

Nutritional supplements for pregnant and lactating bitches

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Abstract

This review covers the use of common nutritional supplements for the bitch and puppies. Basic nutrients, including fat, protein, minerals, vitamins and essential fatty acid supplementation, will be discussed. Newer supplements, such as probiotics for stimulation of the immune system of the bitch and puppy, and for the non-pharmaceutical treatment of weaning diarrhea, will also be covered.

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Keywords: Nutrition; Calcium; Vitamins; Essential fatty acids; Dog

1. Introduction

Balanced commercial dog foods designed for all life stages are the mainstay diet for optimal reproductive capacity in the bitch and optimal growth rates in puppies. Based on recent data, certain micronutrients and macronutrients, when balanced with other nutrients in the formulation, may provide a healthier immune system and more acute hearing and vision in puppies.

2. Pregnant and lactating bitches

2.1. Protein and fat

In general, pregnant and lactating bitches should be fed an energy-dense (30% protein and 20% fat on a dry matter basis) and highly digestible commercial dog food that is balanced for vitamins and minerals. The food should be labeled adequate for “all life stages”. Food intake should not increase during the first 5 wk of

gestation; however, intake requirements will increase to 1.25–1.5 times maintenance during the last trimester. At this time, several small meals daily are recommended, due to abdominal distension caused by the gravid uterus. Bitches with average sized litters should gain no more than 15–25% of their pre-pregnancy body weight, and should weigh 5–10% more than their pre-pregnancy weight immediately after whelping.

During pregnancy in the bitch, protein requirements increase as much as 70% over maintenance, reaching 6.3 g of protein per 100 kcal [1]. High quality, animal-based proteins are preferred. Protein deficiency during pregnancy can reduce birth weights and increase neonatal mortality [2]. During lactation, protein requirements are even higher, particularly in large litters [3]. Multiple meals each day, with concentrated high quality food, are essential to maintain body condition of the bitch, otherwise milk production, and consequently neonatal growth, will be suppressed. In queens, certain amino acids, e.g. taurine, play an important role in the maintenance of pregnancy, whether this is also true in the bitch is not known. Fat contains twice as much energy (kcal) per unit of food than carbohydrates or protein, making it an essential part of an energy-dense diet for late gestation and lactation. Lactation, however, is extremely

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demanding and energy requirements may increase three-fold (relative to basal requirements) by weaning, particularly with large litters. Although protein and fat intake should increase in pregnant and lactating bitches, maintenance of ideal body condition is also an important aspect of feeding pregnant and lactating bitches, as those that are overweight have a greater chance of pseudocyesis and dystocia [4].

2.2. Essential fatty acids

Prior to birth, specific nutritional requirements can affect the long-term health and well being of puppies. Fats and essential fatty acids, such as linoleic and alpha-linoleic acid, are in increased demand during pregnancy and lactation in the bitch. Essential fatty acid deficiency has been associated with pre-term labor, poor placental development and small litter size [1]. In particular, dams fed a diet rich in docosahexanoic acid (DHA) delivered puppies that had improved learning ability, memory, and vision [5–7].

2.3. Vitamins and minerals

Pregnant and lactating bitches do not seem to require calcium supplementation, unless to balance a home-made diet or to treat eclampsia if present. The proper Ca:P ratio in diets for pregnant and lactating bitches is 1:0.8. High dietary calcium during gestation does not seem to increase the risk for eclampsia in dogs [1]. However, there are concerns regarding the role of calcium in the periparturient period. Increased stillbirths have been associated with lower ionized Ca and higher blood parathormone concentrations in German shepherd bitches [8]. During lactation in the bitch, the demand for calcium increases exponentially [9,10]. In particular, small-breed dogs (e.g., Chihuahuas), may be at increased risk for eclampsia, particularly if they are fed home-made diets, such as chicken and rice, without calcium supplementation.

Supplementing pregnant bitches with certain vitamins (e.g. Vitamin E and folate) was historically considered not harmful and perhaps beneficial. Unfortunately, based on recent studies in humans, excessive Vitamin E supplementation may be harmful and lead to a pro-oxidant state (with increased inflammation). Prenatal folate supplementation has been promoted in human medicine to alleviate midline closure defects, e.g. spina bifida and cleft palate. In the only study in dogs, supplementation of folate in Boston terriers decreased the percentage of puppies with cleft palates [11]. Unfortunately, the study was performed with dogs

fed a homemade diet deficient in grains (that contain high concentrations of folate).

2.4. Probiotics

Enterococci are typical lactic acid bacteria (LAB) and occur naturally in a wide variety of environments, including certain foods, as well as in the intestinal tract of animals [12]. Much human research has been conducted studying the potential benefits of SF68 in patients with acute diarrhea, traveler's diarrhea, dysbiosis associated with antibiotic use, irritable bowel syndrome, hepatic, and encephalopathy. Probiotics decreased the incidence, severity and duration of diarrhea [13].

In selecting a potential strain to be used as a probiotic for a pet food supplement, one should consider several important factors, including a long history of safe use in both humans and animals, and approval by the AAFCO. The potential benefits of SF68, based on a large number of trials in humans and animals, were consistent with desirable benefits in pets. Probiotics survived the conditions of the gastrointestinal tract in pets, based on well-controlled *in vitro* and *in vivo* tests. Certain probiotics (e.g. FortiFlora; Nestle Purina PetCare Company, St. Louis, MO, USA) incorporate a proprietary microencapsulation process, which allows for stability of the microorganisms through the production, distribution and storage processes.

