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# How I Feed: The Diabetic Dog

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## Abstract

Dietary and medical management of diabetes mellitus have the same therapeutic goals: minimize clinical signs related to hyperglycemia, avoid life-threatening hypoglycemia, help the patient maintain an optimal body weight and condition, and improve quality of life parameters for the patient and caregiver. Due to their inadequate insulin production, each canine diabetic requires twice-daily parenteral insulin. The feeding regime and nutrient content of the diet can both help and hinder medical therapy. Dietary modifications for patients with diabetes include feeding a consistent amount of a consistent diet at consistent times each day to coincide with insulin administration; feeding higher fiber foods; modification of carbohydrate type; and reduction in total carbohydrate content of the foods consumed. Recommendations should be tailored to the individual patient based on the diet and medical history as well as concurrent medical conditions to ensure patient acceptance and owner compliance.

## Introduction

Diabetes mellitus (DM) is a disorder of glucose metabolism that involves either insufficient insulin production or a peripheral insulin resistance. In dogs, DM is most often due to inadequate insulin production and, thus, requires lifelong twice-daily parenteral insulin injections. This relative insulin deficiency is due to a loss of beta-cell activity most often resulting from immune-mediated destruction of Islet cells or pancreatitis.<sup>1,2</sup> DM can occur in both mixed-breed and purebred dogs but appears to have a genetic component as certain breeds are overrepresented,<sup>3</sup> and it is exacerbated by other concurrent diseases, such as hyperadrenocorticism,<sup>4</sup> hypothyroidism<sup>5</sup> and obesity.<sup>6</sup> In contrast, feline diabetes often occurs due to a peripheral insulin resistance in overweight or obese individuals.<sup>1</sup> The difference in disease pathogenesis between dogs and cats can make the initial dietary recommendations dramatically different between the two species. Some diabetic cats are able to maintain glycemic regulation without the need for additional medical treatment when fed a reduced-carbohydrate diet.<sup>7</sup> Diabetic dogs, in contrast, have an absolute requirement for daily insulin injections. Diet modifications are not a replacement for medical therapy in these patients but can be used to enhance efficacy of parenteral insulin injections and improve glycemic regulation.

The most common diet recommendations for canine diabetics

## Glossary of Abbreviations

**DM:** Diabetes Mellitus

**MER:** Maintenance Energy Requirement

are to change meal times to overlap with insulin administration and to feed a high-fiber diet.<sup>8,9</sup> Specific diet changes are often attempted at the time of diag-

nosis, but administering twice-daily injections while changing the daily diet and treat regime can be daunting for many caregivers. Because owners often focus solely on ensuring their dog eats so they can give the required insulin injections, if a veterinarian recommends a new diet early in the disease course that the dog doesn't find palatable, there is a risk that the owner will panic and give inappropriate foods, such as hotdogs, chicken and cat food, to get the dog to eat. With newer insulin types, improved monitoring and better client education, diabetic dogs now have the same expected survival times as non-diabetic dogs.<sup>10</sup>

## Changes to Feeding Strategy

Parenteral insulin injections are required from the time of diagnosis in canine diabetes. Initial treatment recommendations for otherwise healthy diabetic dogs should concentrate on owners becoming comfortable and competent with insulin therapy and making adjustments to the daily feeding schedule as opposed to making any specific diet changes. The current recommendation is to offer a consistent amount of a consistent food once every 12 hours to coincide with twice-daily insulin administration<sup>8,9</sup> but does not allow for additional food items outside these windows. Although most dogs will readily consume half their daily requirement in one meal, small-breed or finicky dogs may not eat the required meal volume. Additionally, this seemingly simple treatment requirement can result in a dramatic lifestyle change for both dogs and caregivers as it may not have been the meal pattern prior to diagnosis. In the author's experience, feeding schedules for otherwise healthy dogs vary day to day based on family schedules (work, school, etc.) and twice-daily meals are often not the only foods offered.

