# Canine Reproduction and Neonatal Health

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# Care and Feeding of the Lactating Bitch

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## INTRODUCTION

For eons, mother's milk has proven to be the best food for newborns. Studies in several species have documented the mechanisms that keep milk high in nutritional value regardless of the condition of the dam.[1] These studies verify that a lactating bitch will produce a sufficient quantity of nutritious milk to support her puppies even if her condition deteriorates. For conscientious dog breeders, the challenge is to provide nutrition for the dam that will allow her to not only feed her puppies, but also to maintain her own condition.

It is normal for a bitch to lose some bodyweight during lactation but, ideally, the amount lost should not exceed 10% of her original weight.[4] It is much easier to attain this goal if the bitch is in good condition prior to whelping which usually reflects the fact that she was in good condition at mating.

Excellent nutrition, though crucial, is not the only step that breeders can take to insure a healthy dam after her puppies are whelped. Clean, dry facilities are important. Daily exercise and fresh air can make the nursing process more pleasant for the dam, too. Daily examination of the dog's mammary glands allows early detection of infection in the breasts allowing prompt treatment.

*For conscientious dog breeders, the challenge is to provide nutrition for the dam that will allow her to not only feed her puppies, but also to maintain her own condition.*

Of course, a plentiful supply of clean water is very important to the well-being of the dam. Water consumed by the bitch is important to the puppies as well because water turnover is very high in the newborn puppy.[5] This function of nursing is often overlooked by breeders. A consistent fluid intake by the puppy is required to maintain blood volume and this hydration function of milk is as important as the nutritional role.

## DOG MILK CHANGES OVER THE NURSING PERIOD

One of the fascinating features of the nursing process is the ability of milk to change over the lactation. For example, the energy content of dog milk increases steadily for the first 40 days of nursing then decreases by day 50, coinciding with the puppies' ability to eat solid food.[1] This allows an early start on shrinkage of mammary tissue to help the bitch end her milk production. Fat content in the milk varies over the lactation period as well. Early in lactation, the fat level is about 2.4%. By the middle of the nursing period, the fat level increases to about 5% then decreases to about 2.6% near weaning. Calcium is high in milk during the entire nursing period but continues to increase as weaning nears. Magnesium, iron, and zinc all vary over the lactation stage.

It is important to note that the dam's nutritional level must be very high in order to allow this normal variation of nutrients and to provide optimal nutrition for the puppies. A specific example is the so-called "toxic milk" syndrome, which can affect puppies between 3 and 14 days of age. This condition may be caused by uterine infection and/or mammary infection, but some cases respond to zinc supplements suggesting that the disorder may be due, in part, to inadequate zinc intake.[2] This example illustrates the necessity of a high nutritional plane to supply the various nutrients required by the nursing bitch.

Failure to consume colostrum during the critical period when the intestine is open to intact protein absorption seriously compromises the immune status of the neonatal puppy.[5] This occurs either through the bitch's inability to produce colostrum or the puppies' inability to nurse properly. Suitable corrective action requires the manual collection of colostrum from another bitch

or a frozen source, then provision to the puppy via stomach tube.[5]

Although much less desirable, colostrum from another species (eg, bovine) may be used. The antibodies provided by cattle colostrum may not be protective for the puppy, but other nonspecific defenses may be utilized (lysosyme, lactoferrin, and oligosaccharides).[5] These nutrients protect the puppy against bacteria by destroying the pathogen or protecting the puppies intestine against bacterial toxins.

## MILK INTAKE OF PUPPIES

Most dog breeders are unaware of the large quantity of milk produced by lactating bitches. For example, milk intake of Beagle puppies is about 5.5 ounces per day each. With an average litter of pups, a Beagle bitch will need to produce about one quart of milk per day![3] Larger breeds will be required to produce substantially more milk each day. Milk production decreases as puppies begin eating solid food, but milk alone can support normal growth in puppies up to four weeks of age.[1] Regardless, the large amounts of healthy milk required by most litters necessitates a very high level of nutrition for a successful nursing process. This fact, plus the reality that puppies are totally dependent on their mother's milk for nutrition and hydration, makes the production of large quantities of high-quality milk even more poignant.

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## FEEDING THE BITCH DURING LACTATION

Milk production is an energy-consuming process and the energy level in the bitch's food is very important to the lactation process. It is recommended that, soon after whelping, the level of metabolizable energy (ME) intake by the bitch be increased to 200% of the maintenance amount normally utilized. In other words, the bitch must eat twice the food she ate before she was bred. The intake level of ME should be increased to 300% of the maintenance level during the peak lactation period 3–4 weeks post-whelping (For further information, see chapter by R.L. Kelley in this proceedings, pages 9 to 14.)

Many bitches cannot consume enough calories to insure adequate milk production and the maintenance of her body condition in one or two meals per day. Total food quantity should be divided into four or more servings per day to make the total ME more available to the female. In addition, dog foods with minimum levels of 430 kilocalories ME/cup should be utilized to insure energy density and adequate calories in small quan-tities of food.

Often, the easiest method of providing this large number of calories plus the high digestibility required of the lactating bitch is to offer a "performance" type dog food. Designed for hard-working dogs, these foods have very high energy levels in a dense, highly-digestible matrix. The best choice uses fat as the primary energy source. Since fat has over twice the calories per gram as carbohydrates, this allows the nursing mother to get large quantities of energy in a few bites of food. These "performance" foods also have a balanced formula that will supply the nutrients needed as the bitch's milk changes over the nursing period. Note that the best way to compare foods is based on this "percentage of calories method." Dogs eat to get calories so the most accurate measurement is via a percentage of the calories in a food.

*"Performance" foods also have a balanced formula that will supply the nutrients needed as the bitch's milk changes over the nursing period.*

When a highly-digestible, performance food *(Table)* is fed to a nursing bitch, no supplements will be required. Overall, this is the simplest, least expensive method of feeding the lactating bitch and provides optimal nutrition for the dam.

**CHARACTERISTICS OF A PERFORMANCE FOOD SUITABLE FOR THE LACTATING BITCH**

| | |
|---|---|
| Energy Density | 4500 kcal ME/kg or greater |
| Fat | 50-65% of calories* |
| Protein | 30-35% of calories, meat source* |
| Carbohydrate | 10-15% of calories |
| Fiber | 3% to 7% of a moderately fermentable fiber source |
| Fatty acid ratio (omega-6:omega-3) | Between 5:1 and 10:1 |

*Label values for guaranteed analysis will be a minimum of 20% fat and 30% protein

## DISEASES OF THE LACTATING BITCH

Early detection of post-whelping disorders is very important and may save the life of the bitch and pups. There is a wide range of diseases and problems that can occur shortly after whelping, some of which resolve without treatment, while others require heroic surgery. In addition, these conditions can occur as early as several days

before whelping (eg, eclampsia) to several weeks after the pups are born (eg, uterine problems).

The astute and careful breeder is very observant of the bitch's demeanor and appetite. Although it is not unusual for a bitch with newborn pups to eat a scanty amount of food for the first week, failure to eat a normal amount of diet for longer than 7 days suggests problems. If the bitch fails to eat, even during that first week, the owner should carefully examine her for other problems such as fever, foul-smelling vaginal discharge, pale gums, or dehydration. Ideally, the bitch's temperature should be taken daily for the first week after birth. Elevated temperature may indicate uterine infection, mammary gland infection, or low blood calcium. The milk should be examined daily for abnormalities. If any question exists in the breeder's/owner's mind, the bitch should be presented to the veterinarian for evaluation.

Breeders often ask the veterinarian to administer an oxytocin injection after whelping as a "clean-out" shot. Normally, oxytocin need not be given if the bitch is nursing since nursing stimulates the pituitary gland to release oxytocin. However, it may be desirable to administer oxytocin to bitches whose pups were born dead or were removed from the mother at birth.[6]

## UTERINE INFECTIONS

Bacterial infections of the bitch's uterus may be associated with retained afterbirths, decomposed pups in the uterus, or a prolonged whelping. Since the cervix is open during and after whelping, bacteria have access to the uterine vault and they flourish on the devitalized tissues therein. If left untreated, uterine infection can lead to septicemia and toxemia.

*If left untreated, uterine infection can lead to septicemia and toxemia.*

Typical signs of uterine infection are high fever (103.5° to 105° F), failure to care for the pups, and a foul-smelling reddish-brown discharge from the vulva. While it is normal to see a greenish discharge (lochia) for up to 3 weeks, this material is not malodorous nor is there a fever present. A veterinarian should examine bitches with suspected uterine infections as soon as possible.

## MAMMARY GLAND INFECTIONS

Infections of the mammary gland (mastitis) can involve just one gland or several. Since the canine teat has several duct orifices (between 7 and 22),[7] infections can be localized in one area or spread from gland to gland. In addition, mastitis can be acute and life threatening or almost without symptoms, except for loss of a number of pups.

Normal canine milk, when expressed from the teat, may be yellowish to white. The yellow tint is apparent early in lactation, due to the high concentration of colostrum in that early milk. Owners should exercise immaculate hygiene when examining the milk since bacteria on the hands can enter the teat orifice and instigate the infection process.

*Bitches that appear to have mammary gland infections should be presented to the veterinarian for appropriate antibiotic therapy.*

Milk from bitches with mastitis can vary in color from white to greenish-yellow. Severe cases may even have a blood tinged appearance to the milk and the gland can become swollen, hot, and have a bruised appearance. Neglected cases can abcess, with open drainage of pus evident. Bitches that appear to have mammary gland infections should be presented to the veterinarian for appropriate antibiotic therapy.

One difficult decision concerning mastitis involves letting the pups continue to nurse while the mother's mammary glands are infected. Ideally, pups should be removed from bitches with infected mammary glands, but since most cases of mastitis occur when the pups are less than two weeks of age, to remove the pups and begin hand rearing may require the litter to be fed every 2 to 4 hours. This requires a substantial commitment on the part of the owner/breeder. If mastitis is diagnosed after the pups are two weeks old, hand feeding frequency can be reduced to every 4 to 6 hours and the commencement of feeding solid food can begin as early as 3 weeks.[6]

Chronic mastitis in the bitch can occur, even if the only symptom exhibited is that the puppies are not

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thriving. The incidence of this condition in the dog is currently unknown. Regardless, bitches diagnosed with chronic mastitis require aggressive antibiotic therapy. Unlike acute mastitis, chronic cases may require the use of special medicines that will cross the barrier between the blood and milk.

