MODULE 4

USE OF DISCARD FISHERIES TO PRODUCE PET FOOD

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Summary

Today, pet owners treat pets as their own family members, and pets are treated like humans in Europe. Since cats and dogs are carnivores by nature, their feeds consist of high amounts of animal-derived substances that are also used in human nutrition. But in recent years, it raises the question of the impact of animal-derived dog and cat feed on the use of scarce resources and the environmental footprint of meat consumption by cats and dogs. For this reason, the use of discarded fish that are not suitable for human consumption may become an important issue for BARF for cats and dogs. The module includes an introductory part describing the pet (dog and cat) sector in Europe. The module's content addresses definition of the basic nutrition procedures and nutrient requirements of the pets. It contains a description of the biologically appropriate raw food (BARF) for cat and dog nutrition, definition of the BARF, contents of the BARF, the benefits and the main risks of BARF feeding, and the legal limitations for BARF feeding in the EU. It addresses the contents of discard fisheries and fish processing wastes and all aspects of the production of BARF for pets from discard fisheries including processing technology.

1. Overview of The Pet (dog and cat) Sector in Europe

Cats and dogs are the favorite animals to keep in European households. The pet dog (Canis acquaintance) has been the closest friend of humans for over 12,000 years and the domestic cat (Felis catus) for 9000 years (1,2). Today, cats and dogs contribute to the mental health and well-being of children and adults, and pet ownership has become increasingly popular all over the world in recent years (3). Today, pet owners treat pets as their own family members, and pets are treated like humans in Europe (4).

Data for 2021 show that approximately one in four households in Europe owns at least one pet dog (5). According to the data of FEDIAF (4), there are 92,947,732 dogs (in the EU: 72.708.732) and 113,588,248 cats (83,622,248 in the EU) in Europe. The countries with the highest number of cats and dogs in Europe are Germany (27 million), France (22.6 million) and Italy (18.7 million). These countries are followed by the United Kingdom with 24 million. In the EU, too, the estimated percentage of households owning at least one pet is 46% of all households. The estimated percentage of European households with at least one cat or one dog is 25% for cats (4).

According to FEDIAF (4) data, there is annual sales revenue of €50 billion (47.5MB) in 2021 for pet food and related services. The sales value of pet food products in 2021 was €27.7 billion ($28.8 billion), up 21% from 2020. It can be said that pet ownership has an impact on this, along with the Covid pandemic. Because in 2021, the pet industry related services and products increased by 9.7%. The number of pet food companies (approximately 150) and factories (approximately 200) remained unchanged during this period. The pet industry created 10,000 direct jobs per year with a total of 110,000 employees in 2021. In indirect jobs related to the pet sector, 50,000 people find employment. The pet food industry in Europe provides employment to approximately 100,000 people. It is also estimated to create an additional 900,000 new jobs in related pet care industries. This includes suppliers to the pet food industry, approximately 200,000 veterinarians in Europe, 60,000 specialist pet stores, the pet accessories industry, trade shows, pet media, breeders, animal welfare organizations and transport (4).

There is a growing awareness in Europe of pet food, pet equipment and supplies, specialty food products and organic pet food. With the increase in pet ownership, the increase in the pet industry, pet care and feed market continues. In some countries in Europe, pet food is recognized as a premium product segment. Because pet owners are very worried and meticulous about the nutrition of their animals, they prefer to buy quality feeds. The popularity of pet food products is increasing in Europe and manufacturers are seeking to develop new innovative products. In order to provide a better life for pets, pet owners also pay maximum attention to the materials they use. Manufacturers are also trying to offer natural, organic and unprocessed feeds for pet animals in response to this demand. In recent years, the pet feed market in Europe is slowly and gradually shifting towards plant-based feeds and uses animal-derived feeds less (6).

Dogs and cats are traditionally fed offal that are housed on farms or homes and are not used for human consumption. In the past, dogs were used as guards or for hunting, and cats were used to control rodents. However, in industrialized countries, dogs and cats are today mainly kept as companion animals and fed commercially produced high-quality feed. Since cats and dogs are

carnivores by nature, their feeds consist of high amounts of animal-derived substances that are also used in human nutrition. But in recent years, it raises the question of the impact of animal-derived dog and cat feed on the use of scarce resources and the environmental footprint of meat consumption by cats and dogs. Since the contribution of dog and cat foods to general greenhouse gas production is the subject of public debate, it is taken into account in the nutrition of these animals (7). For this reason, the use of discarded fish that are not suitable for human consumption may become an important issue for BARF for cats and dogs.

2. Pet (cat and dog) Nutrition

Since the daily nutritional needs of cats and dogs vary according to their life stages, physical and mental health and activity levels, they should be fed with special feeds that will meet their needs for these periods. Pet food can be complete or complementary feed. This feed must be nutritionally complete, providing all nutrients in the amount and proportions the animal needs. Complementary pet food is designed to be only part of the diet and does not meet the nutritional requirements of the animal when fed only this complementary food (8).

Each animal species needs a specific nutrient profile at different stages of its life (for example, growth stages, pregnancy, lactation or old age). Proteins, amino acids (e.g. taurine), vitamins (e.g. various vitamins such as vitamins A, B, K, D and E), minerals (e.g. calcium, iron, zinc, iodine and copper) and certain they need fats (9).

The gastrointestinal microbiome of cats and dogs is increasingly recognized as a metabolically active organ inextricably linked to pet health. Food acts as a substrate for the microbiome in the gastrointestinal tract of cats and dogs and plays an important role in defining the composition and metabolism of its microbiome. Pet foods should be formulated to contain the typical nutritional building blocks of carbohydrates, proteins and fats. In addition, it should contain microbiome-targeted components such as prebiotics and probiotics. This is because available information indicates that dietary components may affect not only gastrointestinal diseases but also allergies, health, weight management, diabetes, and kidney disease through changes in the GI microbiome (10).

2.1. Digestive system, digestion and absorbtion of the nutrients in dogs and cats

Cats are carnivores and dogs are omnivores, and there are some differences in their nutrient needs and nutrient digestion. Except for a few features, there are no significant differences between the digestive anatomy of the dog and cat. Since dogs and cats have a relatively small digestive system compared to humans, they must be fed with foods with higher digestibility focused on intestinal health. Their digestive systems cannot break down some nutrients like a sheep or other herbivores can (11).

Although the cat's intestinal length is shorter, it has a higher absorption capacity than dogs. Regarding the cecum, the canine cecum is present as a more developed, blunt-ended sac (diverticulum), while the cat's is simply an undeveloped ligament. The digestive system includes

all organs involved in the intake and use of food. This system begins with the mouth and includes the esophagus, stomach, liver, pancreas, intestines, rectum, and anus. The digestive process begins when the animal takes the food with its mouth and starts chewing it and the enzymes in the saliva chemically break down the food. This process continues with swallowing, additional breakdown of food in the stomach, absorption of nutrients in the intestines, and removal of waste. Digestion is important not only for providing nutrients, but also for maintaining proper fluid and electrolyte (salt) balance in the body (12).

