ASSESSMENT OF NUTRITIVE VALUE OF VARIOUS COMMERCIAL DOG AND CAT FOOD BRANDS IN THE KENYAN MARKET

UNIVERSITY OF NAIROBI

BY

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DECLARATION

This dissertation is submitted to the University of Nairobi in partial fulfillment of the requirements for the award of a degree Bachelor of Veterinary Medicine. It is my original work and has not been submitted to any other University for academic Award.

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DEDICATION

To my family: for their support, encouragement and understanding throughout my undergraduate course.

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LIST OF ABBREVIATION

AOAC	-Association of Official Agricultural Chemists
AAFCO	-The association of American Feed Control official
BHA	-Butylated hydroxyuanisole
BHT	-Butylated hydroxytoluene
BUN	-Blood urea nitrogen
BVD	-Blackôs Veterinary Dictionary
CF	-Crude fibre
CHF	-Congestive heart failure
DM	-Dry matter
DHA	-Docosahexanoic acid
EFA	-Essential fatty acids
FLUTD	-Feline Lower urinary tract disease
JSAP	-Journal of Small Animal Practice
ME	-Metabolizable Energy
MER	-Maintenance Energy Requirements
MVM	-Merck Veterinary Manual
NRC	-National Research Council
PUFA	-Poly Unsaturated Fatty acids
RER	-Resting Energy Requirement
Wt	-Weight.

ABSTRACT

Careful assessment of nutritional needs of dogs and cats must be taken into consideration in order to maintain optimal health, be part of a treatment regimen for a diseased state or maximize the quality of life. The aim of this project was to investigate whether the different brands of dog and cat food available in the Kenyan market meet their requirements. Assessment of the different brands of dog and cat food was done in the laboratory using the proximate analysis method. The crude protein, Ether extract (fats), Crude fibre, Moisture, Ash (minerals) and Nitrogen free extract (Digestible carbohydrates) were determined.

Majority (61.9%) of the pet foods sold in the Kenyan are imported with the rest (38.1%) being local brands. There were no local brands of cat foods in the market. Dry foods are more common than the canned foods which were limited to specific retail outlets. All the brands of dog foods, except one, fell short of their declared protein content but met the protein requirements for maintenance. Both the brands of cat foods fell short of protein requirements for maintenance. Energy was well supplied in all the brands of foods due to the high carbohydrate and fat content. Crude fibre was way above the declared content in all the brands of food. Calcium and Phosphorus levels were at par with the nutritional requirements for maintenance in all the brands of foods.

Investigation of the nutritive value of these sampled brands revealed the need for supplementation during specific life stages as they failed to reach all the nutritional requirements at these stages.

CHAPTER ONE: INRODUCTION

1.0 Background information

Nutrition is the cornerstone in maximizing health, performance, longevity and disease prevention. Careful assessment of nutritional needs of dogs and cats must be taken into consideration in order to maintain optimum health, be part of a treatment regimen for a diseased state or to maximize the quality of life (Freeman et al, 2011). An understanding of the basic nutrition and of the nutrient requirements of healthy dogs and cats is integral in understanding of practical feeding practices (Carey and Hirakawa 1995). The simplest method of meeting the nutritional requirements of dogs and cats is to feed a complete and balanced commercial diet designed and appropriately tested for dogs or cats. Despite there being a wide availability of commercially complete and balanced foods for dogs and cats, the consumer is not sure of their quality. This study investigated the quality (nutrient content) of locally sold dog and cat foods and their ability to meet the stipulated nutrient requirements

1.1 Objectives

The general objective of this study was to assess the nutritive value of the different commercial brands of dog and cat foods available in the Kenyan Market,

1.1.1 Specific objectives

1. To review of the nutritional requirements of dogs and cats

2. Determine the different brands of dog and cat food sold in the Kenyan market

3. To investigate the nutritive value of different brands of dog and cat foods in the Kenyan market

4. To assess whether the commercial brands of dog and cat food meet the required nutritional requirements in dogs and cats

1.1.2 Research questions

1. What are the nutritional requirements of dogs and cats?

2. Do the different brands of dog and cat food meet the minimum nutritional requirements of dogs and cats?

3. Are there some brands of dog and cat food that are better suited for different breeds or ages of dogs and cats?

1.2 JUSTIFICATION

Along with proper healthcare and medical attention, nutrition is an important component of the care of dogs and cats. The positive impact of proper nutrition on health and disease is well established in all animals. Appropriate feeding throughout all life stages can help prevent diet associated diseases as well as assist in the management of other diseases. Assurance of proper nutritional health however entails more than meeting nutritional profiles, additional factors such as age, physiological status and environmental factors must be considered.