## GALACTOSTASIS

This condition occurs when milk is not removed from the mammary gland promptly. Galactostasis normally occurs in bitches with small litters or when pups utilize only one or two teats. The condition can also occur as a result of a false pregnancy. As long as there is no inflammation and infection, galactostasis is not usually serious.[6] However, a bitch with this condition is often very uncomfortable. The breeder/owner can provide her some relief by applying cool towel compresses. The veterinarian may prescribe diuretics or pain alleviating drugs. Reduction in food can lead to lowered milk production and aid the bitch with galactostasis. Milking the affected glands may actually lead to increased milk production.

## AGALACTIA (LACK OF MILK)

Agalactia is the condition where the mammary glands do not produce sufficient milk. Most cases are secondary to inadequate nutrition, stress, mastitis, uterine infection, psychological problems, or other diseases.[6] Rarely, bitches suffer from a genetic primary agalactia, which will not respond to therapy. These bitches have a defect in their ability to respond to the hormones of milk production or a congenital defect in the mammary gland itself.

A young, nervous bitch may suffer from psychological agalactia. She will often respond if the breeder/owner spends time trying to reassure and calm her; in some cases, tranquilization may be necessary.[6] An oxytocin nasal spray has been used in these anxious bitches to encourage milk letdown.

Other causes of failure to produce milk may be yet determined. For example, some infections, especially those due to the mycoplasma group of organisms, may be implicated. Research done to evaluate causes of agalactia in other species, such as swine and goats, may offer evidence to help bitches overcome the condition in the future.

## FAILURE OF THE UTERUS TO INVOLUTE

Subinvolution of the placental sites (SIPS) is often implicated when the uterus fails to return to its normal size and shape by 15 weeks after whelping. More common in the young bitch, often the only evidence of SIPS is a bloody discharge from the vagina for several weeks after whelping. Since it is normal for a greenish discharge to be present for up to 3 weeks after whelping, the blood-tinged portion may be obscured for that period of time. The presence of a blood-tinged discharge along with the ability to still feel an enlarged uterus at 12 weeks after whelping is suggestive of SIPS. Since many cases eventually result in spontaneous remission, many of these bitches will not require therapy.[6] However, if the amount of blood is substantial or the veterinarian determines other problems (perforation of the uterine wall) ovariohysterectomy may be required.

## ECLAMPSIA

Low blood calcium is the result of reduction of calcium levels outside the cells of the bitch's body. Signs of eclampsia are nervousness, fever, dry mouth, panting, restlessness, tremors, staggering, stiff gait, and eventually, collapse with seizures and labored breathing. Death can occur if eclampsia is left untreated. While the condition can occur prior to whelping, it is much more common after the birth of the pups. As the demand for milk increases, the likelihood of eclampsia escalates. Normally, by 40 days after whelping, the danger of eclampsia has passed. Small breeds are more likely to have eclampsia, but litter size does not affect the incidence of the disease.[6] Treatment involves intravenous injection of a calcium solution and should begin as soon as possible after the diagnosis has be determined.

*Prevention of eclampsia is based on solid nutrition using a diet suitable for the pregnant and lactating bitch.*

Prevention of eclampsia is based on solid nutrition

using a diet suitable for the pregnant and lactating bitch (see also chapter by R.L. Kelley, *Factors Influencing Canine Reproduction and Nutritional Management of the Pregnant Bitch*). The addition of calcium supplements or diets excessively high in calcium may exert a negative biofeedback on the secretion of hormones by the parathyroid glands that control calcium metabolism. This effect can cause a decrease in both the body's capabilities to mobilize calcium stores from bone and its ability to increase calcium absorption in the intestine. When calcium is suddenly needed for lactation, the body's regulatory mechanisms are unable to adapt quickly enough to the sudden calcium loss. Since calcium is diverted to milk production, the bitch's blood calcium levels decrease. Although a direct link between high dietary calcium and resultant eclampsia has not been made in the bitch, it seems prudent to avoid calcium supplements in pregnant bitches.[8]

## CONCLUSIONS

The complexity of diseases that affect the bitch soon after whelping makes it imperative that the veterinarian be aware of even subtle changes in the new mother's condition. It is better to contact the professional about a minor problem than to delay and court catastrophe.

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# Factors Influencing Canine Reproduction and Nutritional Management of the Pregnant Bitch

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## INTRODUCTION

The ultimate goal of any mating is to produce viable offspring for the propagation of the species. In the bitch, reproductive success should be defined as the generation and weaning of an adequate size litter of healthy viable puppies reflecting the genetic potential of both the dam and sire. To achieve this goal, the breeder will be required to not only select the proper breeding stock, but also to develop a plan by which the stock will be managed. While the basis of the program must be applicable to an entire kennel, it must also have some degree of flexibility to meet the needs of each individual bitch.

When developing a new program or attempting to upgrade an existing breeding program, there are several questions that should be addressed. One of the most critical questions the breeder must answer is "What are my expectations?" To answer this, the breeder must understand that several factors can influence various components of canine reproduction, including litter size. These factors include the bitch's breed, age, and health, the type and quality of semen used for the mating, as well as her plane of nutrition. At first glance, these various influences may appear independent in nature; however, there is a common association. The breeder controls all of them to some degree. Within the breeding program, the breeder decides which bitches are bred, which sires are selected, at what age a bitch will be bred, what type of mating will be employed, and lastly, which and how much food will be fed. These are all critical questions that must be answered since the successful weaning of a litter is probably the most demanding and stressful act that the bitch will experience as an adult.

## FACTORS INFLUENCING REPRODUCTION:

### Breed

Although is has long been recognized that a bitch's breed will influence how many puppies she is expected to produce, there continues to be a lack of information on what is the typical litter size within a given breed. Therefore, we obtained records (728,271 litters) spanning a 3-year period for 15 popular breeds from the American Kennel Club (AKC). Each record contained the litter number, breed code, number of males born, number of males registered, number of females born, number of females registered, mating type of litter (natural, fresh semen, fresh extended semen or frozen semen) and age of bitch when bred. Unfortunately, the records do not indicate the number of puppies that the bitch weaned. Therefore, we were not able to determine if the discrepancy between the number born and the number registered was due to a failure to thrive, substandard quality, or sold with registration agreement (pet only). Practically speaking, it was probably a combination of all the factors. The breeds and the number of litters (in parenthesis) examined were the Labrador Retriever (85113), Poodle (69755), Dachshund (59935), Pomeranian (56976), Chihuahua (55513), Yorkshire Terrier (53141), Shih Tzu (48667), Rottweiler (46805), German Shepherd Dog (44537), Beagle (42823), Cocker Spaniel (39019), Golden Retriever (38233), Miniature Schnauzer (32235), Shetland Sheepdog (28421), and Boxer (27098).

The "typical" litter size for a breed is often difficult for the breeder to obtain. Numerous resources simply report the "average" litter size for a breed. While this practice provides the breeder or veterinarian with a rough number, a simple mean cannot convey the amount of variation for that breed. A good example of this would be the Labrador Retriever. The majority of publications indicate that a Labrador Retriever bitch should whelp 7 or 8 puppies per litter. While 7 to 8 puppies would be accurate with regard to the breed average (7.6), litters of 7 or 8 puppies only accounted for 30% of the Labrador Retriever records in our database.

A more practical method for determining what is a typical litter would be to define in whole numbers a range encompassing the mean ± 1 standard deviation as "typical" and any litter outside that range as "atypical". Using this method for the Labrador Retriever, the typical litter size would be listed as ranging from 5 to 10 with a mean of 7.6 ± 2.6 puppies. This range would account for approximately 75% of all litters and would allow for a more accurate management plan to be developed for the bitch and her whelps. The use of the mean ± 1 standard deviation method has been found to account for at least 70% of all litters in the breeds tested to date. The typical litter sizes for each of the breeds examined are presented in *Table 1*.

**Table 1.** *Typical litter size in various canine breeds*

| Breed | Mean ± SD | Typical[a] Litter Size Range | % of Litters[b] Accounted For | Most Frequent Litter Size | |
|---|---|---|---|---|---|
| | | | | Litter Size | Percentage |
| Beagle | 5.0 ± 2.1 | 3 – 7 | 74.32 | 5 | 17.67 |
| Boxer | 5.8 ± 2.4 | 4 – 8 | 68.63 | 6 | 16.17 |
| Chihuahua | 3.3 ± 1.5 | 2 – 5 | 80.72 | 3 | 23.99 |
| Cocker Spaniel | 5.0 ± 2.0 | 3 – 7 | 76.71 | 5 | 18.62 |
| Dachshund | 3.9 ± 1.6 | 2 – 6 | 87.18 | 4 | 24.04 |
| German Shepherd Dog | 6.6 ± 2.7 | 4 – 9 | 70.78 | 8 | 14.08 |
| Golden Retriever | 7.6 ± 2.7 | 5 –10 | 74.17 | 8 | 16.17 |
| Labrador Retriever | 7.6 ± 2.6 | 5 – 10 | 75.55 | 8 | 16.54 |
| Miniature Schnauzer | 4.6 ± 1.8 | 3 – 6 | 72.01 | 5 | 21.01 |
| Pomeranian | 3.0 ± 1.4 | 2 – 4 | 71.48 | 3 | 26.90 |
| Poodle | 3.4 ± 1.8 | 2 – 5 | 77.94 | 3 | 25.01 |
| Rottweiler | 6.6 ± 2.9 | 4 – 10 | 73.75 | 7 | 12.44 |
| Shetland Sheepdog | 4.3 ± 1.9 | 2 – 6 | 81.12 | 4 | 20.03 |
| Shih Tzu | 4.1 ± 1.6 | 2 – 6 | 87.63 | 4 | 23.69 |
| Yorkshire Terrier | 3.3 ± 1.5 | 2 – 5 | 79.20 | 3 | 24.08 |

[a]Defined as the whole number range of the mean ± 1 standard deviation.
[b]Percentage sum of all litters within the defined typical range

## FACTORS INFLUENCING REPRODUCTION:

### Age

One of the most commonly asked questions with regard to canine reproduction is "How long can I breed my bitch?" Theoretically, the answer is "As long as she will conceive." However, this does not mean that the bitch should be bred or if bred that she will perform at a normal level. Past efforts have demonstrated that parity number influences litter size in the Beagle bitch.[1] Overall, the Beagle bitch was found to have her largest litters in her second and third parities, with slightly smaller litters in the first and fourth parties and significantly smaller litters beyond the fourth parity *(Figure 1)*. However, the focus of that study[1] was the impact of parity number, not age. In practice, it is much easier to account for effects of age than parity since one can choose at what age to first breed a bitch, but cannot increase the parity number without also increasing age.

