owners can find it difficult to handle and prepare.

Will my pet suffer from more parasite problems?

Not if done appropriately.

While there is the potential for increased exposure to intestinal parasites, this is easily managed with a routine preventative worming regime and sourcing meat that is passed fit for human consumption. Natures Menu Ltd provide additional assurances by addressing any parasite risk with an evidence-based deep freeze protocol of 10 days at -18ºC, in which none of the parasites can survive.

Is raw feeding too expensive and complicated for most people?

No.

While we wouldn't recommend homemade diets for the novice raw feeder, due to the risks of nutritional imbalances, there are now reliably complete and balanced commercially produced brands such as Natures Menu Ltd. Their foods come as frozen nuggets that can be defrosted and served making raw feeding both convenient and simple. Costing of raw feeding will vary hugely dependent on the method used but it is becoming increasingly affordable with recent popularity and demand. For example, the complete and balanced range of Nature Menu Ltd raw is comparable to the cost of feeding a higher quality kibble diet.

Are dogs too far removed from wolves to handle a raw diet?

No.

The domestic dog is an extremely close relative of the grey wolf, differing from it by at most 0.2% of mitochondrial DNA. Changes to classification placed the domestic dog (*Canis lupus familiaris*) in the same species as the wolf (Canis lupus), effectively making it a 'domesticated wolf'. All species of dogs and wolves remain able to interbreed and produce fertile offspring. Dogs left to their own devices will still form packs to hunt and when breeding without human influence their features revert to a 'wolf-type'. Since living closer to humans, dogs have evolved genetically to digest starch more readily than their wolf relatives (Axelsson et al, 2013). However, this does not allow us to conclude that their

optimal nutrition resides in a starchy diet when this adaptation only occurred as a means to increase survival and utilise their changing resources.

Do different breeds of dog need different diets?

No.

This recent fad is not much more than a clever marketing trick. While we do accept that every dog is an individual and some nutritional problems do run within particular breeds, not every dog within a breed is the same either. This fad also becomes a little unstuck when feeding mixed breeds and mongrels who cannot have a breed-tailored diet when their breed ancestry is unknown. All dog breeds still have the same dentition and musculature in spite of the different shapes, sizes and colours, and their digestive tracts are all identical and so would all suit the same ideal diet.

When there are so many varieties of kibble out there is there really a need for raw?

Yes.

Kibble, similarly to canned pet food, is highly processed and often the protein is sourced from rendered animal by-products and left-overs from the human food industry. Raw is an entirely different option to feed: unprocessed, natural food with nothing artificial added. It provides a third option and gives pet owners the power to make the choice themselves, but with the same level of convenience.

Doesn't raw salmon carry a dangerous parasite?

Yes.

Salmonids are the second intermediate host to the common trematode ***Nanophyetus salmincola*** and dogs are commonly the final host. This parasite is a vector for the bacteria Neorickettsia helminthoeca which is the true cause of 'salmon poisoning disease' in dogs fed raw salmon. In order to address this issue raw salmon must be frozen for at least 24 hours prior to feeding as this ensures the salmon is safe to dogs.

Does my veterinary practice need to barrier-nurse raw fed animals?

This is sometimes suggested by academics, however, as with a lot of things to do with raw feeding, it is important to keep this advice in some context. Whilst it is possible that some raw-fed animals may shed more bacteria (and antibiotic-resistant bacteria) in their faeces, compared to non-raw fed

animals, adequate hygiene protocols and cleanliness in the hospital environment (as would normally be carried out anyway) should minimise any additional risk this may cause.

One might also ask, if we are going to barrier nurse raw fed animals, where should we draw the line? There are studies that have shown that, regardless of other factors including diet, hospitalisation duration itself is significantly associated with a dog becoming colonised with antibiotic-resistant E coli bacteria (Ogeer-Gyles et al, 2006). Wedley et al. (2017) demonstrated that the prior use of antibiotics within the last 3 months was a risk factor in increasing the faecal shedding of antibiotic-resistant bacteria. We might also consider if we are going to barrier-nurse raw-fed animals, should we also be barrier nursing cats that hunt live prey or dogs that scavenge dead animals or drink from dirty puddles on their daily walk?

We can therefore see that there are many factors which might contribute to an animal being a higher 'risk' to the other animals in its proximity, and perhaps singling out raw feeding as an exception is currently unjustified.

Where can I find out more about responsible raw pet food manufacturing?

The recently published PFMA Guidelines for the Manufacture of Raw Food in the UK can be freely downloaded from pfma.org.uk. Here you will find a wealth of additional information that PFMA members should follow to produce a responsible and safe product for consumers and their pets.

References

Anderson et al, 2018. Effect of kibble and raw meat diets on peripheral blood mononuclear cell gene expression profile in dogs. *The Veterinary Journal,* Volume 234, pp. 7-10.

Axelsson et al, 2013. The genomic signature of dog domestication reveals adaptation to a starch-rich diet. *Nature,* Volume 495, pp. 360-365.