Providing a consistent feeding schedule and a consistent diet at each meal are recommended to help prevent life-threatening hypoglycemia.<sup>11</sup> For finicky dogs and caregivers who have difficulty with a twice-daily feeding schedule, some flexibility in feeding regime may be possible. Postprandial blood glucose elevations occur within the first two hours of meal ingestion in healthy dogs,<sup>12</sup> and the commonly used intermediate acting insulin types have peak effects occurring within the first 4-6 hours after administration.<sup>13</sup> If needed, foods can be divided between a

“main meal” that provides approximately 40% of the daily intake and is given with insulin, and a smaller “treat” that provides an additional 10% of the daily intake and is offered two to three hours after each insulin injection. These additional food items become part of the dietary plan, and if the caregiver is unable to accommodate any of the additional treat times, that food item should be added to the corresponding meal to ensure a consistent nutrient intake for the given insulin dosage.

## Ensuring Adequate Energy Intake

For diabetic dogs already at an optimal body weight, the goal of therapy is weight maintenance. Diabetes mellitus can increase daily energy requirements though the extent will vary with each patient depending on the severity of disease. Initially feed 10-15% above prediabetes requirements and recheck weight regularly. This starting amount can be based on the calculated maintenance energy requirement (MER) of  $70BW_{kg}^{3/4} \times 1.6$  (neutered adult dog factor), but as individual dogs can vary up to 50% above or below this amount even without concurrent disease, evaluating current and previous dietary intake may provide a more accurate starting estimate. Weight and body condition should be measured and recorded at each recheck examination with an adjustment in energy intake as needed.

Even in overweight or obese dogs, the initial recommendation should be for weight maintenance until glycemic control is established. This will allow the veterinarian and caregiver to evaluate the efficacy of insulin therapy independent of intentional calorie restriction. A modest reduction in energy intake can then be made to help achieve a rate of no more than 1% of body weight lost per week. Loss of adiposity may help minimize peripheral insulin resistance and improve exogenous insulin efficacy. Frequent re-evaluations of weight and clinical signs of disease are required to monitor for any needed change in insulin dosage or changes in energy intake. Hypoglycemia can occur if the overweight or obese diabetic dog loses weight quickly without a corresponding decrease in insulin dosage.

## Nutrient Modifications

*Dietary Fiber:* Research on diet modifications for diabetic dogs has largely focused on changes to fiber type and amount.<sup>14-21</sup> Fiber is a broad nutrient classification and includes types that dissolve in water (soluble) and those that do not (insoluble); fiber is also classified according to whether it is utilized by intestinal bacteria (fermentable) or not (nonfermentable). For dogs that were otherwise healthy prior to the diagnosis of diabetes, studies have differed on whether improved glycemic control is seen with higher intake of total dietary fiber (both soluble and insoluble types)<sup>14-18</sup> or higher intake of insoluble fiber alone,<sup>19,20</sup> or whether fiber should be ignored altogether and diabetic dogs should instead be fed a lower digestible carbohydrate diet.<sup>21</sup>

An important consideration when reconciling these seemingly conflicting results is that these researchers used the terms “high” and “low” in reference to the fiber content of the control diets,

assuming that the control diet was equivalent to a typical over-the-counter commercial dog food. Since these studies included small numbers of test subjects and did not report profiles of the diets fed or feeding practices prior to the testing period, it is possible that the changes (or lack thereof) in diabetic parameters were related to a relative modification in fiber or total digestible carbohydrate intake, or both, as well as improved owner compliance when participating in a nutritional study.

Transitioning to a veterinary therapeutic diet with a higher fiber content than the original diet may be beneficial for uncomplicated canine diabetics that are difficult to regulate on insulin alone. These types of therapeutic diets often have higher levels of total dietary fiber (both soluble and insoluble) compared to over-the-counter diets, but the specific diet selected should be based on the patient’s current fiber intake when possible. Diets with high insoluble fiber levels often have lower calorie densities and lower overall digestibility, and an increase in meal volume is often required to prevent unintended calorie restriction and weight loss. This may be advantageous in overweight or obese diabetic dogs that require weight loss but is an undesirable side effect in underweight patients or those with volume limitations. Additionally, it is also important to inform owners that increasing fiber intake can increase stool volume and frequency of defecation. In dogs without ready access to proper elimination areas, such as those living in apartments, increasing stool volume may pose a husbandry challenge for caregivers.