Analysis of the aforementioned AKC database, which was independent of parity number, demonstrated that litter size is influenced by the bitch's age in almost all of the tested breeds. In general, larger breed bitches declined in their reproductive performance at a younger age than did the smaller breed bitches. This observation is logical, since larger breeds generally have shorter life expectancies. For reporting purposes, we defined the "apparent critical age" as the age in years where the average litter size for a breed declines at least 15% below the breed average. The findings for each breed analyzed is shown in *Table 2*.

The age at which bitches produce the largest litters ranged from as low as 1–2 years of age for the Boxer to as high as 1–7 years of age for the Yorkshire Terrier. Several of

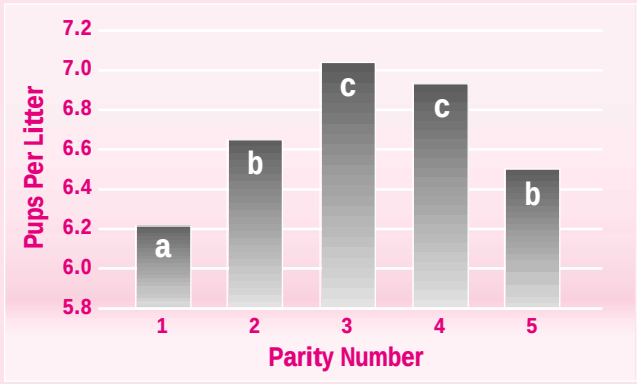


**Figure 1.** *Effect of parity on litter size in the Beagle bitch. Bars with different superscripts significently different (P<.05)*

**Table 2.** *Age-associated effects on canine reproduction across breeds*[a]

| Breed | Age of Peak Litter Size[b] | Apparent Critical Age[c] |
|---|---|---|
| Beagle | 2 – 3 | 6 |
| Boxer | 1 – 2 | 5 |
| Chihuahua | 1 – 4 | 10+ |
| Cocker Spaniel | 1 – 3 | 6 |
| Dachshund | 1 – 4 | 8 |
| German Shepherd Dog | 1 – 3 | 5 |
| Golden Retriever | 1 – 3 | 5 |
| Labrador Retriever | 1 – 3 | 5 |
| Miniature Schnauzer | 2 – 3 | 6 |
| Pomeranian | 1 – 4 | 10+ |
| Poodle | 1 – 5 | 9 |
| Rottweiler | 1 – 3 | 5 |
| Shetland Sheepdog | 1 – 4 | 8 |
| Shih Tzu | 1 – 4 | 8 |
| Yorkshire Terrier | 1 – 7 | 8 |

[a]Age reported in years
[b]Based on the reported number of puppies born
[c]Critical age defined as year when litter size declines ≥15% below breed average

the larger breeds were found to have an apparent critical breeding age of 5 years, including the Labrador Retriever, Rottweiler, German Shepherd Dog, and Golden Retriever. In contrast, an apparent critical age was not detected for the Pomeranian and Chihuahua breeds, reported as 10+ years since only bitches 10 years and younger were included in the analysis (>99.5% of the total records). An interesting point of this observation was that the Pomeranian and Chihuahua were found to produce some of the smallest litter size averages at 3.0 ± 1.4 and 3.3 ± 1.5 pups per litter, respectively. The lack of an observed apparent critical age for these breeds does not imply that Pomeranian and Chihuahua bitches should be bred at 7 to 10 years of age. Both breeds were found to produce their largest litters between 1 and 4 years of age. Beyond 4 years of age, litter size did numerically decline, however, never achieved the qualifying level of ≥15%. It remains unknown how the age of the bitch at breeding will affect the health of the bitch and her puppies. Although the reason remains unknown, it should be noted that the percentage of puppies registered for a litter from a bitch older than 7 years old was dramatically reduced in almost all the breeds examined.

## FACTORS INFLUENCING REPRODUCTION: Mating Type

Another key decision that a breeder must make prior to a bitch's estrus is what type of service will be used to achieve the wanted pregnancy. There are two basic choices, a natural service or the use of artificial insemination (AI).

The vast majority of canine litters are produced by natural matings. However, the use of AI has been dramatically increasing over the past few years. At present, it is unknown what the exact percentages are for natural verses AI, however, it would be safe to assume that less than 5% of all litters are produced through the use of AI. Analysis of the AKC database (described earlier) revealed that less than 0.5% of the 728,271 litters were reported as being produced by AI. The highest percentages of AI produced litters were reported in the Labrador Retriever (1.01%), Shetland Sheepdog (0.97%), and the Golden Retriever (0.93%).

Despite the increasing popularity of AI, it remains unknown if litter size is affected. To address this question, we analyzed the previously described AKC database for puppy number accounting for mating type. Depending on breed and semen type, litters produced by AI were reduced as little as 2% and as much as 49% when compared to litters produced by natural service. Across all breeds, litter size was reduced by approximately 15% when produced by fresh or chilled extended semen and by 25% when produced by frozen semen relative to natural service produced litters *(Figure 2)*. While this data suggest that litter size is reduced when AI is utilized, extreme caution must be taken with this interpretation. There are several factors that we were unable to account for including: 1) were precautions taken to predict when the bitch ovulated, 2) were all or a subpopulation of the AI litters produced by bitches with a history of reproductive complications, and 3) what percentage of the AI breedings were performed professionally versus by the novice hand. In addition, the number of observations for the two mating types was extremely unbalanced — less than 0.5% of all observations were reported as AI produced. Perhaps there will be definitive information forthcoming in the near future to resolve if the reduction in litter size by AI matings is real.

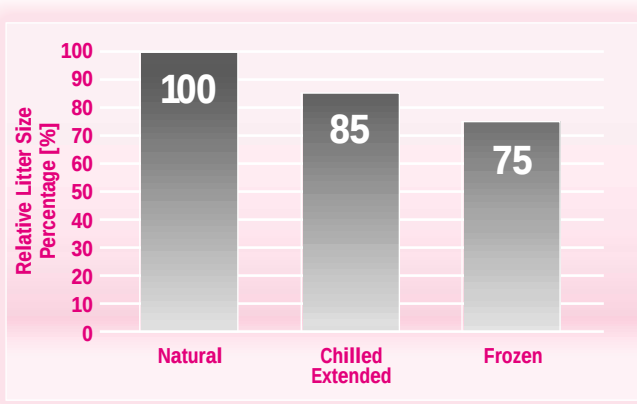


**Figure 2.** *Effect of semen type on relative litter size in the bitch.*

## FACTORS INFLUENCING REPRODUCTION: Nutrition

Nutrition has long been recognized to influence the reproductive success in the bitch. Campbell and Phillips[2] and Ontko and Phillips[3] provided some of the earliest insight into the specialized nutritional requirements for the reproducing bitch. In both studies, diets known to be sufficient for canine growth and maintenance were found to be inadequate for reproduction. Collins[4] concluded that the stress associated with reproduction would manifest even the smallest of nutrient inadequacies in diets assumed to be complete. These dietary inadequacies may not be severe enough to inhibit the bitch from reproducing, however, they most likely will prevent her from performing at her genetic potential. Should the bitch's diet fail to meet her required nutrient levels, she will respond by mobilizing nutrients from body fat, muscle, and skeletal tissue. In extreme cases, her body's only solution may be to reduce the demand by decreasing the number of offspring or aborting the pregnancy all together. Further, since deficiencies in maternal nutrition in other species have now been associated with adult disorders in progeny,[5] it is essential that we understand and optimize maternal nutrition.

While it is often easy to recognize malnourishment, the distinction between dietary sufficiency and optimal

nutrition can be vague. It is also critical to remember that optimal nutrition for the bitch expands beyond her maintenance. In addition to her body's maintenance, optimal nutrition will supply all nutrients required for the growth of her reproductive tissues and for the growth and development of her puppies. To meet these demands, the bitch has two nutrient sources — her diet and mobilizing her body stores. Required nutrients would include all of the essential amino acids and the essential fatty acids (functional components of cellular membranes and the endocrine system) as well as various vitamins and minerals.

However, this is not to imply that one should simply switch to a diet with the highest available nutrient (protein or energy or both) content or use various dietary supplements to enhance a food. Excess nutrition can be as detrimental as nutrient deficiencies. Excess dietary energy can often contribute to extreme maternal weight gain, which dramatically increases the chance of dystocia during parturition. The use of dietary supplements can supply excessive amounts of nutrients such as minerals, thus altering the balanced dietary matrix of the diet. The key to optimal nutrition is supplying a food that has a balanced nutrient profile at levels that meet the animal's need. As Mosier[6] stated in 1977, "only by feeding well-managed balanced diets can the health of an individual be maximized". Components within the dietary matrix that should be considered are not only the level of protein, fat, carbohydrate, vitamins and minerals, but also the type of protein and fat and the ratio of nutrients, such as protein to fat.

## NUTRITIONAL MANAGEMENT DURING PREGNANCY

### Pre-Breeding

Prior to any mating, the breeder should take every precaution to ensure that the bitch is in ideal health. This includes not only being current on all vaccinations and free from infections and parasites, but also in optimal physical condition. Animals should be exercised and maintained on a diet that matches energy needs relative to energy output. An important note to remember is that the reproductive process does not begin at mating, but several weeks prior to the mating process when ovarian follicles are being recruited for the upcoming cycle. Because of this, it is important that the breeder not confuse optimal physical condition with athletically finished. The breeding bitch should have evident muscle tone, but also have a slight degree of body fat. This body condition will help promote a healthy endocrine system that will influence the degree of reproductive success.

### What to Feed?

As mentioned earlier, nutrition has long been recognized in numerous publications as an influential factor in bitch reproduction.[4,6-13] Often, the recommendations from these references are generally vague, suggesting only to feed a high-quality food with sufficient energy for reproduction. There are a few publications[4,6,10] that have addressed the effect of certain nutrient classes on canine reproduction. Generally speaking, however, past research has directed little effort to defining "quality" or to the role of specific nutrients in canine reproduction. Additionally, there has been a severe lack of studies designed to separate diet sufficiency and "optimal nutrition". There are numerous diets, both commercially available and home recipes, that are sufficient for reproduction. This merely means that animals were able to reproductively perform within expected levels while consuming a defined diet. Unfortunately, these expected levels are often well below the level that the bitch is genetically capable of performing.