CHAPTER TWO: LITERATURE REVIEW

2.1 Nutrients

The 6 classes of nutrients are water, protein, fat, carbohydrates, vitamins and minerals. Of all these, only fats, proteins and carbohydrates provide energy.

Water

This is the most important nutrient. Lack of water can lead to death in a matter of days. Although animals can live after losing almost all their body fat and more than half of their protein, a 10% loss of body water results in death (Carey and Hirakawa,1995). Approximately 70% of lean adult body weight is water and many body tissues are composed of 70%-90% water(Carey and Hirakawa,1995). The presence of an aqueous medium within the cells is essential for the occurrence of most metabolic and chemical processes.

Clean fresh water must be made available at all times. Multiple water sources encourage consumption especially for cats which often do not drink a lot of water(Carey and Hirakawa,1995). Total water intake comes from three possible sources: Water present in food, metabolic water, and drinking water. Daily fluid requirements in dogs and cats must compensate for daily fluid losses through urination, excretion and respiration. The quantity of water required depends on several factors including animalôs diet, environment, activity level and health status(MVM,2010).

The moisture content of canned pet foods varies from 60-87%, Dry foods contain 3-11% 0f water and semi-moist foods contain 25-35% water(Carey and Hirakawa). In a thermoneutral environment, most mammalian species need 44-66 ml/kg body weight. Water requirements are highly associated with the amount of food consumed. In this case, daily maintenance fluid requirements in ml should equal the animalôs MER in kcal of ME(MVM,2010). Daily water

intake should be 2-3 times the dietary dry matter intake. When provided with ample water, healthy animals can effectively self regulate their intake.

Protein

Proteins in the body have numerous functions including transport functions, metabolic reactions, endocrine functions and resistance to disease(Bauer J et al,1995). A primary function of dietary protein is as a source of essential amino acids and nitrogen for the synthesis of non essential amino acids .Amino acids supply both nitrogen for the synthesis of nitrogenous compounds as well as a variable amount of energy when catabolized. The degree to which a dog or cat is able to utilize dietary proteins as a source of nitrogen and amino acids is dependent on the digestibility and quality of the protein(J.S Heath,1978).

Ten amino acids are essential in the diet of dogs: Arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine(MVM,2010). Cats need all these plus taurine(MVM,2010). Non essential amino acids may become conditionally essential when an animal has an underlying disorder that either interferes with synthesis of the amino acids or results in its excessive consumption or loss.

Protein requirements for dogs and cats differ with age, activity level, temperament, life stage, health status and protein quality of the diet (Carey and Hirakawa,1995). Most commercial dog foods contain a combination of cereal and meat proteins with digestibility of 75-90% Digestibility is less for plant protein ingredients and protein of poor biological value (Carey and Hirakawa,1995). If excessive heat is used during processing or preparation, proteins can become chemically unavailable for digestion and absorption(Carey and Hirakawa,1995).

Healthy adult dogs need approximately 2g of protein of high biological value per kg body wt/day while the cat has a higher protein requirement of 4g per kg body wt/day

(MVM, 2010).The biological value of a protein is related to the number of essential amino acids it contains and its digestibility. The higher the biological value of a protein, the less amount is needed in the diet. An example of a protein of very good biological value is egg while vegetable proteins have poor biological value (Carey and Hirakawa,1995).

Optimal diets of growing puppies should contain a minimum of 22% protein as dry matter (AAFCO guidelines) or 45g protein/1000 kcal ME (NRC guidelines,2010) for puppies of 4-14 weeks old. For puppies greater than 14 weeks old, 35g proteins/1000 kcals ME. Adult dogs require a minimum of 18% protein as dry matter or 20g protein/1000 kcal of ME. Growing kittens should get 30% protein as dry matter or 45g protein/1000 kcal ME. Optimal diets for adult cats should contain 26% protein as dry matter or 40 g protein/1000 kcal ME. Growing kittens are more sensitive to the quality of dietary protein and amino acid balance than adults. Proteins suitable for cats must supply more than 500 mg of taurine /kg diet dry matter (MVM, 2010).