For owners who decline higher fiber therapeutic diets or for animals that refuse to eat a higher fiber therapeutic diet, comparing labels of over-the-counter foods are challenging. Pet food labels in the United States require “Crude Fiber” reporting. Crude fiber is a laboratory analysis of the insoluble, nonfermentable plant portion of the diet (primarily cellulose, hemicellulose and lignin) and does not reflect the Total Dietary Fiber or Digestible Carbohydrate content of the food. Crude fiber is also reported as a percentage (i.e., grams per 100 grams as fed) and cannot be readily compared against diets with differing energy densities or different moisture contents. If needed, a powdered fiber supplement (e.g., psyllium husk or oat bran) or a high-fiber cereal (e.g., Fiber One Original or Grape-Nuts Original) can be mixed with the original diet at each meal to help increase the individual patient’s fiber intake. Caution should be used when selecting fiber supplements or cereals as many include added fructose, maltose or sucrose to enhance palatability.

*Glycemic Index:* Every plant-based ingredient used in the production of either commercial or home-prepared pet diets will have inherently different combinations of protein, fat, carbohydrate, and fiber. The effect that these basic nutrient combinations have on the degree of postprandial hyperglycemia is referred to as the “Glycemic Index” of that ingredient. Foods that have high simple sugar or starch contents, such as white rice or white potato, will have a higher glycemic index, though those that contain protein, fat and/or fiber in addition to starch, such as barley or oats, will have a lower glycemic index. In addition, ingredient

and nutrient interactions can occur during cooking (in both pet food and human food manufacturing) that can both increase and decrease the glycemic index depending on the ingredient and ingredient combination. Information on glycemic index of specific human foods can be found online ([glycemicindex.com](http://glycemicindex.com)) and provided to caregivers.

**Simple Sugars:** Whenever possible, simple starches and sugars should be eliminated from the diet of diabetic patients. Many over-the-counter and prescription chewable supplements, as well as semi-moist commercial foods and treats and edible enrichment chews, may contain simple sugars (often listed in the ingredients list as starch, molasses or sugar). Owners should be educated to review ingredient

lists of all selected foods and treats before feeding and to monitor for changes in water intake or urination after introduction of any new foods or treats.

## Clinical Complications

Inadequate insulin levels also can cause a concurrent dysregulation of fat metabolism leading to hyperlipidemias.<sup>22</sup> A reduction in dietary fat intake may be required if the hyperlipidemia does not resolve with insulin therapy and improved glycemic regulation. Additionally, patients with a history of pancreatitis or a primary disorder of lipid metabolism (e.g., Miniature Schnauzers) may develop life-threatening complications from hypertriglyceridemia and would benefit from early dietary intervention. Fat reduction should always be made relative to the current intake, and in the author's experience, fat restriction below the adult dog daily requirement is rarely necessary in diabetic dogs.

One of the most common complications of long-term management of DM in people is the development of diabetic nephropathy leading to renal failure and death.<sup>23</sup> Although hypertension and proteinuria have been identified as sequelae of long-term DM in dogs,<sup>24,25</sup> progression to overt renal failure and effects on long-term survival are not known. Changes aimed at ameliorating hypertension and proteinuria, namely dietary sodium and protein reduction, have not been specifically evaluated in canine diabetes. Avoiding high-sodium diets (i.e., dietary sodium >2.0 grams per 1000 kcal of diet) would be prudent as increases in water intake and urination due to dietary sodium content can mimic clinical