Again you may ask, "what should I feed?" First and foremost, select a commercially available premium food with animal-based protein sources that is recommended for gestation and lactation and manufactured by a reputable company. While there are many "home based" diet recipes circulating, it is extremely difficult to achieve a complete and balanced diet using these recipes. These diets can often be deficient in vitamins, minerals, or other nutrients and are undefined with regard to amino acid and fatty acid levels. They may also vary over time due to an inconsistent ingredient supply. Commercial formulas offer distinct advantages by allowing the breeder to feed a product of known nutrient content and type proven to support the reproductive process.

Approximately two weeks prior to breeding, the bitch should be transitioned (if necessary) from her maintenance diet to a diet comprised of approximately 30% highly digestible animal-based protein and 20% fat. The fat portion of the diet should be balanced for fatty acid content to supply an omega-6 to omega-3 fatty acid ratio in the range of between 5:1 and 10:1.

Findings from a recent study conducted by The Iams Company comparing three diets demonstrated positive benefits of feeding this dietary matrix (Eukanuba® Premium Performance Formula).[1] When fed throughout the reproductive cycle, this diet resulted in fewer misconceptions, a reduced number of stillbirths and more consistent-sized litters from breeding to breeding.[1] The exact amount of food required will vary depending on breed and metabolic rate; however, the level of intake should be closely monitored to target a caloric intake similar to maintenance levels, thus avoiding overfeeding the bitch.

### Pregnancy

During the first 4 weeks of pregnancy, the breeder should continue to feed the bitch the above mentioned 30% protein / 20% fat diet at maintenance levels. It is

possible that you may observe a change in the bitch's appetite at approximately 3 weeks post-breeding, first decreasing followed by a dramatic increase. This, however, may not indicate that you are overfeeding or underfeeding the bitch. This period of pregnancy parallels maternal recognition of pregnancy and embryonic implantation that may trigger these appetite changes. It is very important that the bitch be maintained on her normal routine during this period to prevent any undue stress, which could be detrimental to the pregnancy.

At approximately 5 weeks post-breeding, the food intake of the bitch should be increased slightly each day to achieve a 50% increase in energy by the end of week 6 *(Figure 3)*.[14] For example, if the bitch is consuming 1,000 calories/day for maintenance, by the end of week 6, she should be consuming approximately 1,500 calories/day. One can generally obtain this information from the product manufacturer. It will be necessary to closely monitor the bitch for weight gain during the later stages of gestation to ensure that she is gaining sufficient weight. It is impossible to give an exact percentage of weight that a bitch should gain since the increase will vary greatly from breed to breed, even within similar adult sizes. For instance, one might expect a Golden Retriever to gain more weight than a German Shepherd on average since they typically give birth to larger litters. However, a good rule of thumb would be to target a 25% weight gain in the bitch by the end of week 8 (d 56) post-breeding *(Figure 4)*.

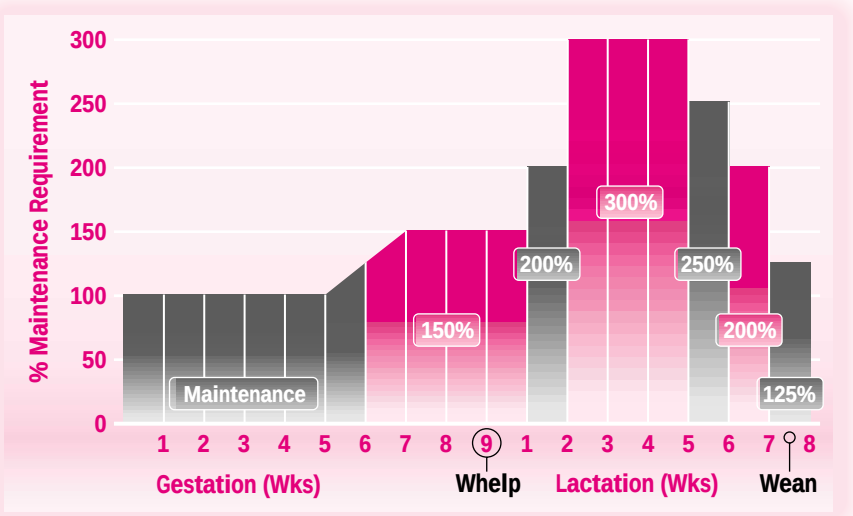


**Figure 3.** *Metabolizable energy requirements of the bitch. Adapted from Lepine AJ. Feeding management of the reproductive cycle, in Proceedings. Canine Reproductive Health Symposium at the 1997 North American Veterinary Conference; 27-29.*

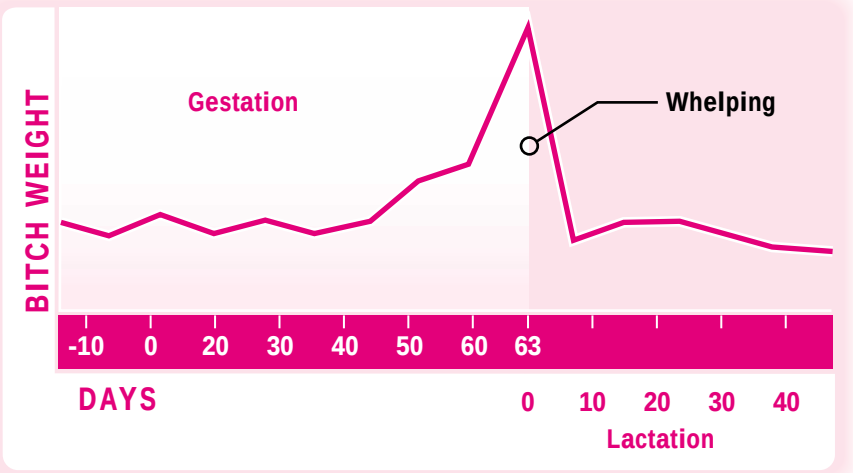


**Figure 4.** *Weight changes during reproduction in the bitch. Adapted from Lepine AJ. Feeding management of the reproductive cycle, in Proceedings. Canine Reproductive Health Symposium at the 1997 North American Veterinary Conference; 27-29.*

## Dietary Supplements

The use of dietary supplements for the gestating bitch has been the topic of many debates. Numerous publications have hinted at the benefits of nutrient supplementation.[2,3,10] Some of the most commonly mentioned nutrients include protein, calcium, and vitamins. In practice, the only reason to utilize dietary supplements is when the diet fails to supply the needed amount of a given nutrient. However, the theory of supplementation is often much easier than putting it into practice. The majority of currently available commercial foods are formulated to provide a well-balanced supply of various nutrients, with "balanced" being the key word.

A critical point to remember is that *nothing can be added to or taken away from a diet without affecting the overall nutrient profile*. One should also remember that few supplements are pure sources of a given nutrient. For example, cottage cheese (for calcium) and liver (for protein) are two commonly used diet supplements for the breeding bitch. However, since neither of these foods is composed of a single nutrient, the net result is that more than just the desired nutrient is delivered. For example, both cottage cheese and liver add large quantities of phosphorus. In fact, cottage cheese adds more phosphorus than calcium, the targeted nutrient *(Table 3)*. Thus if incorporated into the diet, the calcium to phosphorus ratio of the diet will be altered.

**Table 3.** *Effect of dietary supplements on the nutrient balance of a commercial diet*[a]

| | | ALTERED NUTRIENT LEVEL BY ADDITION OF | | |
|---|---|---|---|---|
| Nutrient | Amount of Nutrient Provided By Feeding 300 grams of Dry Diet[a] | ½ cup Cottage Cheese | 3 oz. Beef Liver | 100 g Extra Dry Diet |
| Protein (g) | 93 | 106 | 115 | 124 |
| Fat (g) | 63 | 67.5 | 67 | 84 |
| Calcium (mg) | 3500 | 3563 | 3509 | 4700 |
| Phosphorus (mg) | 2900 | 3080 | 3305 | 3850 |
| Ca:P (ratio) | 1.2:1 | 1.15:1 | 1.05:1 | 1.2:1 |

[a]Based on the average analysis of Eukanuba® Premium Performance, guaranteed to contain 30% protein, 20% fat and 4452 kcal ME.

While the intention is good, it is important not to confuse an increase in the level of nutrition required with a need to change the diet profile. The bitch does require that nutrient intake be increased during the latter phase of pregnancy and lactation, however, the increase does not mean that the diet profile should be altered. It is critical to remember that during these periods, the bitch will be consuming a greater volume of food, which will increase her nutrient intake but maintain dietary balance with regard to the formulation *(Table 3)*.

## CONCLUSIONS

Feeding your bitch does not have to be complicated. While the science associated with nutrition and reproduction may require years to understand, the actual practice of providing nutrition can be summarized fairly simply, *feed the appropriate amount of a diet that meets the animal's needs*. While this practice still requires the breeder to make evaluations as to the exact diet that will be fed, it does eliminate questions such as to what mix of products and/or supplements must be utilized.

Based on our efforts in the area of canine reproduction, the greatest success has been achieved feeding a diet, such as Eukanuba® Premium Performance Formula, consisting of approximately 30% protein (animal-source based) and 20% fat with an omega-6:3 ratio of 5:1 to 10:1. The benefits of feeding this formula have included increased conception rate and live births and more consistent maternal productivity. While nutrition is only one component of bitch management, it is one of the most (if not the most) important. Thus by providing the proper nutrition, the breeder has taken a great step forward in achieving a successful breeding program.

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# The Influence of Diet on the Puppy's Developing Immune System

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## OVERVIEW OF THE IMMUNE SYSTEM

In all mammals, the body has various defenses against invading disease agents (pathogens), ranging from non-specific to specific. Non-specific physical barriers, such as skin and mucous membranes, protect against the initial entry of pathogens such as bacteria, viruses, and parasites. However, once those barriers are overcome, a functional immune system is required to mount a specific response to protect and clear the body from infection. The immune system is an intricate network of specialized and interacting tissues, organs, cells, and chemicals.

Immunity can be innate (inherent) or acquired. Puppies and other mammals including humans are born with innate immunity, which consists of both cellular and chemical defense mechanisms that rely heavily on detection of the difference between invading microorganisms and what is considered "self" or part of the individual's body. When invaders are detected, enzymes that can digest bacterial cell walls are activated, and cells that recognize these invading microorganisms and destroy them are deployed. This response is specific and does not require priming, but is slow and usually not sufficient to clear the body of a pathogen. Rather, it serves to contain the infection until the next level of defense — known as acquired immunity — develops.