In cats and dogs, saliva secretion continues during feed intake and chewing. Saliva consists of 99% water, the remaining 1% mucus, inorganic salts and enzymes. The mucus in the saliva is a lubricant, making it easier to swallow especially dry foods. Unlike humans, the saliva of dogs and cats lacks alpha-amylase activity, which affects starch digestion. Vomiting is quite common in dogs due to a well-developed vomiting center. Vomiting provides dogs with an effective defense mechanism by which toxins can be excreted from the gut. In terms of enzymatic differences, pepsin is more important in cats than in dogs. Because pepsin is involved in the digestion of collagen. There are differences in carbohydrate digestion and absorption in dogs and cats. Since the activity of pancreatic amylase is about three times greater in dogs than in cats, dogs adapt to high levels of dietary starch faster than cats. Also, the activity of brush border enzymes is lower in cats. Therefore, cats can tolerate starch levels of up to 4 g/kg body weight before they have diarrhea, while dogs can consume up to 2.5 times that without any side effects. Another difference is that cats are relatively unresponsive to varying levels of carbohydrate intake, while dogs can regulate the rate at which their small intestines absorb monosaccharides in response to different starch levels. Since the large intestine of dogs and cats is not expected to digest polysaccharides, it is considerably shorter than that of herbivores. The residence time of undigested food residues in the large intestine is approximately 12 hours in the dog, and only 8% of total food digestion takes place in the large intestine. Due to the limited length of the canine large intestine, fiber fermentation is only ± 7-35%, while starch digestion varies between 15-100% depending on the nature of the starch reaching the lower intestine.

Due to effective pre-fat digestion in dogs and cats, fat reaching the lower intestine is usually minimal, preventing dyac from inhibiting bacterial fermentation. Adequate fiber levels in dog and cat foods help prevent diarrhea and constipation. Thus, the normal water content of feces remains in the range of 65-75% (14).

2.2. Nutrient requirements of dogs and cats

Water

Since about 60% to 70% of a pet's body is made up of water, pets need access to fresh and clean water at all times. Without enough water, the pet can get sick or die. Some, if not all, of the water that animals need comes from their diets. Dogs are more thirsty when they are active. On hot or hot days, dogs may drink twice as much water as on a cool day. Cats can withstand acute dehydration slightly better than dogs. Homeostatic control of water balance in cats differs from dogs in some respects (15).

The daily water consumption of dogs is 50-60 ml of water per kg of body weight or 200 ml of water for an energy intake of 200 kcal/day.

Protein

Proteins are the building blocks of organs, muscles, bones, blood, immune system, hair and nails in the body. Protein is necessary for the growth and development of the structural components of cats and dogs and for the development of the immune system. Dogs tend to prefer foods high in protein. Since cats are also hunters, they are naturally carnivorous. Animal-based proteins contain all the essential amino acids that cats and dogs need. Proteins in pet foods are made up of a variety of different ingredients, both animal and vegetable origin, such as poultry, beef, pork, fish, eggs, corn, rice, peas or soybeans. It is important that the pet consumes the right amount of protein and that the protein, which is affected by the source of the protein and the processing of the food, can be easily digested and absorbed. Proteins are made up of amino acids. There are hundreds of different amino acids, but few of them are essential for dogs and cats. Pets can produce some amino acids themselves, and therefore these are non-essential amino acids that do not need to be present in the diet. However, other amino acids (essential) are amino acids that must be taken with food and cannot be synthesized in the body. There are 10 essential amino acids for dogs and 11 essential amino acids for cats. These are arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine and taurine (for cats). In instant pet foods, manufacturers often use a variety of ingredients to provide the required amount and type of protein/amino acid. Excess protein consumed by the pet is not stored in the body and is also not used to build more muscle tissue. Feeding more of the extra protein than the pet needs does not provide any health benefits for the pet (8).

Domestic cats and dogs are carnivores that have evolved differently in the diet and metabolism of amino acids. Dogs insufficiently synthesize citrulline (the precursor to arginine) from glutamine, glutamate, and proline in the small intestine. Taurine is not an essential amino acid for dogs as they can synthesize taurine. Although most dog breeds have the potential to convert cysteine to taurine sufficiently in the liver, a small proportion (1.3%-2.5%) of Newfoundland dogs fed commercially available balanced diets exhibit a taurine deficiency, possibly due to gene mutations. Certain dog breeds (eg, golden retriever) are more prone to taurine deficiency, possibly due to lower hepatic activities of cysteine dioxygenase and cysteine sulfinate decarboxylase.

Taurine is found only in proteins of animal origin. De novo synthesis of arginine and taurine is very limited in cats. A cat's digestive system can break down animal proteins with digestive enzymes and absorb nutrients from them. Taurine is necessary for the formation of bile, eye health and the functioning of the heart muscle. Taurine deficiency can cause irreversible retinal disorders in the eyes, decreased reproductive activity during pregnancy and lactation (due to fetal resorption), poor birth, growth retardation in surviving kittens, dilated cardiomyopathy in cats, and immunosuppression.

Cats need high amounts of taurine for bodily functions, but they have limited enzymes to produce taurine from other amino acids such as methionine and cysteine. The need for adult cats is greater than for kittens. Lactating cats are more susceptible to taurine deficiency, especially since it is

excreted in milk. The enzymes cysteine dioxygenase and cysteine sulfinic acid decarboxylase, which convert methionine and cysteine to taurine in the liver, are deficient in cats. Cats do not have an enzyme system capable of synthesizing sufficient amounts of taurine from cysteine. Taurine is also important for the formation of bile salts in cats that cannot use glycine for this purpose, other animals can use glycine instead of taurine. Taurine supplementation for cat foods is recommended at 1 g/kg (0.1% for dry food) and 2 g/kg (0.2% for canned food) (14).

Cats also have special needs for arginine. Most animals need arginine to produce ornithine. Because ornithine is necessary in animals to bind ammonia formed by the breakdown of protein. In cats, on the other hand, ornithine can only be produced from arginine. In the case of arginine deficiency in cats, not enough ornithine can be produced to bind ammonia and therefore high ammonia levels can cause severe symptoms such as salivation, vocalization, ataxia and even death. Although arginine deficiency is rare in cats, it can occur in cats that do not eat or have certain liver diseases such as hepatic lipidosis. Therefore, the concentrations of both taurine and arginine in cat milk are the highest among domestic mammals.

The recommended protein requirement for kittens is 30%, and 25-30% for adult cats. Pregnant and lactating cats need higher protein. Sick, weak and frail animals need extra protein. If a healthy cat gets too much protein, some of it is excreted in the urine and the rest is used as calories or converted to fat. High protein diets are not recommended if the cat has kidney problems.

Recommended protein needs are 28% for a puppy, 18% for an adult dog, 25% for a performance dog, 35% for a sled dog, and 28% for a nursing dog (13).

During adulthood, cats and dogs can lose 34% and 21% of their lean body mass, respectively. Adequate intake of high-quality protein (i.e., 32% and 40% animal protein on a dry matter basis, respectively) in the diets of aging dogs and cats is recommended to alleviate aging-related decreases in mass and function of skeletal muscles and bones. Pet food grade animal source foods are excellent sources of both proteinogenic amino acids and taurine for cats and dogs and can help optimize their growth, development and health (3).

It is important to meet the needs of especially high quality protein, amino acids and omega-3 fatty acids of pet animals, especially fish, fish processing residues and discarded fish, cats and dogs, and it is recommended to be used in dry or wet feeds to be prepared for them.