Probiotics have been used successfully by veterinarians in Austria and Switzerland since 1985 for the maintenance and restoration of healthy gut microflora in dogs and cats with disturbances caused by changes in diet, stress and antibiotic therapy. *Enterococcus faecium* (*E. faecium*) can temporarily survive in the gastrointestinal tract of healthy adult dogs for approximately 14 d. Feeding *E. faecium* reduced the fecal *Clostridium perfringens* concentrations in dogs, with increased concentrations of fecal bifidobacteria and lactobacilli. Probiotics significantly improved fecal scores in dogs with naturally occurring diarrhea [14].

3. Supplementing puppies (4 wk to 12 mo of age)

3.1. Energy and protein requirements

Growth rates differ dramatically among small, medium-, large-, and giant-breed puppies. For example, a miniature poodle may be sexually and physiologically mature at 6–8 mo of age; whereas, a Great Dane may not achieve maturity until 28–36 mo. Due to these breed size differences in the rate of growth, food companies

have designed foods for small, medium, large, and giant breeds. Diets for small puppies are higher in energy and protein, whereas those for the large and giant breed are lower in caloric content, with sufficient protein to support proper growth and development. Overfeeding large-breed puppies increased the incidence of osteoarthritis and obesity [15]. Mismatch in the amount of protein and energy in the diet may result in relative protein deficiency that can cause immune problems and carbohydrate intolerance later in life [16]. Puppy foods that matched the amount of protein to the amount of energy in the diet optimized growth in small-, large- and giant-breed puppies. Ideally foods for growing puppies should contain at least 25% protein on a percent-energy basis. Feeding instructions should be considered guidelines, as individual puppies differ and may require adjustments to keep them in a lean body condition (4–5 out of 9 on the Purina scale). Excess body weight is a risk factor for osteoarthritis in both humans and dogs, whereas avoiding obesity can help reduce osteoarthritis. Dogs maintained in lean body condition through food restriction, experienced decreased severity, and delayed onset of osteoarthritis [17].

3.2. Essential fatty acids

Optimal amounts of omega-3 and omega-6 fatty acids are essential to promote a healthy immune system, skin and haircoat, both in utero and in developing puppies. Foods should contain the proper amount (0.05% DHA, AAFCO recommendation) of essential fatty acids, including linoleic acid, for growth and development [18]. Feeding diets rich in DHA fed to puppies up to 12 wk in age will improve memory and vision.

Furthermore, Omega-3 fatty acids (e.g. DHA), are required for normal development of retinal function and hearing in puppies.

3.3. Vitamin and mineral supplements

Differences in mineral requirements between large- and small-breed puppies may be one of the most important aspects of puppy nutrition. Although miniature poodle puppies will grow and develop normally on a wide range of calcium intake, Great Dane puppies require a very specific amount (1.5%) of calcium for normal skeletal growth. Skeletal defects (hip dysplasia, panosteitis, etc.) and depressed growth were observed when high concentrations of calcium were fed to Great Dane puppies; however, normal growth and development was observed when the puppies were fed 0.80 to

1.5% Ca on a dry matter basis [19]. Conversely, severely reduced growth and pathological fractures were noted in Great Dane puppies fed $\leq 0.55\%$ Ca on a dry matter basis (low calcium) [19]. Feeds designated for small-, large-, and giant-breed puppies have varying amounts of calcium and phosphorus (in the appropriate ratios) to control growth and development of bones and cartilage. The adult size of a puppy is not determined by rate of growth (accelerated beyond normal), but by the genetic makeup of the puppy (in general, the size of the parents). Slower, controlled growth of the skeleton is associated with more normal development. Conversely, rapid growth has been associated with development of osteoarthritis, osteochondrosis dissecans, hip dysplasia, and metabolic bone disease in large- and giant-breed dogs [15,17]. Calcium supplements should not be given, due to the detrimental effects on bone growth, particularly in large-breed puppies. Natural supplements, such as yogurt and cottage cheese, contain excessive amounts of calcium; for example, 250 mL of yogurt contains 450 mg of Ca.

3.4. Probiotics

Puppies can be susceptible to diarrhea, particularly at weaning, or if insufficient colostrum has been ingested. In both cases, administration of probiotics, e.g. *Enterococcus faecium*, will repopulate the intestine with “helpful” bacteria for 14 d, facilitating restoration and stabilization of gut flora. Although other probiotics are available from several pharmaceutical companies, most have not undergone rigorous clinical trials and studies to prove efficacy. Yogurt contains too much calcium to be used as a probiotic; furthermore, most yogurts do not contain measurable amounts of beneficial bacteria to be considered probiotics. The probiotic should be tested to ensure stability (doesn’t revert to a pathogenic strain), and whether it survives in the gut for at least 14 d.

The microflora in the gastrointestinal tract consists of normal and pathogenic organisms. Helpful microorganisms contribute to intestinal mucosal integrity, metabolism, and immune status (both local and systemic). In addition, probiotics or live-active cultures, had beneficial effects in the host animal by improving their intestinal microbial balance. In one study, dogs fed *E. faecium* had significant increases in IgA [20]. This enhancement of the immune system in young puppies has the potential for substantial implications for improving the immune response to early vaccination, particularly against viruses such as *distemper* and *parvovirus*, which directly affect the intestinal tract.

4. Conclusions

In conclusion, feeding dogs a balanced commercial diet will provide the necessary macronutrients (protein, fat, etc.), vitamins and minerals required for reproduction. Added benefits may arise from the use of DHA-supplemented diets and from the use of probiotics to stimulate the immune system, particularly in puppies. However, oversupplementation, or supplementation in the face of adequate dietary intake, may actually cause harm in the case of certain vitamins (A and E) and minerals (calcium).

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