Acquired immunity is a complex, sophisticated system that can rapidly develop a specific response against invading pathogens. It can be divided into the following two components: cell-mediated and humoral immunity. Cell-mediated immunity includes both T and B cells (lymphocytes) and their interactions. These blood cells recognize foreign invaders by their protein (antigen) makeup and through cell to cell interactions and cytokine release (soluble immune mediators), result in production of additional T and B cells (proliferative response). These cells are then responsible for sustaining the immune response, destroying the invading pathogen and infected cells, and terminating the immune response once the infection has been cleared. As well, some cells survive that are known as memory cells. In the event of another attack by the same pathogen, the immune system is able to respond much more rapidly and vigorously as a result of these memory cells.

*Acquired immunity is a complex, sophisticated system that can rapidly develop a specific response against invading pathogens.*

Humoral immunity is also referred to as the antibody-mediated immune response. When an invading pathogen has been recognized, antigen-specific B cells proliferate and are transformed into antibody-secreting cells (plasma cells). Antibodies are blood-borne immune proteins (immunoglobulins) that are able to bind specifically with infected cells, as well as free microorganisms, which lead to their destruction. There are five different immunoglobulin isotypes (IgG, IgA, IgM, IgE, and IgD). The two isotypes most common in serum are IgG and IgM. As with T cells, memory B cells remain after the infection to produce specific antibodies if the same pathogen is detected.

## NEONATAL IMMUNITY

When puppies are born, they emerge from a sterile environment (the uterus) to become exposed to a host of microorganisms, all of which are potentially pathogenic. Unfortunately, the immune system is not fully functional and developed for some time after birth. As a result, newborn puppies are especially vulnerable to infection in the first few weeks of life and require immune assistance in order to survive. This assistance is provided by the mother, via transfer of immune cells and immunoglobulins through the colostrum and milk, and immediately confers

some level of immune protection for the newborn. This transfer of immunity from mother to newborn is essential for the newborn's survival.

The immune system then requires time to develop to its fully functional capacity. Both the distribution of immune cell types and their responses have been reported to change as puppies and kittens grow and develop.[1] T cell populations are significantly smaller and their proliferation response to an antigen is less in neonatal canines, compared with that in adult dogs.[2,3] By 16 weeks of age, however, puppies have lymphocyte populations that appear similar to those of healthy adult dogs.[3,4]

Although our understanding of how and when the canine neonate immune system matures is incomplete, much of what we do know is related to the ability of the puppy to respond to vaccination. Studies have shown that puppies are able to develop a specific immune response to vaccination, similar to the adult response in character but of lower magnitude, within the first 24 hours after birth,[5] and even when maternal antibodies were also present.[6] These studies demonstrated that neonatal puppies possess both a functional B cell and T cell system.

*The condition of the immune responses of young puppies is an important consideration for breeders and veterinarians as they try to protect these animals against infectious disease.*

The condition of the immune responses of young puppies is an important consideration for breeders and veterinarians as they try to protect these animals against infectious disease. Vaccinations are critical to this protection. The purpose of vaccinations is to stimulate humoral (antibody) and/or cellular immune responses to an antigen and generate an appropriate immune memory so that subsequent exposure of the animal to an infectious agent will not result in disease.

Because nursing puppies are protected against disease by the antibodies they receive from their mother and because their immune responses are immature, the vaccination process is usually begun at weaning and continued until the transferred (maternal) antibodies are gone and the puppy's immune responses are more durable. In practice, this translates to administering the first set of vaccinations at 6–9 weeks of age and giving boosters every 3–4 weeks until the animal is about 16 weeks *(Table)*. For animals that have not received colostrum or maternal milk, vaccinations can be given as early as 2–3 weeks of age and continued every 3–4 weeks until they are 16 weeks old. A notable exception is rabies vaccines, which confer longer-lasting immunity and are not given until 12 weeks or as indicated by local law. Owners and breeders should discuss vaccination strategies with their veterinarian to obtain specific recommendations for their animals.

**Table.** *Vaccination recommendations for dogs (Source: American Veterinary Medical Association)*

| Disease | Age at 1st vaccination (wks) | Age at 2nd vaccination (wks) | Age at 3rd vaccination (wks) | Revaccination interval (mo) |
|---|---|---|---|---|
| Distemper* | 6–10 | 10–12 | 14–16 | 12 |
| Hepatitis* | 6–8 | 10–12 | 14–16 | 12 |
| Parvovirus* | 6–8 | 10–12 | 14–16 | 12 |
| Parainfluenza* | 6–8 | 10–12 | 14–16 | 12 |
| Coronavirus* | 6–8 | 10–12 | 12–14 | 12 |
| Leptospirosis* | 10–12 | 14–16 | — | 12 |
| Bordatellosis | 6–8 | 10–12 | 14–16 | 12 |
| Rabies | 12 | 64 | — | 12 or 36, depending on vaccine |

* Can be combined in one vaccination

## NUTRITION AND IMMUNE FUNCTION

Interactions between nutrition and immunity have been well documented. Diets deficient in protein, energy, minerals, vitamins, and essential fatty acids have long been known to impair immunity.[7] More recently, supplementation above and beyond the required levels has been reported to be successful in improving health and immune function in a wide range of species. One group of nutrients that has attracted special interest for enhancing immune function is known as antioxidants.

Antioxidants are thought to benefit immune function by their effects on free radicals.[8] Free radicals (also known as reactive oxygen species) are chemically reactive compounds with an unpaired electron that are produced daily in the body as a result of aerobic (oxidative) metabolism and normal immune system functioning. If free radical

*Antioxidants are thought to benefit immune function by their effects on free radicals.*

accumulation is not controlled, however, it can damage healthy cells. Primary targets for damage of these reactive oxygen species are double bonds, typically found in high concentrations in polyunsaturated fatty acids in cell membranes. Immune cells are especially susceptible to free radical damage because their cell membranes contain high levels of these polyunsaturated fatty acids. The body has systems in place to combat these free radicals, including enzyme systems, endogenous factors, and antioxidants. Antioxidants that can be obtained through the diet include vitamin E, ß-carotene, and lutein.

### Vitamin E

Vitamin E is a term used to encompass a group of potent, chemically similar antioxidants. One form of vitamin E, α-tocopherol, is most abundant in the body,[9] has the highest biological activity,[10,11] and reverses vitamin E-deficiency symptoms in humans.[12] In cells, vitamin E contributes to membrane stability, regulates membrane fluidity, and protects cellular components from oxidative damage. Interestingly, immune cells possess a higher vitamin E level than other cells[13,14]; as previously mentioned, these cells contain a high level of fatty acids that make them more susceptible to oxidative damage.

Vitamin E supple-mentation has been reported to increase various measures of immune function in several species, including cats.[15] Studies have demonstrated that adding vitamin E to vaccines as an adjuvant increased the vaccination titer (antibody) response in several species.[16-19] Intramuscular injection of vitamin E prior to vaccination, as well as nutritional supplementation with vitamin E, also resulted in increased titer responses.[20-23] Although supplementation with moderate levels of vitamin E can enhance vaccination responses, studies in humans have shown that over-supplementation with high levels of vitamin E was associated with lower antibody titer response to influenza vaccination.[23] Recent studies in cats conducted by The Iams Company have identified a nutrient range for vitamin E that provides immune system benefits, and this range is thought to be similar for dogs.

### ß-Carotene

Another group of antioxidants that can improve immune function is the carotenoids. Carotenoids are naturally-occurring plant pigments that have been suggested to play important roles in modulating immunity and health of humans and animals.[24-27] Studies have shown that ß-carotene increases the number[28,29] and function of immune cells,[29-33] as well as modulates nonspecific cellular defenses.[29,34]

Iams-sponsored studies have revealed that ß-carotene is effectively absorbed in dogs.[35,36] In addition, feeding 20 mg of ß-carotene per day to adult Beagles increased prevailing antibody levels after 8 weeks and was also associated with an increase in the delayed-type hypersensitivity (DTH) response (a measure of cell-mediated immunity.[35] In a follow-up Iams-sponsored study, dietary supplementation with ß-carotene modified immune cell numbers, increased T and B cell proliferation responses, and increased DTH response in dogs.[37] Feeding ß-carotene also has been shown to improve various measures of immune function in senior, as well as adult, dogs.[35,37]

### Lutein

Lutein is another carotenoid antioxidant found abundantly in plants and microorganisms, and is a major blood carotenoid in some species (humans, chickens). Like ß-carotene, lutein functions as an antioxidant, protecting lipid-containing cell membranes from oxidative damage[38] and having a pronounced synergistic protective effect when mixed with other carotenoids.[39]

In dogs, lutein can be absorbed from the diet and taken up in blood lymphocytes.[40,41] Lutein has been reported to increase cell-mediated immune responses, such as the delayed-type hypersensitivity and lymphocyte proliferation responses in dogs after 6 weeks of supplementation.[41] In addition, humoral immunity, measured as elevated IgG levels, was also enhanced in these dogs with lutein supplementation.

## ANTIOXIDANT STUDY

### Antioxidant Combination Package

It has been proven that vitamin E, ß-carotene, and lutein improve immune function in a variety of species, including dogs. However, their effects in neonates have not been reported. To determine the effect of these antioxidants as a combination package on immune function in neonatal dogs, 40 puppies were randomized at weaning (6 weeks of age) by litter, body weight, and gender into two treatment groups. The control group was fed a nutritionally complete diet (Eukanuba® Medium Breed Puppy Formula) and the experimental group was fed the same diet with supplemental vitamin E, lutein, and ß-carotene. Puppies were fed for four months, with blood samples collected at various time points for lymphocyte proliferation determination. Puppies were vaccinated throughout the feeding period according to standard procedures. At the end of the 4-month feeding period, puppies were vaccinated again (for secondary vaccination response measurement) and blood samples were collected to measure antibody titer response. After the last sample was collected, animals were then inoculated with a novel antigen (sheep red blood cells [sRBC]); for measurement of a primary response to vaccination) and samples were collected at various time points for serum antibody titer analysis.

## Results

Results from this study show that puppies fed the antioxidant-supplemented diet had significantly higher lymphocyte proliferation responses to different cell stimuli, testing both T and B cell function *(Figures 1–3)*. The longer the puppies were fed the diets, the greater the difference between the treatment groups. Dietary antioxidant supplementation thus significantly improves both T and B cell-mediated immune function in puppies.