Energy

The three main sources of energy are fat, carbohydrates and protein. Factors affecting energy intake in cats and dogs are growth, breastfeeding, stress, physical exertion, race, environmental conditions and age. Trauma, illness, stress, and sepsis will increase an animal's metabolism, thereby increasing the animal's energy requirement. Because they are true carnivores, proteins are cats' primary energy source. However, because they are omnivorous, carbohydrates are the primary source of energy for dogs.

The energy requirements of cats and dogs can be calculated using resting energy requirement (RER= 30xbody in kg) + 70) and life energy requirement (MER= 1.0-1.8xRER). The RER can also be multiplied by a factor to estimate the animal's energy requirements for different life stages:

- Puppies= 3 x RER,
- Kittens 2.5 x RER,
- Gestation 3 x RER,
- Lactation dogs 4 to 8 x RER,
- Lactation cats 2 to 6 x RER (13)

Lipids

The fats in pet foods are a source of essential fatty acids needed to synthesize certain hormones and protect cell membranes. Dietary fats consist of animal fats or vegetable sources. Some vitamins (A, D, E, and K) can only be absorbed, stored, and transported in fat. Dietary fats increase the flavor of the feed and fats are a very good source of energy.

Fats also provide essential fatty acids that the dog or cat's body cannot synthesize on its own. Omega-3 fatty acids in oils are essential for cell membranes and reduce inflammation. Fatty acids keep skin and hair healthy, produce some hormones, absorb vitamins, provide body heat insulation and protect organs. Good sources of omega-3 fatty acids are fish, shellfish and flaxseed. Omega-6 fatty acids are important for aiding the tissue repair process and are found in vegetable oils (13).

Cats cannot convert linoleic acid to other fatty acids. Because of these characteristics, it should be ensured that there is sufficient arachidonic acid in the diet of cats. Cats have limited activity of the enzyme desaturase, which is involved in the metabolism of essential fatty acids. Arachidonic acid is an essential food for cats, so they need animal fat. However, dogs can convert linoleic acid to arachidonic acid, whereas in cats, arachidonic acid synthesis is limited. For this reason, care should be taken to ensure that there is sufficient amount of arachidonic acid in cat foods. Otherwise, symptoms of insufficient essential fatty acids appear. Symptoms related to the deficiency of essential fatty acids in cats are insufficient growth, skin hyperkeratosis, hair loss, delay in blood clotting time, mouth and skin lesions, fatty liver, prolongation of wound healing time, degeneration in testicles and kidneys (14).

The recommended lipid requirement for kittens is 20%, and 15-20% for adult cats. The recommended fat requirement is 17% for puppies, 9-15% for adult dogs, 20% for performance dogs, 50% for racing dogs and 17% for lactating dogs (13).

Carbohydrates

Carbohydrates are nutrient stored as glycogen in the liver and muscle and used by the body to provide instant energy for activities. While there is no limit to the minimum carbohydrate level required in pet foods, carbohydrates provide a concentrated source of dietary energy and dietary fiber. Carbohydrates come in two basic structures, digestible carbohydrates (starches and sugars), which provide energy, and indigestible carbohydrates (fiber), which are important for stool quality and intestinal motility. Fiber can aid in weight management as they are low in calories and help

provide a feeling of fullness. Fiber absorbs water and aids in the peristaltic movements of the digestive tract. Fiber is a type of carbohydrate that affects the bacteria in the pet's gut. However, to get the most benefit from fiber in pets, the fiber must be fermentable. Fermentable fiber can be found in wheat, rice or vegetables. High fiber foods are not good for growing young cats and dogs. The recommended fiber levels in cats and dogs vary between 3.5-6.0% (14). Although carbohydrates make up a significant portion (30-70%) of dry commercial pet foods, they can sometimes cause medical problems in dogs such as obesity and digestive disorders. Carbohydrates are mainly vegetable ingredients such as corn, barley, peas, rice, wheat and potatoes. Dietary fiber sources include, for example, dried beet pulp, wheat bran or soybean hulls. Many carbohydrate sources also provide other nutrients such as protein, fat or vitamins. By grinding and cooking, carbohydrates become easily digestible (8)

Cooked or extruded forms of carbohydrates are easily and quickly digested by dogs and cats.

Sucrose and lactose are less tolerable. Cats can use the glucose formed by digesting starch in their diet. However, there is a problem in digesting lactose. That's because the levels of lactase enzyme needed to break down lactose into individual sugars are lower. While these enzyme activities are at the highest level in dogs and kittens, the activity decreases as age progresses and especially in adult cats. An adult cat produces little or no lactase as its food is no longer milk but meat. This causes lactose intolerance. If an adult cat consumes milk or dairy products, lactose is not broken down and passes from the small intestine to the large intestine unchanged, unable to enter the bloodstream (8, 14). The ability to digest lactose is dependent on β-galactosidase activity in the gut. It is known that β-galactosidase activity is higher in kittens. In some adult dogs, digestive disorders are observed at intakes of more than 0.6-1 g lactose/kg body weight/day (equivalent to 10-20 ml milk/kg body weight). Amylase activity is 3 times higher in dogs than in cats. When high carbohydrate is introduced into the diet in dogs, amylase activity is limited to a 6-fold increase and a 2-fold increase in cats. Because of this feature, two weeks is enough for dogs to adapt to a new diet, while cats need months of acclimation period. Cats can tolerate 4-5 g starch/kg body weight per day without diarrhea. Dogs, on the other hand, can tolerate more than 2.5 times of well-cooked starch.

Minerals and Vitamins

The most important macro minerals needed in the body are calcium, phosphorus, potassium, sodium, chloride and magnesium. Trace elements such as iron, copper and selenium are needed in less quantity. Cats and dogs also get essential minerals from their diet. Calcium and phosphorus are important for healthy bones and teeth. Magnesium, potassium and sodium are an important part of muscle health. While the desired Ca:P ratio in their diet is 1:1 in cats, it is 1.4:1 in dogs. However, in sources such as meat, poultry and fish, Ca:P is 1:15-20. This leads to Ca deficiency and causes some health problems (8, 14).

Vitamins are nutrients that are needed in very small amounts but have many functions in the body. Dogs and cats cannot synthesize all the vitamins they need and therefore these vitamins must be provided through their diet. Minerals and vitamins are partially provided by components that provide

the main nutrients protein, carbohydrates and fat, and other minerals and vitamins are provided by some feed additives (8).

If the protein, fat and carbohydrates in the diet of pets are balanced, they can get all the nutrients they need. Vitamin supplements are not usually necessary unless prescribed by a veterinarian to treat vitamin deficiency. In fact, excessive vitamin intake can cause health problems. For example, too much vitamin A can lead to brittle bones and joint pain. Too much vitamin D can cause overly dense bones and kidney problems.

Food Allergy

In some cats and dogs, immunological mechanisms come into play against specific antigens, while digesting most foods without sensitivity. Antigens are proteins, and the most important are glycoproteins. Antigenic foods for dogs are milk protein, soybeans, wheat, beef, horse-chicken-pork, eggs and yeast. Fish is also antigenic to cats. Food allergies can occur suddenly, months or years after feed consumption (13, 14).