Baede et al, 2017. Raw pet food as a risk factor for shedding of extended-spectrum beta-lactamase-producing Enterobacteriaceae in household cats. *PLOS ONE,* 12(11), p. e0187239.

Bermingham et al, 2011. Five-week dietary exposure to dry diets alters the faecal bacterial populations in the domestic cat. *British Journal of Nutrition,* Volume 106, pp. 49-52.

Bermingham et al, 2017. Key bacterial families (Clostridiaceae, Erysipelotrichaceae and Bacteroidaceae) are related to the digestion of protein and energy in dogs PeerJ doi 10.7717/peerj.3019

Bojanic et al, 2017. Isolation of Campylobacter spp. from Client-Owner Dogs and Cats, and Retail Raw Meat Pet Food in Manawatu, New Zealand. *Zoonoses and Public Health,* Volume 64, pp. 438-449.

Bond and Linburg, 1990. Carcass feeding of captive cheetahs: the effects of a naturalistic feeding program on oral health and psychological wellbeing. *Applied Animal Behaviour Science,* Volume 26, pp. 373-382.

Chengappa et al, 1993. Prevalence of Salmonella in raw meat used in diets of racing greyhounds. *Journal of Veterinary Diagnostic Investigation,* Volume 5, pp. 372-377.

Coelho et al, 2018. Similarity of the dog and human gut microbiomes in gene content and response to diet. *Microbiome,* 6(72).

Crissey, et al., 1997. Use of a Raw Meat-Based Diet or a Dry Kibble Diet for Sand Cats (Felis margarita). *Journal of Animal Science,* Volume 75, pp. 2154-2160.

Day et al., Extended-spectrum ß-lactamase-producing Escherichia coli in human-derived and foodchain-derived samples from England, Wales, and Scotland: an epidemiological surveillance and typing study. *Lancet Infect Dis* https://doi.org/10.1016/S1473-3099(19)30273-7

Dierenfeld et al, 2002. *Nutrient composition of whole vertebrate prey (excluding fish),* s.l.: US Dept. of Agriculture.

Dilitzer et al, 2011. Intake of minerals, trace elements and vitamins in bone and raw food rations in adult dogs. *British Journal of Nutrition,* Volume 106, pp. 53-56.

EFSA, 2010. *Analysis of the baseline survey on the prevalence of Campylobacter in broiler batches and of Campylobacter and Salmonella on broiler carcasses in the EU, 2008 - Part A: Campylobacter and Salmonella prevalence estimates,* s.l.: s.n.

EFSA, E. F. S. A., 2017. The European Union summary report on trends and sources of zoonoses, zoonotic agents and food-borne outbreaks in 2016. *EFSA Journal,* Volume 15, p. 5077.

Fagan and Edwards, 2009. *Influence of diet consistency on periodontal disease in captive carnivores,* s.l.: Zoological society of San Diego Dept of Veterinarian Services.

Finley et al, 2007. The risk of Salmonellae shedding by dogs fed Salmonella-contaminated commerical raw food diets. *Canadian Veterinary Journal,* Volume 48, pp. 69-76.

Finley et al, 2008. The Occurrence and Antimicrobial Susceptibility of Salmonella Isolated from Commerically Available Canine Raw Food Diets in Three Canadian Cities. *Zoonoses and Public Health,* Volume 55, pp. 462-469.

Fredriksson-Ahomaa et al, 2017. Raw Meat-Based Diets in Dogs and Cats. *Veterinary Science,* 4(33), pp. 1-9.

Georgsson, et al., 2006. The influence of freezing and duration of storage on Campylobacter and indicator bacteria in broiler carcasses. *Food Microbiology,* Volume 23, pp. 677-683.

Hielm-Bjorkman, V., 2014. *Exploratory Study: 632 shared experiences from dog owners changing their dogs' food to a raw food (BARF) diet.* [Online]
Available at: www.mushbarf.com/en/information-and-resources-about-barf-feeding

Hofshagen & Kruse, 2005. Reduction in flock prevalence of Campylobacter spp. in broilers in Norway after implementation of an action plan. *Journal of Food Protection,* Volume 68, pp. 2220-23.

Joffe and Schlesinger, 2002. Preliminary assessment of the risk of Salmonella infection in dogs fed raw chicken diets. *Canadian Veterinary Journal,* Volume 43, pp. 441-442.

Kernot, 2017. CVO- Work to be done on antimicrobial use. *Veterinary Times,* 47(45), p. 1.

Kelley, Lepine, Burr & al, e., 2004 Effect of dietary fish oil on puppy trainability. s.l., s.n.

Laikko, et al., 2004. Canine tonsillitis associated with Listeria monocytogenes. *Veterinary Record,* 154(23), p. 732.

Lefebvre et al, 2008. Evaluation of the risks of shedding Salmonella and other potential pathogens by therapy dogs fed raw diets in Ontario and Alberta. *Zoonoses and Public Health,* Volume 55, pp. 470-480.

Lenz et al, 2009. Perception, practices, and consequences associated with foodborne pathogens and the feeding of raw meat to dogs. *Canadian Veterinary Journal,* Volume 50, pp. 637-643.