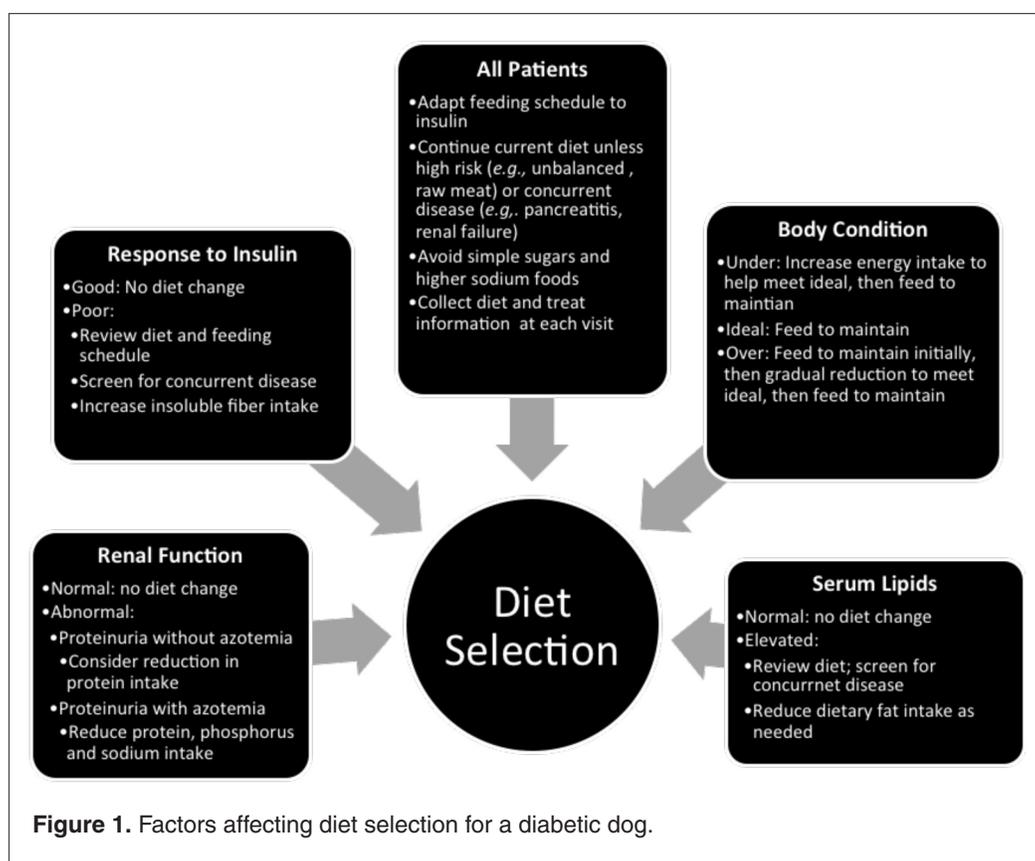


Figure 1. Factors affecting diet selection for a diabetic dog.

signs of DM. Protein reduction is not warranted early in treatment of canine diabetes without evidence of proteinuria. Many diabetic dogs can have loss of lean body mass either as a result of inadequate energy intake or alteration in muscle catabolism; protein reduction would be contraindicated in these patients.

## Summary of Recommendations

The most important thing to remember when developing a dietary plan is that there is not one perfect approach for all diabetic dogs. There are commercial diets designed to enhance glycemic regulation when used in combination with twice-daily insulin, but these require owner and patient compliance to be maximally effective. Recommendations should instead be tailored to the individual's medical history, food preferences and concurrent disease states. A summary of these considerations are listed below and shown in Figure 1. For dietary management of canine diabetes, I have a few simple recommendations.

- 1) **Obtain a diet and treat history from the owner.** This should be done at the time of initial diagnosis and rechecked at each office visit to review owner compliance and identify any gaps or inconsistencies in management that could lead to current or future problems.
- 2) **Encourage adherence to a consistent feeding schedule** that balances patient needs with owner constraints and allows the owner to become comfortable with giving twice-daily injections.

- 3) **Have the owner omit any foods or treats that include simple sugars or higher sodium contents.** Higher sodium foods are not contraindicated with DM but can exacerbate clinical signs of polyuria and polydipsia that can be confused with poor regulation.
- 4) **Avoid making abrupt diet changes** unless additional nutrient restriction is required (e.g., fat reduction for pancreatitis or marked hypertriglyceridemia), the patient has other medical conditions that would benefit from a diet modification, or the owner is feeding a diet that poses a risk to the patient or other members of the household, such as an unbalanced home-prepared diet or raw meat.
- 5) **Adjust food intake as needed.** For patients that are at an ideal body condition, or even overweight or obese, I recommend feeding for weight maintenance for the first month. Overweight and obese patients would benefit from weight loss and gradual calorie reduction can be done after insulin effectiveness has been established. Patients that are underweight at the time of diagnosis may require even higher energy intake to help them reach and then maintain a more optimal body condition.
- 6) **If the diabetic patient is difficult to regulate** after the first three to four weeks of initiating insulin therapy despite good owner compliance, increasing fiber intake either by transitioning to a higher fiber therapeutic diet or additional supplemental fiber may improve glycemic control.
- 7) **Don't focus only on the bloodwork** to determine glycemic control. Blood glucose fluctuates day to day and an individual animal's needs may also change throughout the course of disease. Monitoring body weight and clinical signs of DM at each visit are good indicators of overall glycemic regulation.<sup>26</sup>

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