3. Biologically Appropriate Raw Food (BARF) for Cat and Dog Nutrition

In developed countries, there is a new tendency to feed cats and dogs using commercial feeds or using at home recipes. The reason for this is to eliminate health problems in pet animals caused by heat treated with heat treated and believe that these raw feeds are more useful. In this context, the diets of wildlife -related species are used as a justification, but differences in biology and lifestyle bring limitations to such comparisons (16).

Animal by -products (ABPs) are materials of animal origin that people do not consume. People do not enter the food chain. Depending on the raw material resource and intended use in Europe, animal by -products are divided into three categories: Category 1, Category 2 and Category 3. Pet Food Industry can only use Category 3 ABPs. Category 3 ABPs consist of animals obtained from animals announced in accordance with human consumption. These are ideal pet food components due to their high nutrition and energetic values and should be used in the best possible way to protect resources. Category 1 and 2 animal oils are prohibited for safety reasons for animal nutrition and are allowed only for biofuel production. Animal oils are basic raw materials for the diet of pets (17).

Giving raw meat -based diets to pets has become an increasingly popular tendency among pet owners. Animal owners who want to ensure the best for pets seek veterinary opinions about food options. However, the benefits of these feeds in terms of nutrition, risks (infectious diseases) and especially meat -based pet diets in terms of public health should be taken care of (18).

The raw meat diet is a type of diet based on feeding dogs and cats with unprocessed meat, edible bones and organs. This nutrition model is based on the principles of the evolutionary nutrition of the dog and is the most common and popular raw diet for dogs. The advocates of the raw meat diet

believe that this natural diet, which has passed the evolutionary test for millions of years in the wildlife, is most appropriate for animals (19).

What is BARF?

BARF stands for biologically suitable raw food or bone and raw food. BARF dog food is becoming more popular with pet parents who are making educated decisions about their pet's health and well-being. A BARF diet usually consists of 75% meat, 5% offal organs, 10% raw bones, 5% fresh vegetables and fruit, and 5% other healthy ingredients. The BARF diet is defined as a pet food diet consisting of thermally untreated animal products for domestic pets. Raw meat-based diet prepared foods and pet owner-prepared diet are also called homemade barf. However, there is not much lack of information regarding the potential risks and benefits from this nutritional practice. Proponents of BARF diets base their infectious disease risks on when feeding an animal with a BARF diet. That is, the microbiological safety of BARF diets is an important segment in which manufacturers are responsible for additional control of all other production procedures (cold chain at all production and storage stages) to minimize contamination with zoonotic pathogens (20).

What does A BARF contain?

BARF means biologically suitable raw food or bone and raw food. BARF dog food becomes more popular among pet parents who make trained decisions on the health and prosperity of pets. A BARF diet is usually 75 % meat, 5 % offal organs, 10 % raw bones, 5 % fresh vegetables and fruit and 5 % other healthy components. The BARF diet is defined as a pet food diet consisting of non -thermal products for pets in homes. Raw meat -based diet is called ready -made feeds and the diet prepared by the domestic animal owner. However, there is not much lack of information about the potential risks and benefits caused by this nutritional practice. The advocates of the BARF diets are based on the risks of infectious disease when feeding a BARF diet and animal. In other words, the microbiological safety of the BARF diets is an important segment in which all other production procedures (cold chain in all production and storage stages) are obliged to control all other production procedures (cold chain in all production and storage stages) to minimize the contamination of manufacturers with zoonotic pathogens (20).

What are the main risks of BARF feeding?

The RMBD (raw meat-based diet) and BARF diets encompass dietary regimens based on raw ingredients (including raw meat) popular in pet nutrition. Animal tissues and organs and other uncooked ingredients are increasingly popularly used by pet owners to feed their pets. However, the risk of exposure to microbiological and parasitic agents is an important issue that such diets need to be addressed for domestic cats and dogs living with humans (22).

There are documented risks associated with raw feeding, mainly associated with unbalanced and malnutrition of cats and dogs, and infection affecting pets and/or household members. The main risks of raw feeding (16):

- Nutritional problems such as calcium/phosphorus imbalances and specific vitamin deficiencies,
- Bacterial pathogens (Salmonella, E. coli, Campylobacter spp., Listeria monocytogenes, Yersinia enterocolitica, Brucella spp., Toxoplasma gondii),
- Antimicrobial resistant bacteria,
- They are non-bacterial pathogens and zoonoses.

What are the benefits of BARF feeding?

- A balanced barf diet provides dogs with all essential nutrients,
- A stronger immune system,
- Improved cardiovascular health,
- Increased mental ability,
- Lower digestive problems,
- Healthier hair and skin,
- Decreased incidence of obesity,
- Decreased incidence of disease and degenerative disorders (21).

What are the legal limitations for BARF feeding?

The EU has established strict rules governing the use of animal proteins to ensure the quality and safety of pet diets. Animal proteins from veterinary slaughtered animals, fish or seafood for pets must meet the very high standards of EU legislation. Animal-based ingredients are feed sources containing many body parts of animals. These are the parts that the consumer does not prefer, but that pets love to consume. Foods with this feature consist of kidneys, spleen, lungs, pork trotters, udders and parts of fish left over from processing. Animal-based ingredients not allowed in pet foods include:

- Any product from animals slaughtered under veterinary supervision that can be used subject to veterinary permission and is not suitable for human consumption,
- Waste products, dead on the way, diseased animals, etc.

4. Discard fish for BARF

4.1. Contents of discard fisheries and fish processing wastes

Fish are considered highly nutritious products due to the presence of well-balanced macronutrients such as proteins, lipids and micronutrients such as vitamins and minerals (23). In general, the whole fish body contains about 70% to 80% water, 20% to 30% protein, and 2% to 12% lipid (24). Nutritional composition of fish muscle 15-24% protein, 0.1-22% lipid, 6.1-10.3%

Docosahexaenoic acid (DHA), Eicosapentaenoic acid (EPA), 0.1% vitamins, 1-2% minerals, It consists of 0.5% calcium and 0.25% phosphorus (23). The quality and characteristics of fish products are quite diverse, depending on the potential content of raw materials. Fish processing for various products is done with a large amount of by-products and about 45% of the fish is thrown away. Discarded waste includes fish heads, bones, fins, scales, etc. (24).

A large amount of by-products is produced as a result of fishing and fish processing, and this is estimated to be up to 60% of the total fish weight. Usually, fish processing by-products are dumped into the oceans and land as waste and contain highly valuable nutrients that can cause serious environmental pollution (Figure 2).