Leonard et al, 2011. Factors relating to Campylobacter spp. carriage in client-owned dogs visiting veterinary clinics in a region of Ontario, Canada. *Epidemiology and Infection,* Volume 139, pp. 1531-1541.

Limb, 2018. Summit delegates clash over antibiotic use; creating alternatives to antibiotics is vital for future; US Farmers "massively overusing" antibiotics. *Veterinary Record,* Volume 182, pp. 125,243, 278-279.

Logan et al, 2010. Periodontal Disease. In: *Small Animal Clinical Nutrition (5th Edition).* Kansas: Mark Morris Institute, pp. 989-1001.

Marx et al, 2016. Raw beef bones as chewing items to reduce dental calculus in Beagle dogs. *Australian Veterinary Journal,* 94(1-2), pp. 18-23.

Mehlenbacher et al, 2012. Availability, Brands, Labelling and Salmonella Contamination of Raw Pet Food in the Minneapolis/St. Paul Area. *Zoonoses and Public Health,* Volume 59, pp. 513-520.

Morley et al, 2006. Evaluation of the association between feeding raw meat and Salmonella enterica infections at a Greyhound breeding facility. *JAVMA,* Volume 228, pp. 1524-1532.

Nemser et al, 2014. Investigation of Listeria, Salmonella, and Toxigenic Escherichia coli in Various Pet Foods. *Foodborne Pathogens and Disease,* 11(9), pp. 706-709.

Nilsson et al, 2015. Hygiene quality and presence of ESBL-producing Escherichia coli in raw food diets for dogs. *Infection Ecology and Epidemiology,* 5(28758).

Ogeer-Gyles et al, 2006. Development of antimicrobial drug resistance in rectal Escherichia coli isolates from dogs hospitalized in an intensive care unit. *JAVMA,* Volume 229, pp. 694-699.

Overdevest et al, 2011. Extended-spectrum Beta-lactamase genes of Escherichia coli chicken meat and humans, the Netherlands. *Emerging Infectious Diseases,* Volume 17, pp. 1216-1222.

Pan Y, Kennedy AD, Jönsson TJ, Milgram NW 2018. Cognitive enhancement in old dogs from dietary supplementation with a nutrient blend containing arginine, antioxidants, B vitamins and fish oil.

Parsons, et al., 2010. Prevalence of Campylobacter spp. in a cross-sectional study of dogs attending veterinary practices in the UK and risk indicators associated with shedding. *The Veterinary Journal,* 184(1), pp. 66-70.

Plantiga et al, 2011. Estimation of the dietary nutrient profile of free-roaming feral cats: possible implications for nutrition of domestic cats. *British Journal of Nutrition,* Volume 106, pp. 35-48.

Procter et al, 2014. A cross-sectional study examining Campylobacter and other zoonotic enteric pathogens in dogs that frequent parks in three cities in South-Western Ontario and risk factors for shedding of Campylobacter spp. *Zoonoses and Public Health,* Volume 61, pp. 208-218.

Reiter et al, 2005. Update on the etiology of tooth resorption in domestic cats. *Veterinary Clinics of North America: Small Animal Practice,* 35(4), pp. 913-942.

Rosenquist, Sommer, Nielsen & Christensen, 2006. The effect of slaughter operations on the contamination of chicken carcasses with thermotolerant Campylobacter. *International Journal of Food Microbiology,* Volume 108, pp. 226-232.

Sandri et al, 2017. Raw meat based diet influences faecal microbiome and end products of fermentation in healthy dogs. *BMC Veterinary Research,* 13(65).

Schmidt et al, 2015. Antimicrobial resistance factors and characterisation of faecal E.coli isolated from healthy Labrador retrievers in the United Kingdom. *Preventative Veterinary Medicine,* Volume 119, pp. 31-40.

Strohmeyer et al, 2006. Evaluation of bacterial and protozoal contamination of commericallly available raw meat diets for dogs. *JAVMA,* Volume 228, pp. 537-542.

Towler, 2016. *Is there a higher risk of salivary Salmonella in domestic dogs (Canis familiaris) when fed a biologically appropriate raw food (BARF) diet,* s.l.: s.n.

Van Bree et al, 2018. Zoonotic bacteria and parasites found in raw meat-based diets for cats and dogs. *Veterinary Record,* Volume 182, p. 50.

Van duijkeren, 1995. Disease condition of canine anal sacs. *Journal of Small Animal Practice,* 36(1), pp. 12-16.

Wedley et al, 2017. Carriage of antimicrobial resistant Escherichia coli in dogs: Prevalence, associated risk factors and molecular characteristics. *Veterinary Microbiology,* Volume 199, pp. 23-30.

Weese et al, 2005. Bacteriological evaluation of commercial canine and feline raw diets. *Canadian Veterinary Journal,* Volume 46, pp. 513-516.

Westgarth et al, 2009. Risk factors for the carriage of Campylobacter upsaliensis by dogs in a community in Cheshire. *Veterinary Record,* Volume 165, pp. 526-530.