The antioxidant-supplemented puppies also exhibited higher antibody titer responses to distemper, parainfluenza and parvovirus vaccine at the end of the feeding period *(Figure 4)*. These higher antibody response levels indicate a more successful vaccination response, with concurrent lower likelihood of subsequent infection with these viruses.

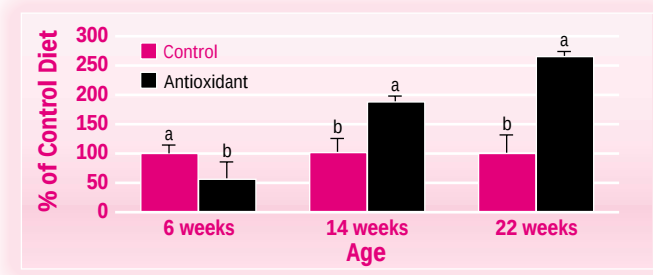


**Figure 1.** *Dietary antioxidant supplementation significantly (P<.05) enhanced T cell proliferation responses (Concanavalin A) in puppies at 14 and 22 weeks of age. Results are expressed as a percentage of the value from control-diet fed puppies (mean ± SEM).*

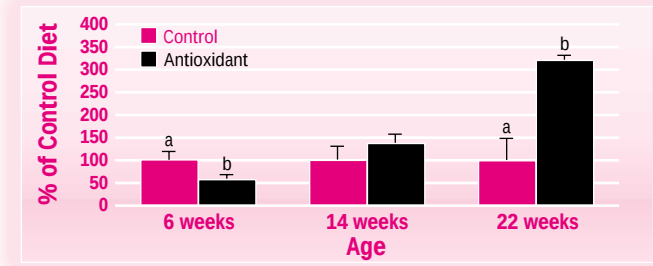


**Figure 2.** *Dietary antioxidant supplementation significantly (P<.05) enhanced T cell proliferation responses (phytohemagglutinin) in puppies at 22 weeks of age. Results are expressed as a percentage of the value from control-diet fed puppies (mean ± SEM).*

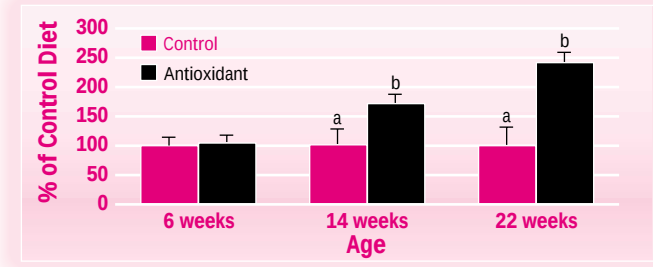


**Figure 3.** *Dietary antioxidant supplementation significantly (P<.05) enhanced B cell proliferation responses (Pokeweed mitogen) in puppies at 14 and 22 weeks of age. Results are expressed as a percentage of the value from control-diet fed puppies (mean ± SEM).*

In addition, the antioxidant-supplemented group generated significantly higher IgM titers to sRBC inoculation *(Figure 5)*. The IgM response is the initial response produced in humoral immunity, and as such confirm that antioxidant-supplemented puppies exhibit significantly enhanced humoral immune function.

## CONCLUSION

Scientific evidence indicates that neonatal dogs can benefit from a boost in immune function. Puppies possess a lower level of immune response than adult dogs, contributing to the development of a vulnerable period that puts them at higher risk for disease and death. Previous research in dogs, as well as other species, shows that nutritional supplementation can influence immune function. This recent study shows that in neonatal dogs, dietary supplementation with antioxidants can improve both cell-mediated and humoral immune function and enhance the responses necessary to protect puppies against infectious disease.

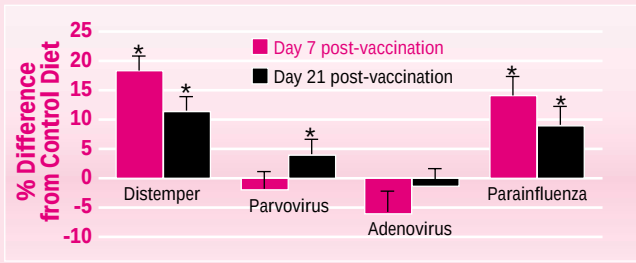


**Figure 4.** *Dietary antioxidant supplementation significantly (P<.05) increased titer (antibody) responses to distemper, parvovirus, and parainfluenza vaccine in puppies at 7 and 21 days post-vaccination. Results are expressed as a percentage difference of $log^3$ titer values from control diet-fed puppies (mean ± SEM).*

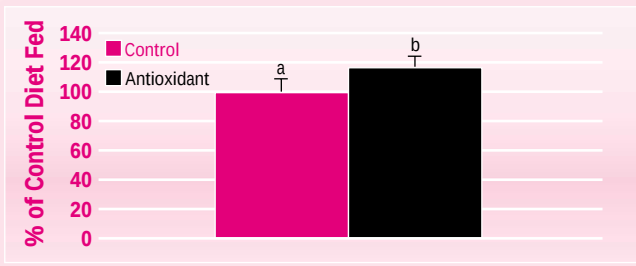


**Figure 5.** *Dietary antioxidant supplementation significantly (P<.05) increased IgM titer (antibody) responses to inoculation with sheep red blood cells in puppies. Results are grouped over the 21-day period after inoculation and expressed as a percentage difference from the value from control-diet fed puppies (mean ± SEM).*

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*Selecting the right sire will always begin by knowing the strengths and weaknesses of the bitch to be bred.*

# Selecting Sires

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## INTRODUCTION

Much can be said about this subject and all the considerations that are involved, but selecting the right sire will always begin by knowing the strengths and weaknesses of the bitch to be bred. If you don't know her strengths or weaknesses any sire will do. For example, if she has good overall conformation and good breadth of pedigree, the job of finding the right sire is less difficult. On the other hand if she has some good traits and several faults, the job of finding the right sire requires more thought and research.

The task of finding the best sire always gets easier when you have a clear understanding of what it is that you expect to get in the litter. You can't have as your goal breeding a champion. You have to focus on the specific traits of conformation, health or temperament. A combination of these three generally works best. By using pedigree analysis techniques, a breeder can learn about the qualities and the lack of qualities in the pedigree of the bitch, as well as those in the pedigree of each sire that is being considered.

## PEDIGREE RESEARCH

Because there is no direct way of looking into a pedigree to see if the desired genes or undesirable genes are present, an indirect method is needed. This means finding out about the phenotypes of the ancestors for three generations. It also includes learning about the littermates of the bitch and each sire that is being considered. The former approach is called pedigree depth and the latter is called breadth of pedigree. Both are important and useful methods.

As soon as the strengths and weaknesses of the bitch are known, a list of stud dog candidates can be developed. Start with a large number of good candidates. Ten may seem to be more than enough, but you will find that ten is not too many. The list of candidates must be screened, sorted and then reduced to a smaller group, usually to the best two or three. Experience teaches us that some will be better than others based on appearance, quality of pedigree, health history, and offspring produced.

*The task of finding the best sire always gets easier when you have a clear understanding of what it is that you expect to get in the litter.*

## REASONS FOR SELECTING A SIRE

The most popular reasons used to select a sire are

1. *Convenience:* proximity to the residence of the bitch
2. *Cost:* the economics; the cheapest stud dog
3. *Pedigree:* number of champion ancestors
4. *Offspring produced:* quality pups
5. *Ancestors/litter mates:* known producers

By themselves, these reasons are not sufficient for selecting a stud dog because none are sufficient to evaluate the faults and virtues of the bitch. Cost, convenience, and show records are sometimes perceived as legitimate reasons by those who lack experience and knowledge. The best search for the right stud dog always includes knowledge about his traits, health history, temperament, and the qualities seen in his offspring. Geography and economics have nothing to do with his genetics or his ability to complement the strengths and offset the weaknesses of the bitch.

Developing a list of 10 stud dogs begins by contacting breeders, handlers, and judges who are knowledgeable about the breed. Stud dog advertisements usually promise more than they can produce. As a general rule, one should be cautious about those who recommend their own dogs because of their vested interest in the matter.

*The best search for the right stud dog always includes knowledge about his traits, health history, temperament, and the qualities seen in his offspring.*

Once a list of 10 dogs has been developed, each potential sire should be checked against those traits and characteristics which are considered to be important to the breeding. Sometimes they are also related to a breed's function (sound hips, temperament, size, strength, etc). The diseases to be checked should be those that are specific to the breed. In the final analysis, the ideal stud dog should be able to complement the strengths of the bitch and offset her faults.

Evaluating stud dogs must be systematic and include the careful examination of the pedigree, including the relationship of ancestors to each other. If there are common relatives in a potential stud dog's pedigree that have produced serious health problems, poor temperament or life-threatening diseases, take him off the list. When you are finished, write down what is known about each pedigree in a summary statement. Compare the pedigree of each sire with what is needed to complement the pedigree of the bitch. This is a sorting process that will result in finding one or two candidates that have the best health histories, temperament, breed traits, and progeny. What you will discover is that the most popular sires will usually be the ones that have produced more offspring than the others. There will also be more information about them than others who are less popular. In either case, as the facts are gathered and studied, the original list of stud dogs will be shortened.

## FIRST-HAND EVALUATION

Seeing the dogs first-hand has no substitute. Visit the breeders' kennels and watch the dogs at shows. Remember that the skillful handling of these dogs in the ring by paid professionals and the limited amount of time allowed a judge makes the show ring the second best place to see and evaluate them. Even the best of breeders can miss an important fault that is carefully hidden. It is always best to see them in a more relaxed setting.

*Seeing the dogs first-hand has no substitute.*

Successful breeding programs always include an analysis of the information collected. The four steps generally used to check the desirability of sires and dams are as follow:

1. Frequency of desired traits occurring among their ancestors (three-generations pedigree)
2. Frequency of the desired traits found in their littermates
3. Number of carriers or affected littermates and ancestors (three-generations pedigree)
4. Number of pups produced with desired traits

When answers to the above are taken together, a reasonable projection can be made about their potential value. For example, if there are no ancestors or littermates with the desired traits, and if nothing is known about their health history or temperament, there is little reason to believe they will produce the traits desired. They should be removed from the list or placed near the bottom.