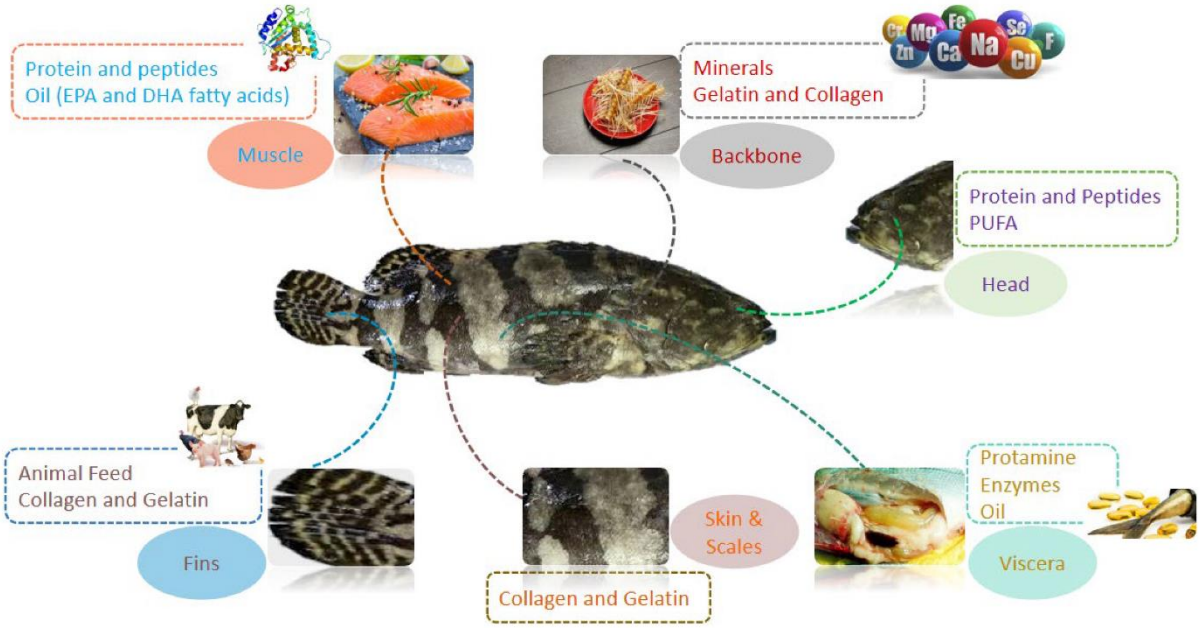

Figure 1. Bioactive compounds found in various parts of fish (23)

The protein found in fish has high nutritional value due to essential amino acids. Fish lipids are important for health and are rich in polyunsaturated fatty acids (PUFAs), particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Similarly, fish contains a perfect balance of all essential vitamins, especially vitamins A and D, and is also an important source of B vitamins. Mineral substances such as calcium, iron, zinc, selenium, iodine and phosphorus are found in significant amounts in fish. These micronutrients have high bioavailability and antioxidant properties that are beneficial for curing various diseases. However, fish and their products can easily spoil if not properly protected (23).

However, global population growth, global climate change and significant increases in food prices have caused worldwide environmental problems and concerns about global food security. Sustainability of aquaculture practices has been discussed in recent years due to the increasing awareness about the impact of waste products from aquaculture (25). Each year, large amounts of fish waste are produced during fish processing, and fish waste is often discarded. The use of

renewable natural products such as fish waste in the manufacture of pharmaceutical and nutraceutical products is considered the first step towards 'greening' the life cycle of chemical products in the fields of environmental protection and sustainability. Therefore, it is urgently necessary to improve the management of fishing waste and fish by-products to provide viable routes for value-added content production. It is also expected that the evaluation of these wastes and the processing of these materials into useful products will reduce environmental pollution (24). Because a significant amount of fish by-products are produced during the processing of caught or farmed fish (26). All discarded fish and fish processing residues have attracted attention in recent years, prompting researchers to develop methods to turn them into useful products. Fish scraps and the by-products from which they are processed make up a significant portion of the original fish and their disposal has a high environmental and economic impact. The use of waste as a raw material for the production of different classes of biofuels and high-value chemicals is gaining interest in a vision of circular economy and zero waste policies, a concept known as “biorefinery”. In this context, an interesting way to gain value is the extraction of omega-3 fatty acids (ω-3 FAs) for nutraceutical application. According to a widely accepted solution hierarchy in waste management, the primary solution to be implemented should be the prevention of waste generation. Alternative measures to be taken include the evaluation of waste in order to obtain value-added products, which is an extremely attractive possibility from both an environmental and an economic point of view (27). The use of fish by-products and fisheries wastes will result in a future reduction of waste to be discharged into the aquatic environment, resulting in excessive nutrient enrichment in the waters and finally aquatic eutrophication. They can also be used as a source of aquatic feed for farmed fish, thus supporting the development and sustainability of aquaculture. In addition, fishing waste and by-products are a major source of complementary high value-added compounds. However, potential hazards associated with the presence of contaminants should be considered before use (28).

In addition to all these, tons of fish that are not suitable for human consumption in fishing are either thrown directly into the sea from ships or thrown on land without any processing. This negatively affects sustainable food production and water footprint in the seas and on land. The use of these discarded fish in the production of raw feed, i.e. BARF, especially for pet animals such as cats and dogs, is a very important topic within the scope of circular bioeconomy and reducing water footprint.

The following section contains innovative information on the availability of discarded fish in BARF production, the related work flow chart, the main risks and precautions to be taken.

4.2. Production of BARF for pets from discard fisheries

In terms of their genetic and physiological characteristics, dogs (*Canis lupus familiaris*) and wolves (*Canis Lupus*) are in the same classification. The differences that exist between them today have occurred as a result of the development of many different dog breeds with the selection of human beings over the years. In the developmental stage of dog breeds, close contact with humans has made dogs dependent on humans. The increasing number of domesticated animal adoptions by humans and the difficulty in meeting their nutritional needs has led to the

development of a new diet for these animals. This new diet, namely dry pet food, which is composed mostly of carbohydrates and grains, is economical and easy to prepare, leading to its widespread use in pet feeding. However, studies have shown a dramatic increase in many diseases indirectly related to the diet in pets, such as periodontal disease, obesity, chronic digestive problems, kidney disease, allergies, and cancer. However, when the anatomical features of dogs, which are closely related to wolves, are examined, the characteristics of a carnivorous animal become evident. These structures can first be explained by the fact that dogs and wolves have the same number and shape of teeth. These dental structures have evolved to meet their need to tear and shred meat. Like their carnivorous relatives in the wild, dogs also have sharp and rough teeth. In addition, their teeth are hinged to allow them to break down large pieces of meat. This dental structure sets them apart from herbivores. As for the domestic cat, a member of the Felidae family, it has also been subjected to human selection, and it is a species that carries the characteristics of the 39 living species of cats. The modern cat (*Felis catus*) exhibits the dental and skeletal structure of its carnivorous wild relatives, just like dogs (29). Additionally, both dogs and cats have their eyes positioned on the sides of their skulls, ahead of their craniums, to focus on prey animals (30). This suggests that these animals, which have evolved alongside humans, have a carnivorous and predatory nature. Carnivorous animals in nature feed on the meat, organs, and other parts of the animals they hunt. Although they may consume some vegetables that they can access, they do not have a digestive system suitable for breaking down grains and seeds. Especially cats are "obligate" carnivores. In recent times, pet owners have started to prepare and commercialize diets containing raw tissues of farm or wild animals, which are particularly intended for dogs and cats and are prepared either fresh or frozen. This new type of diet or feeding style is called "Biologically Appropriate Raw Food" or "Bones And Raw Food" (BARF) (31). The BARF diet was actually developed to mimic the feeding style of pet animals' close relatives in the wild. The carbohydrate starch, which forms the basis of dry food diets, although better digested by dogs than by wolves (29, 32) has also been shown to cause many chronic diseases in dogs due to its high content. Researchers and pet owners have also described the most remarkable difference in animals fed with the BARF diet as an increase in life energy (33, 34). It has been reported that the raw diet delays aging in cells, provides cell oxygenation, supports cell renewal and the immune system. Pet owners also report that the odor and volume of their pet's feces decrease by 20% on the BARF diet. In addition, it is reported that dogs have whiter teeth, cleaner teeth, and reduced bad breath. Finally, pet owners have reported that obesity problems, which are common in pets, have also been eliminated. However, there are also negative attitudes towards the BARF diet. The most important of these attitudes are the biological hazards such as the mature forms, eggs, larvae, pathogenic bacteria, and viruses that raw materials may contain. The anatomical and physiological characteristics of carnivorous animals are an important defense mechanism against these hazards. To give some examples of these characteristics; the duration of food in the carnivore's stomach is quite long, approximately 4-8 hours. During this time, the food in the stomach is exposed to a repeated hydrochloric acid bath. Here, the low pH destroys some of the pathogens and inhibits the growth of others. Then, a small amount of stomach contents is released into the duodenum, where the second microbial breakdown occurs and the pancreas secretes peptides called defensins, which inhibit and kill any pathogens. This structure does not eliminate all biological hazards that raw

materials may contain, but along with several steps in the BARF process, these features reduce biological hazards to an acceptable level. Additionally, the feeding behavior of stray dogs, such as obtaining food from garbage, consuming dead animal carcasses, burying excess food and later feeding on contaminated food, demonstrates this situation. By the way, the main problem is determining the daily intake amount of the BARF diet. Mimicking the feeding style of wolves, which are the wild relatives of our domestic animals, has helped in calculating this amount. However, some differences were encountered in this comparison and they were designed according to the nutritional needs of dogs over time. When evaluating the intense energy requirement of an adult wolf weighing around 40 kg, it is estimated that they need to consume about 2.5-6 kg per day, which is approximately 10-15% of their body weight (29, 31). When calculated based on an adult dog's energy requirement and body weight, it is estimated that they should be fed with the BARF diet at a rate of 2-3% of their body weight (35). When preparing BARF diets, they are generally divided into two categories according to their content: "Complete BARF" and "Partial BARF." The classic BARF diet contains no grains and consists entirely of animal proteins such as red meat, white meat, fish, fat, offal, and eggs. In contrast, the partial BARF diet contains some plant proteins and carbohydrates such as pasta, millet, green vegetables, or fruit (36, 37). In the composition of nutrient elements in partial BARF diets, there are generally two different combinations. In the first combination, there is 50% carbohydrate (vegetables and fruit), 40% protein (meat protein, offal, and meaty bones), 5% fat, and 2-5% fiber and mineral substances. In the other combination, 70% of the diet is meat (meat protein, offal, and meaty bones), 28% is carbohydrate (vegetables and fruit), and 2% is fiber and mineral substances (37).

Figure 2. Protein sources of the partial BARF diet

The protein sources of the Partial BARF diet are shown in Figure 1, which include raw poultry meat, slaughterhouse by-products, poultry bones, red meat carcass shaving products, esophagus,

trachea, lungs, all offal, stripped bones, seafood, eggs, and game meats. The plant-based sources of carbohydrates, fiber, minerals, and vitamins in the Partial BARF diet consist of raw vegetables and fruits that can be obtained seasonally, as shown in Figure 2.

Figure 3. Carbohydrate, fiber, mineral and vitamin sources of the partial BARF diet.

In our project, the MARIPET BARF diet, which is our main product, will be prepared as a partial BARF diet. The protein source in the MARİPET BARF diet is discarded seafood, and the carbohydrate source is seasonal fruits and vegetables that are easily accessible. In the selection of fruits and vegetables, choices will be made to address nutrient deficiencies that may arise from the use of seafood. Selection will focus on dense sources of fiber, containing high amounts of vitamin C and iron, and having a high dry matter-to-water binding capacity. Seafood, which is the main protein source in the MARIPET BARF diet, contains approximately 18-22 g of protein per 100 grams. Fish protein, which is rich in exogenous amino acids, is necessary for building muscles and maintaining healthy bone and muscle mass. Depending on the type of fish, it generally contains a large amount of omega-3 essential fatty acids. Seafood is also a rich source of selenium, iodine, and vitamin D. Selenium strengthens the immune system and provides a necessary nutrient source for healthy fur and nails. It has been reported that fish, which is the main protein source of the MARIPET BARF diet, exhibits an anti-tumor effect in cats and dogs due to its omega-3 fatty acids.

4.3. Processing technology for BARF from discard fisheries

The most important step in the preparation process of MARIPET BARF is to determine the production stages. Once the production stages are established, including the selection of leftover fish on the ship to delivery to pet owners, a quality plan and HACCP (Hazard Analysis and Critical Control Point) manual can be prepared. HACCP is an abbreviation for "Hazard Analysis and Critical Control Points". The system is a systematic approach that ensures the identification and control of hazards that affect product safety. It is necessary to determine the production stages to prevent physical, chemical, and biological hazards that may occur in pets fed with MARIPET BARF. A production protocol created in a healthy way will enable MARIPET BARF to be

produced in a standardized manner in different countries and cities. The workflow prepared for MARIPET Barf is shown in Figure 4.

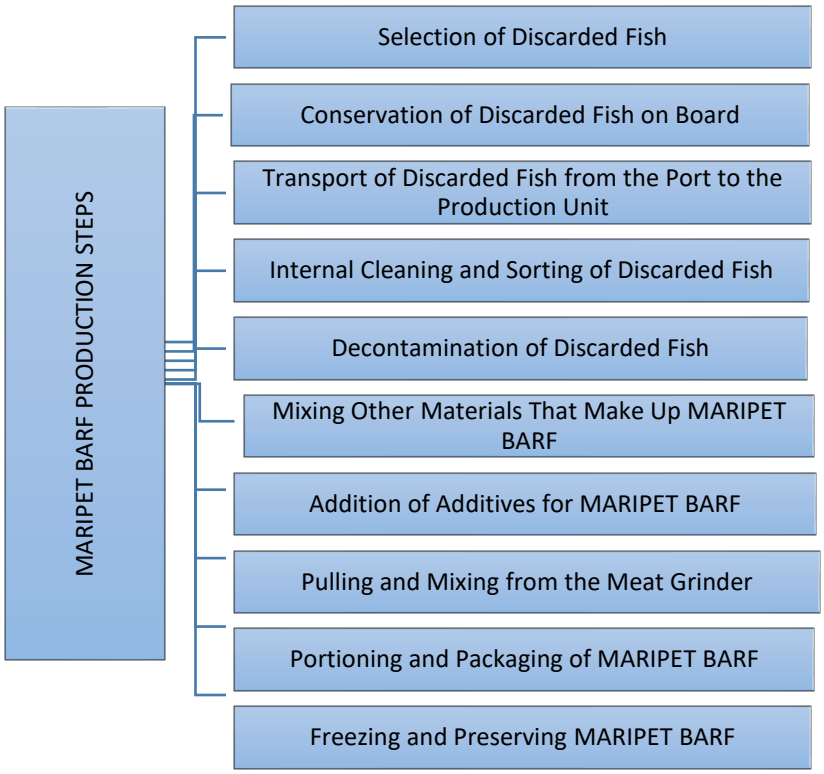

Figure 4. MARIPET BARF Production Steps

Selection of discarded fish

There are 388 fish species in the Mediterranean, 389 in the Aegean Sea, 249 in the Marmara Sea, and 151 in the Black Sea. Only a few of these fish species are commercially valuable and caught as fishery products. However, there are no species-specific characteristics for fishing methods such as trolling used in the seas. Therefore, when all the fish caught by the trawl are pulled onto the ship, the fish that are not commercially valuable, those that are injured or have damaged integrity, and those that are smaller or larger than legal fishing sizes, are generally referred to as "discard fish". These discard fish are either thrown back into the sea directly or brought to the port for disposal. In MARIPET BARF production, the discard fish to be used must be selected on board and preserved.