If Mendel* were asked to suggest an approach, he would probably begin by asking if the parents had produced offspring consistent in size, shape, and color because he knew from his experiments that if the parents came from pedigrees that produced different sizes, shapes, and undesirable colors they should not be expected to produce individuals that would be similar to each other or to their parents. He discovered this simple truth in the 1860's and it should not be ignored today. Illustrated in *Table 1* are 10 candidates that were considered in a search for the best stud dog for a hypothetical bitch. The reader should list the defects and traits considered important to his breed.

## ANALYSIS OF THE CANDIDATES

Dogs numbered 1, 5, 6, and 7 (from *Table 1*) have the best health histories and look very good on five of the six important breed traits. They also ranked highest for having the best ratios of offspring that meet desired breed characteristics. Sires #2, 4, 8, 9, and 10 should not be considered further unless more information can be found. To use these five sires is equivalent to breeding blind.

At first glance, sire #3 looked like a promising candidate based on his offspring. He produced two of four offspring of the correct size, three of four with good shoulders, and two of four with correct top lines, coat, and feet. But look at his health history. This is what makes him a risky choice. He has not been tested for PRA, liver

*Gregor Mendel (1822-1884) was an Austrian botanist monk who conducted artificial pollination experiments on plants and discovered its recessive and dominant behavior, which laid the foundation for the science of genetics.

| Name of Sire | PRA* | Liver | HD* | Heart | Tail | Size | Shoulder | Back | Coat | Teeth |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Ch Way to Go | Carrier | Clear | OFA | NT | C | 6/9 | 4/7 | 4/6 | 6/6 | 6/6 |
| 2. Ch Nestle Quick | NT | NT | OFA | NT | I | 2/9 | M | 2/7 | 5/6 | 6/6 |
| 3. Ch Jump N Joy | NT | NT | OFA | NT | I | 2/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| 4. Ch Nice Topper | NT | NC | NT | NC | I | 3/4 | 1/4 | 3/9 | M | M |
| 5. Ch Holly Top | Clear | Clear | NT | Clear | C | 7/9 | 4/9 | 6/9 | 7/9 | 9/9 |
| 6. Van Joner's Que | Clear | Clear | OFA | NT | C | 4/8 | 4/8 | 8/9 | 7/9 | 7/9 |
| 7. Ch VanCleves Asa | Clear | Clear | OFA | Clear | C | 8/10 | 6/10 | 6/8 | 7/9 | 9/9 |
| 8. Ch Slade Rimee | NT | NT | OFA | M | C | M | 9/10 | M | 3/9 | 6/9 |
| 9. Ch Fryer We Not | NT | NC | NT | NT | I | 1/5 | 2/9 | 1/9 | 3/9 | 3/9 |
| 10. Hope Well Bee | M | NT | NC | Clear | C | 2/5 | M | 3/9 | M | 1/4 |

NC – Not clear NT – Not tested C – Correct I – Incorrect M – Missing information

* PRA = Progressive retinal atrophy
HD = Hip dysplasia

**Table 1.** *Check list and candidates*

or heart disease, all common problems in his breed. His only health asset is that he was OFA certified normal for his hips.

The final selection should come from sires #1, 5, 6, or 7. The most promising one is #7 based on health history and desired traits observed in his offspring. Selection of the right stud dog should be a slow and deliberate process. Temperament should not be overlooked in this process.

Some breeders do not believe in testing their stud dogs on the grounds that it is too costly because they do not believe in the predictability of x-rays or the reliability of laboratory test results. Others will argue that if bloodlines and pedigrees are clear of carriers and defects, there is no need to waste time and money on unnecessary tests. The stud dogs owned by these breeders should not be considered. I recall one breeder who told me that he did not check his dogs for hip dysplasia (HD) because he "did not have HD in his lines." Later I learned that he usually sold his pups at 8 weeks of age. Since it is unlikely that HD or any other disease will occur prior to four months of age, he misleads himself and others into believing what is not true.

*Temperament should not be overlooked in this process.*

## CONCLUSION

Establishing a breeding program requires commitment to long-term goals. Selection of the foundation sire is a crucial step toward achieving these goals. To be successful breeding dogs, this selection process must go far beyond just reading stud dog ads. A careful analysis of the faults in a bitch and searching for a sire that will offset those faults in his pups is the first step toward becoming a successful dog breeder.

# COLOR CHART — STICK DOG PEDIGREE

Sire _____

Dam _____

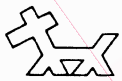
Whelped ____ /____ /____ Size of Litter ____ Males ♂ ____ Females ♀ ____

| Actual | | Predicted |
|---|---|---|
|  | # 1 |  |
|  | # 2 |  |
|  | # 3 |  |
|  | # 4 |  |
|  | # 5 |  |
|  | # 6 |  |
|  | # 7 |  |
|  | #8 |  |














Notes About Litter:

COLOR
1st -
2nd -
3rd -
4th -

# Early Neurological Stimulation

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## INTRODUCTION

Surprising as it may seem, it isn't capacity that explains the differences that exist between individuals because most seem to have far more capacity than they will ever use. The differences that exist between individuals seem to be related to something else. The ones who achieve and out perform others seem to have within themselves the ability to use hidden resources. In other words, it's what they are able to do with what they have that makes the difference.

In many animal-breeding programs the entire process of selection and management is founded on the belief that performance is inherited. Attempts to analyze the genetics of performance in a systematic way have involved some distinguished names such as Charles Darwin and Francis Galton. But it has only been in recent decades that good estimates of heritability of performance have been based on adequate data. Cunningham (1991) in his study of horses found that only by using Timeform data, and measuring groups of half brothers and half sisters could good estimates of performance be determined. His data shows that performance for speed is about 35% heritable. In other words only about 35% of all the variation that is observed in track performance is controlled by heritable factors, the remaining 65% are attributable to other influences, such as training, management and nutrition. Cunningham's work while limited to horses provides a good basis for understanding how much breeders can attribute to the genetics and the pedigrees.

Researchers have studied this phenomena and have looked for new ways to stimulate individuals in order to improve their natural abilities. Some of the methods discovered have produced life long lasting effects. Today, many of the differences between individuals can now be explained by the use of early stimulation methods.

## STIMULATION AND PERFORMANCE

Man for centuries has tried various methods to improve performance. Some of the methods have stood the test of time, others have not. Those who first conducted research on this topic believed that the period of early age was a most important time for stimulation because of its rapid growth and development. Today, we know that early life is a time when the physical immaturity of an organism is susceptible and responsive to a restricted but important class of stimuli. Because of its importance many studies have focused their efforts on the first few months of life.

Newborn pups are uniquely different than adults in several respects. When born their eyes are closed and their digestive system has a limited capacity requiring periodic stimulation by their dam who routinely licks them in order to promote digestion. At this age they are only able to smell, suck, and crawl. Body temperature is maintained by snuggling close to their mother or by crawling into piles with other littermates. During these first few weeks of immobility researchers noted that these immature and under-developed canines are sensitive to a restricted class of stimuli which includes thermal, and tactile stimulation, motion and locomotion.

Other mammals such as mice and rats are also born with limitations and they also have been found to demonstrate a similar sensitivity to the effects of early stimulation. Studies show that removing them from their nest for three minutes each day during the first five to ten days of life causes body temperatures to fall below normal. This mild form of stress is sufficient to stimulate hormonal, adrenal and pituitary systems. When tested later as adults, these same animals were better able to withstand stress than littermates who were not exposed to the same early stress exercises. As adults, they responded to stress in "a graded" fashion, while their non-stressed littermates responded in an "all or nothing way."

Data involving laboratory mice and rats also shows that stress in small amounts can produce adults who respond maximally. On the other hand, the results gathered from non-stressed littermate show that they become easily exhausted and would near death if exposed to intense prolonged stress. When tied down so they were unable to move for twenty-four hours, rats developed severe stomach ulcers, but litter mates exposed to early

stress handling were found to be more resistant to stress tests and did not show evidence of ulcers. A secondary affect was also noticed.

Sexual maturity was attained sooner in the littermates given early stress exercises. When tested for differences in health and disease, the stressed animals were found to be more resistant to certain forms of cancer and infectious diseases and could withstand terminal starvation and exposure to cold for longer periods than their non-stressed littermates.

Other studies involving early stimulation exercises have been successfully performed on both cats and dogs. In these studies, the Electrical Encephalogram (EEG) was found to be ideal for measuring the electrical activity in the brain because of its extreme sensitivity to changes in excitement, emotional stress, muscle tension, changes in oxygen and breathing. EEG measures show that pups and kittens when given early stimulation exercises mature at faster rates and perform better in certain problem solving tests than non-stimulated mates.

In the higher level animals the effect of early stimulation exercises have also been studied. The use of surrogate mothers and familiar objects were tested by both of the Kelloggs' and Dr. Yearkes using young chimpanzees. Their pioneer research shows that the more primates were deprived of stimulation and interaction during early development, the less able they were to cope, adjust and later adapt to situations as adults.

While experiments have not yet produced specific information about the optimal amounts of stress needed to make young animals psychologically or physiologically superior, researches agree that stress has value. What also is known is that a certain amount of stress for one may be too intense for another, and that too much stress can retard development. The results show that early stimulation exercises can have positive results but must be used with caution. In other words, too much stress can cause pathological adversities rather than physical or psychological superiority.

## METHODS OF STIMULATION

The U.S. military in their canine program developed a method that still serves as a guide to what works. In an effort to improve the performance of dogs used for military purposes, a program called "Bio Sensor" was developed. Later, it became known to the public as the "Super Dog" Program. Based on years of research, the military learned that early neurological stimulation exercises could have important and lasting effects. Their studies confirmed that there are specific time periods early in life when neurological stimulation has optimum results. The first period involves a window of time that begins at the third day of life and lasts until the sixteenth day. It is believed that because this interval of time is a period of rapid neurological growth and development, and therefore is of great importance to the individual.

The "Bio Sensor" program was also concerned with early neurological stimulation in order to give the dog a superior advantage. Its development utilized six exercises which were designed to stimulate the neurological system. Each workout involved handling puppies once each day. The workouts required handling them one at a time while performing a series of five exercises. Listed in order of preference the handler starts with one pup and stimulates it using each of the five exercises. The handler completes the series from beginning to end before starting with the next pup. The handling of each pup once per day involves the following exercises:

1. Tactical stimulation (between toes)
2. Head held erect
3. Head pointed down
4. Supine position
5. Thermal stimulation.

1. Tactile stimulation. Holding the pup in one hand, the handler gently stimulates (tickles) the pup between the toes on any one foot using a Q-tip. It is not necessary to see that the pup is feeling the tickle. Time of stimulation 3–5 seconds *(Figure 1)*.