Preserving discard fish on board

The contamination rates from the environment, high water activity, large amounts of trimethylamine oxide (TMA-O), high postmortem pH (often pH>6), the presence of nitrogenous compounds (NPN) that are not part of the protein structure, and microbial interactions are effective in spoilage of seafood. In order to prevent these spoilage indicators, the most effective and widespread methods applied for maintaining the nutritional value and freshness of fish meat, such as cooling and freezing, should also be applied to discard fish. Depending on the equipment available on the fishing vessel, the discard products should be cooled with ice, ozonated ice, or sea water cooled with ice, or mechanically cooled sea water (RSW) to reach a central temperature of 0°C.

Transporting the discard fish from the port to the production unit

Discard fish, whose center temperature is lowered to 0 °C on the ship, is transported to the factory where MARIPET BARF will be produced by refrigerated vehicles that are at 0/+4 °C or foam boxes that provide thermal insulation. Precautions must be taken to prevent the center temperature of discard fish from rising above +4 °C during transportation.

Internal cleaning and trimming of discarded fish

Discard fish and seafood whose tissue integrity is disrupted and internal organs are damaged during fishing cannot be used in BARF production. They must be removed from the batch. Then, fish and seafood must be cleaned of internal organs that contain high levels of contamination. For this, personnel must cut the fish from the belly and remove the internal organs as much as possible without damaging them, and then wash them with clean water. When fish and seafood, species such as Needle (Tail) Stingray, Gurnard, Turbot, Scorpionfish, Toadfish, Pufferfish, Rina Fish, and Varsam Fish, which contain toxins, must be selected.

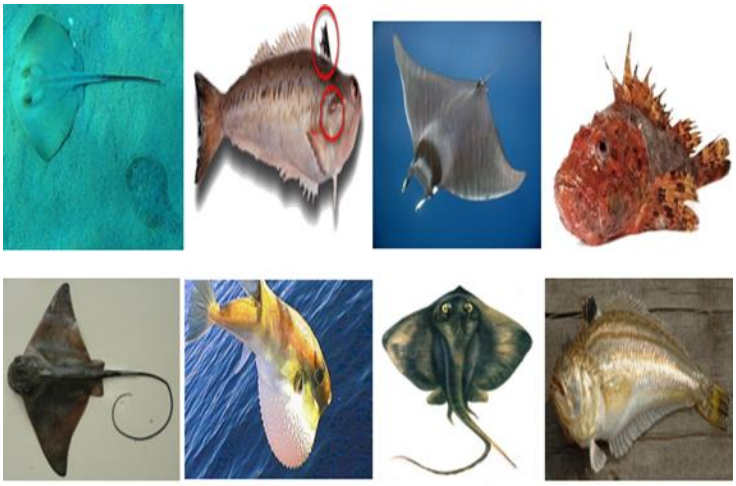

Figure 5. Toxic Fish Species Found in Seas

Decontamination of discard fish

Decontamination of discard fish After removing and washing the internal organs of discard fish and other seafood, they should be decontaminated using a substance such as chlorine dioxide, electrolyzed water, or ozonated water. For this purpose, the fish should be immersed in water containing 0.5 ppm chlorine dioxide for 1 minute, followed by rinsing with water. If ozonated water is used for decontamination, applying 5 ppm of atmospheric ozone is sufficient. Additionally, washing with electrolyzed water will eliminate some of the bacteria belonging to *Achromobacter*, *Pseudomonas*, *Flavobacterium*, *Vibrio*, *Bacillus*, *Clostridium*, and *Escherichia* genera that are found on the skin and in the digestive system of the fish.

Mixing with other ingredients to form MARIPET BARF

Mixing MARIPET BARF with other Ingredients Nutrients will be selected to balance the disadvantages of MARIPET BARF, such as the high water content, low fiber content, and low levels of water-soluble vitamins in discarded seafood. For this purpose, pasta will be used, particularly to bind free water. Pasta is a food that is high in starch, rich in B1 and B2 vitamins, iron, calcium, phosphorus, potassium, and other mineral substances. The low fiber content will be enriched with cabbage, green leafy vegetables, fruits, and oat bran, which are easily available depending on the season. Additionally, mechanically separated poultry meat (MSPM) will be added at around 1% for calcium requirements.

Adding food additives

The MARIPET BARF diet focuses on preserving the nutritional content, particularly by extending or preventing two decay processes. One is to prevent oxidation due to the high content of fish oil, and the other is to use antimicrobial additives to prevent microbial spoilage. In the preparation of the MARIPET BARF diet, rosemary extracts with a high effect in animal fat feed materials, designated as E 392, will be used at a dose of 50 mg/kg to exhibit an antioxidant effect. Antimicrobial additive E 200 Sorbic acid will be used at a level of 2000 mg/kg.

Grinding and mixing in a meat grinder

After all the ingredients of the MARIPET BARF diet are mixed, the mixture is passed through the 8 mm sieve (mirror) of the meat grinder. The entire mixture is mixed again by adding 0.5% NaCl. Then, it is passed through the 3 mm sieve (mirror) of the meat grinder.

Portioning and Packaging of MARIPET BARF

The MARIPET BARF mixture is filled into plastic permeable artificial sausage casings in 500 g portions for dogs and 100 g portions for cats. The plastic casings prevent moisture from escaping from the inside and also prevent microbial contamination from the outside during transportation.

Freezing and freeze preservation

Freezing and cryopreservation destroys all forms of parasites and eliminates the danger of parasites. However, it does not cause a very serious reduction in the number of pathogenic

microorganisms. In addition, freezing and freezing prevent pathogenic microorganisms from reaching the number that can cause disease by breeding. For this purpose, MARIPET BARF, which is packaged in desired weights, is shock freezing at -40 °C. Then, the products whose core temperature has reached -18 °C by freezing are stored in warehouses with an ambient temperature of -18 °C until shipment.

Content of MARIPET BARF diets

MARIPET BARF Diet As an example, a mixture ratio consisting of two different proportions of the main protein source, discard fish, is given.

MARIPET BARF diet-1	***MARIPET BARF diet-2***
- Discarded fish 75%	- Discarded fish 80%
- Pasta 15%	- Bulgur 10%
- Seasonal Vegetables and Fruits 9%	- Seasonal Vegetables and Fruits 9%
- Mechanically Separated Poultry Meat 1%	- Mechanically Separated Poultry Meat % 1

For both examples, 5 g of rosemary extract, 200 g of sorbic acid, and 500 g of salt will be used for 100 kg of MARIPET BARF production

4.4. Stabilisation of the nutrient content of the BARF

Due to the preparation of MARIPET BARF from raw materials and the natural food source strategy, very few additives have been used in its production. Heat triggers enzymatic activity and microbial growth, which causes spoilage of food. Therefore, the main preservation factor for standardizing and preserving the nutrient content is achieved by reducing heat to a level that prevents spoilage. For this purpose, the freezing method is preferred to ensure a long shelf life of MARIPET BARF, which preserves the original color, flavor, texture, and nutrient value of the product better than other preservation methods. However, during production, two additives with E numbers are used to protect MARIPET BARF against oxidation and microbial growth that may occur due to the high temperature in the production area and incorrect thawing practices by pet owners.

4.5. Packaging, labelling, storage and transportation strategies for the BARF

Freezing and frozen storage

MARIPET BARF production uses completely raw materials. The lack of heat treatment applied to the food ingredients makes BARF a risky food product in terms of biological hazards. These biological hazards are mainly the eggs, larvae, and adult forms of pathogenic bacteria and parasites. The most effective method to prevent these existing hazards is to reduce the core temperature of MARIPET BARF to -18°C in shock freezing chambers at -40°C and to store it at -18°C. Freezing and frozespon storage destroy all forms of parasites and eliminate the risk of

parasite-related hazards. In addition, it does not cause a significant decrease in the number of pathogenic microorganisms. However, it prevents the pathogenic microorganisms from reaching the number that can cause disease by preventing their growth.

Transfer of MARIPET BARF to pet owners

The use of completely raw materials in MARIPET BARF production makes it mandatory to transfer the product under freezing conditions to pet owners. For this purpose, perishable food products must be transported by cargo companies that are capable of carrying them within their specific temperature limits and with great care, or with an appropriate temperature. As an alternative to transportation, MARIPET BARF can be delivered to the cargo company in polystyrene foam boxes with dry ice. If the polystyrene boxes are not opened, they can maintain the -18°C feature for up to 110 hours. During the winter months, this time is longer and the products are stored at -18°C in polystyrene boxes. MARIPET BARF products delivered to pet owners have a shelf life of 4 days in a +4°C refrigerator, 8 days in a -6°C refrigerator, 3 weeks in a -12°C freezer, and 1 year in deep freezers at -18°C. The amount to be given to the pet should be thawed slowly in the lower compartment of the refrigerator at +4°C about 24 hours before feeding.

5. Risk Assesments and Precautions for Pet Owners

BARF, or raw feeding, brings along many biological hazards. These hazards include parasite eggs, larvae and adult stages, as well as bacteria and viruses in general. In addition, toxic species found in the marine ecosystem can also be considered as a chemical hazard. In this section, we will evaluate the hazards present in BARF feeding in terms of dangers for both pets and pet owners, specifically for MARIPET BARF. Parasite-related hazards for pets include some single-celled (protozoan) or multicellular (helminth) parasites. Eating raw meat and tissues from farm animals can expose dogs and cats to these parasites. Among them, there are also zoonotic parasites, which have the potential to infect humans. When animals' tissues are eaten raw, dogs can be exposed to Neospora caninum, *Sarcocystis* spp., *Cryptosporidium* spp., *Cystoisospora* spp., *Echinococcus granulosus*, *Taenia multiceps*, *Taenia hydatigena*, *Taenia ovis*, *Toxocara canis* and *Trichinella* spp., and for cats *Toxoplasma gondii*, *Sarcocystis* spp., *Cystoisospora* spp., *Toxocara cati*, and *Trichinella* spp. Some parasites can be transmitted, such as (31, 38-40). However, most of these parasites use farm-originated mammalian animals such as cattle, sheep, goats, and pigs as intermediate or final hosts in their biological cycles. In particular, for the biological development of the form of the parasite that has the ability to reproduce in cats and dogs, they need to consume the cystic structures created by the larvae forms of the parasites in the muscles or internal organs of farm animals. Generally, slaughterhouse by-products and offal used in BARF production are risky products for reaching cats and dogs, which are the final hosts of the parasite. Many of these mentioned parasites are of zoonotic nature. This means that the pet animal harboring the final form of the parasite will release its eggs and larvae into the home or garden environment with its feces. Animal owners who come into direct or indirect contact with this feces can also reach the final form of the parasite. Generally, it is thought that these parasites are destroyed during the freezing stage in BARF production. However, many parasite species can survive between 3 and 300 days at -20°C. MARIPET BARF has an advantage over other BARF products in that it does not contain

any source of muscle and offal tissue from farm animals (40, 41). Additionally, there are parasitic species that can be transmitted from fish to humans, but these are destroyed by a 4 day -18°C freezing process (42, 43). Meat, which is the most important raw material intended for consumption by humans and pets, is often contaminated with microorganisms. The most common ones are *E. coli*, *Salmonella* spp., *Clostridium* spp., *Campylobacter* spp., and *Listeria* spp. Although these pathogenic microorganisms are more commonly associated with red meat and poultry, the raw materials used in preparing MARIPET BARF may also be highly microbially contaminated (44).

Fish caught in the waters where Iskarta seafood is harvested may contain *Vibrio* spp., *Salmonella* spp., and *Escherichia* spp. due to contamination. Similarly, vegetables, which are another ingredient in MARIPET BARF, may be contaminated from irrigation sources. Heat treatments applied to food and feed are effective in reducing microbial contamination. However, heat treatment is not applied in BARF production. Therefore, products will be frozen to prevent microbial growth at low temperatures, and some microorganisms will be destroyed by freezing. Second, the use of antimicrobial additives aims to prevent excessive microbial growth. In addition to these measures, healthy cats and dogs are not affected by these pathogens due to the high acidity of their digestive systems. However, very young, very old, or otherwise health-impaired pets may experience some serious health problems. In addition to all of this, it is actually the pet owners who take on the microbial risk of BARF products. When thawing frozen BARF in the refrigerator, transferring it to a food bowl, cleaning the bowl, and even petting the animal after feeding, they may become contaminated with the pathogens present in BARF. To reduce the risk of these pathogens for pet owners, frozen BARF should be thawed in a tightly sealed container in the refrigerator. As BARF is a raw product, it should be consumed by the animal without being left in the food bowl for too long, as it may lead to bacterial growth. Additionally, kitchen utensils and food bowls that come into contact with MARIPET BARF should be washed with hot soapy water or detergent after use. Pet owners should wear gloves or use hand sanitizer or antimicrobial liquid soap to wash their hands at this stage. It should also be kept in mind that these pathogens may be present in the feces of our pets and can spread.

Conclusion

Disposal of discarded fish in fishing is a significant waste of resources and negatively impacts the sustainable use of marine biological resources and marine ecosystems and the financial viability of fisheries. Globally, it is estimated that between 7 and 10 million tons of commercial fisheries are wasted annually. The EU's common fisheries policy aims to put an end to this wasteful practice. The obligation to land these discarded fish was introduced in 2015 and this obligation has been in full force since January 2019 (45). The purpose of this is to encourage fishermen to hunt more selectively, to reduce discards and avoid undesirable catches. It is possible to use these discarded fish, which are landed, in the production of omega-3 fatty acids with high added value, as a protein source in animal nutrition, especially in aquaculture, as well as in the production of BARF for pet animals.

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