2. Head held erect. Using both hands, the pup is held perpendicular to the ground, (straight up), so that its head is directly above its tail. This is an upwards position. Time of stimulation 3–5 seconds *(Figure 2)*.

3. Head pointed down. Holding the pup firmly with both hands the head is reversed and is pointed downward so that it is pointing towards the ground. Time of stimulation 3–5 seconds *(Figure 3)*.

4. Supine position. Hold the pup so that its back is resting in the palm of both hands with its muzzle facing the ceiling. The pup while on its back is allowed to sleep struggle. Time of stimulation 3–5 seconds *(Figure 4)*.

5. Thermal stimulation. Use a damp towel that has been cooled in a refrigerator for at least five minutes. Place the pup on the towel, feet down. Do not restrain it from moving. Time of stimulation 3–5 seconds *(Figure 5)*.

These five exercises will produce neurological stimulations, none of which naturally occur during this early period of life. Experience shows that sometimes pups will resist these exercises, others will appear unconcerned. In either case a caution is offered to those who plan to use them. Do not repeat them more than once per day and do not extend the time beyond that recommended for each exercise. Over stimulation of the neurological system can have adverse and detrimental results. These exercises impact the neurological system by kicking it into action earlier than would be normally expected. The result being

**Figure 1.** *Tactile stimulation.*

**Figure 2.** *Head held erect.*

**Figure 3.** *Head pointed down.*

**Figure 4.** *Supine position.*

**Figure 5.** *Thermal stimulation.*

an increased capacity that later will help to make the difference in its performance. Those who play with their pups and routinely handle them should continue to do so because the neurological exercises are not substitutions for routine handling, play socialization or bonding.

## BENEFITS OF STIMULATION

Five benefits have been observed in canines that were exposed to the Bio Sensor stimulation exercises. The benefits noted were:

1. Improved cardio vascular performance (heart rate),
2. Stronger heart beats,
3. Stronger adrenal glands,
4. More tolerance to stress, and
5. Greater resistance to disease.

In tests of learning, stimulated pups were found to be more active and were more exploratory than their non-stimulated littermates over which they were dominant in competitive situations.

Secondary effects were also noted regarding test performance. In simple problem solving tests using detours in a maze, the non-stimulated pups became extremely aroused, whined a great deal, and made many errors. Their stimulated littermates were less disturbed or upset by test conditions and when comparisons were made, the stimulated littermates were more calm in the test environment, made fewer errors, and gave only an occasional distress when stressed.

## SOCIALIZATION

As each animal grows and develops, three kinds of stimulation have been identified that impact and influence how it will develop and be shaped as an individual. The first stage is called early *neurological stimulation*, and the second stage is called *socialization*. The first two (early neurological stimulation and socialization) have in common a window of limited time. When Lorenz (1935) first wrote about the importance of the stimulation process he wrote about imprinting during early life and its influence on the later development of the individual. He states that it was different from conditioning in that it occurred early in life and took place very rapidly producing results which seemed to be permanent. One of the first and perhaps the most noted research efforts involving the larger animals was achieved by Kellogg & Kellogg (1933). As a student of Dr. Kellogg's I found him and his wife to have an uncanny interest in children and young animals and the changes and the differences that occurred during early development. Their history-making study involved raising their own newborn child with a newborn primate. Both infants were raised together as if they were twins. This study like others that would follow attempted to demonstrate that among the mammals there are great differences in their speed of physical and mental development. Some are born relatively mature and quickly capable of motion and locomotion, while others are very immature, immobile and slow to develop. For example, the Rhesus monkey shows rapid and precocious development at birth, while the chimpanzee and the other "great apes" take much longer. Last and slowest is the human infant.

One of the earliest efforts to investigate and look for the existence of socialization in canines was undertaken by Scott-Fuller (1965). In their early studies they were able to demonstrate that the basic technique for testing the existence of socialization was to show how readily adult animals would foster young animals, or accept one from another species. They observed that with the higher level animals it is easiest done by hand rearing. When the foster animal transfers its social relationships to the new species, researchers conclude that socialization has taken place. Most researchers agree that among all species, a lack of adequate socialization generally results in unacceptable behavior and often times produces undesirable aggression, excessiveness, fearfulness, sexual inadequacy, and indifference toward partners.

Socialization studies confirm that the critical periods for humans (infant) to be stimulated are generally between three weeks and twelve months of age. For canines the period is shorter, between the fourth and sixteenth week of age. During these critical time periods two things can go wrong. First, insufficient social contact can interfere with proper emotional development which can adversely affect the development of the human bond. The lack of adequate social stimulation, such as handling, mothering, and contact with others, adversely affects social and psychological development.

Second, over mothering can prevent sufficient exposure to other individuals, and situations that have an important influence on growth and development. The literature shows that humans and animals respond in similar ways when denied minimal amounts of stimulation. In humans, the absence of love and cuddling increases the risk of an aloof, distant, asocial or sociopathic individual. Over mothering can also have its detrimental effects. It occurs when a patient insulates the child from outside contacts, or keeps the apron strings tight, thus limiting opportunities to explore and interact. In the end, over mothering generally produces a dependent, socially maladjusted and sometimes emotionally disturbed individual.

The absence of outside social interactions for both children and pups usually results in a lack of adequate learning and social adjustment. Protected youngsters who grow up in an insulated environment often times become sickly, despondent, lacking in flexibility, and unable to make simple social adjustments. Generally, they are unable to function productively or to interact successfully when they become adults.

Owners who have busy life styles with long and tiring work and social schedules often times cause pets to be neglected. Left to themselves with only an occasional trip out of the house or off of the property they seldom see other canines or strangers and generally suffer from poor stimulation and socialization. For many, the side effects of loneliness and boredom set in. The resulting behavior manifests itself in the form of chewing, digging, and hard to control behavior (Battaglia).

It seems clear that small amounts of stress followed by early socialization can produce beneficial results. The danger seems to be in not knowing where the thresholds are for over and under stimulation. Many improperly socialized youngsters develop into older individuals unprepared for adult life, unable to cope with its challenges, and interactions. Attempts to re-socialize them when adults have only produced small gains. These failures confirm the notion that the window of time open for early neurological and social stimulation only comes once. After it passes, little or nothing can be done to overcome the negative effects of too much or too little stimulation.

The third and final stage in the process of growth and development is called *enrichment*. Unlike the first two stages it has no time limit and by comparison covers a very long period of time. Enrichment is a term which has come to mean the positive sum of experiences, which have a cumulative effect upon the individual. Enrichment experiences typically involve exposure to a wide variety of interesting, novel, and exciting experiences with regular opportunities to freely investigate, manipulate, and interact with them. When measured in later life, the results show that those reared in an enriched environment

tend to be more inquisitive and are more able to perform difficult tasks. The educational TV program called Sesame Street is perhaps the best known example of a children's enrichment program. The results show that when tested, children who regularly watched this program performed better than playmates who did not. Follow up studies show that those who regularly watched Sesame Street tend to seek a college education and when enrolled, performed better than playmates who were not regular watchers of the Sesame Street Program.

There are numerous children studies that show the benefits of enrichment techniques and programs. Most focus on improving self-esteem and self-talk. Follow up studies show that the enriched Sesame Street students when later tested were brighter and scored above average and most often were found to be the products of environments that contributed to their superior test scores. On the other hand, those whose test scores were generally below average, (labeled as dull) and the products of underprivileged or non-enriched environments often times had little or only small amounts of stimulation during early childhood and only minimal amounts of enrichment during their developmental and formative years. Many were characterized as children who grew up with little interaction with others, poor parenting, few toys, no books and a steady diet of TV soap operas.

A similar analogy can be found among canines. All the time they are growing they are learning because their nervous systems are developing and storing information that may be of inestimable use at a later date. Studies by Scott and Fuller confirm that non-enriched pups when given free choice preferred to stay in their kennels. Other litter mates who were given only small amounts of outside stimulation between five and eight weeks of age were found to be very inquisitive and very active. When kennel doors were left open, the enriched pups would come bounding out while littermates who were not exposed to enrichment would remain behind. The non-stimulated pups would typically be fearful of unfamiliar objects and generally preferred to withdraw rather than investigate. Even well bred pups of superior pedigrees would not explore or leave their kennels and many were found difficult to train as adults. These pups in many respects were similar to the deprived children. They acted as if they had become institutionalized, preferring the routine and safe environment of their kennel to the stimulating world outside their immediate place of residence.

Regular trips to the park, shopping centers and obedience and agility classes serve as good examples of enrichment activities. Chasing and retrieving a ball on the surface seems to be enriching because it provides exercise and includes rewards. While repeated attempts to retrieve a ball provide much physical activity, it should not be confused with enrichment exercises. Such playful activities should be used for exercise and play or as a reward after returning from a trip or training session. Road work and chasing balls are not substitutes for trips to the shopping mall, outings or obedience classes most of which provide many opportunities for interaction and investigation.

Finally it seems clear that stress early in life can produce beneficial results. The danger seems to be in not knowing where the thresholds are for over and under stimulation. However, the absence or the lack of adequate amounts of stimulation generally will produce negative and undesirable results. Based on the above it is fair to say that the performance of most individuals can be improved including the techniques described above. Each contributes in a cumulative way and supports the next stage of development.

## CONCLUSION

Breeders can now take advantage of the information available to improve and enhance performance. Generally, genetics account for about 35% of the performance but the remaining 65% (management, training, nutrition) can make the difference. In the management category it has been shown that breeders should be guided by the rule that it is generally considered prudent to guard against under and over stimulation. Short of ignoring pups during their first two months of life, a conservative approach would be to expose them to children, people, toys and other animals on a regular basis. Handling and touching all parts of their anatomy is also necessary to learn as early as the third day of life. Pups that are handled early and on a regular basis, generally do not become hand shy as adults.

Because of the risks involved in under stimulation a conservative approach to using the benefits of the three stages has been suggested based primarily on the works of Arskeusky, Kellogg, Yearkes and the "Bio Sensor" program.

Both experience and research have dominated the beneficial effects that can be achieved via early neurological stimulation, socialization and enrichment experiences. Each has been used to improve performance and to explain the differences that occur between individuals, their trainability, health, and potential. The cumulative effects of the three stages have been well documented. They best serve the interests of owners who seek high levels of performance when properly used. Each has a cumulative effect and contributes to the development and the potential for individual performance.



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