Signs produced by protein deficiency or an improper protein: calorie ratio may include: reduced growth rate in young animals, anemia, weight loss, skeletal muscle atrophy, persistence unresponsive parasitism, reproductive problems and failure to respond properly to treatment of injury or disease (J.S Heath,1978).

Fats

Dietary fats are classified into simple lipids, compound lipids and derived lipids. Simple lipids include triglycerides and waxes with triglycerides being the most common form of lipids found in diets and the most important(Buffington et al,2004). They are divided into short, medium or long chain fatty acids. Essential fatty acids are long chain fatty acids that cannot be synthesized in the body

Fatty acids can either be saturated or unsaturated. Polyunsaturated fatty acids (PUFA) are either omega-3, Omega-6 or Omega-9 depending on where the first double bond is. The more double bonds a fatty acid has, the more prone it is to rancidity (Carey and Hirakawa, 1995). Saturated fatty acids are used primarily for energy in the body. Unsaturated fatty acids are found in cell membranes and blood lipoproteins. Generally, the triglycerides in animal fats contain more saturated fatty acids than those in vegetable fats. Most plan oils contain 80%-90% unsaturated fatty acids while animal fats contain 50%-60% unsaturated fatty acids (MVM, 2010).

Fat is a concentrated source of energy yielding 2.25times the ME of soluble carbohydrate or protein. Excessive dietary fat relative to other nutrients may result in excessive energy intake and subsequent suboptimal intakes of proteins, minerals and vitamins. Fat in the diet contributes to palatability and acceptable texture in the food (J.S Heath, 1978).

Dietary fats especially of the unsaturated form need a protective antioxidant system which if insufficient in the diet results in oxidation of PUFAs leading to steatitis (A yellow discolouration of fats) (MVM, 2010).Antioxidant protection can be from natural preservatives e.g. Vitamin C or synthetic preservatives e.g. BHA, BHT or ethoxyquin. Rancid fats in diets results in fat soluble vitamin deficiency (MVM,2010).

Optimal diets for growing puppies should contain a minimum of 8% fat as dry matter (AAFCO guidelines) or 21.3 g/1000 kcal ME (NRC guidelines,2010) Adult dogs need a minimum of 5% fat or 10g/1000 kcal ME. Growing kittens and adult cats ,diets should contain a minimum of 9%fat as dry matter or22.5 g/1000 kcal ME. Dogs and cats have a dietary requirement for specific EFA including linoleic acid which is found in corn and soy oil. Cats have a dietary requirement for arachidonic acid, another EFA which must be obtained from animal sources. Unlike dogs, cats cannot readily convert linoleic acid to

arachidonic acid. Dietary requirements for both linoleic acid and arachidonic acid are 5 g and 0.2g/kg of diet respectively for cats.Ŭlinoleic acid , an omega -3 fatty acid is essential in dogs and possibly in cats(MVM,2010). The primary source of this EFA is fish oils. Current minimum requirements are 0.8g/kg diet of Ŭlinoleic acid when linoleic acid is 13g/kg in diet(dry matter basis) for puppies and 0.44g/kg diet of Ŭlinoleic acid when linoleic acid is11g/kg diet (dry matter basis) for adults(MVM,2010). Other EFAs include Docosahexanoic acid (DHA) which is essential for neurological growth and development in puppies and kittens. Puppies fed on a diet containing sufficient amounts of DHA are easier to train and perform better in learning experiments.(MVM,2010) NRC recommended levels of DHA are 0.13g/kcal ME for puppies and 0.11g/100kcal ME for adults(MVM,2010).

Most commercial adult dog foods typically contain 5-15% fat (DM basis)Puppy diets contain 8-20% fat (DM basis) One reason for this wide range is of fat content is the purpose of the diet. Wprk, stress, lactation and growth require more than maintenance. Deficiencies of EFAs though rare in dogs and cats fed properly, include: dry, scaly, lusterless coat and reproductive disorders.

Carbohydrates

Carbohydrates in dog and cat foods include low and high molecular weight sugars, starches and various non starch polysaccharides or dietary fibres. Although there is no minimum dietary requirement for simple carbohydrates or starches, for dogs and cats, certain tissues such as the brain and RBCs need glucose for energy. Glucose is synthesized from glucogenic amino acids and glycerol if dietary carbohydrates are inadequate. Cats normally get their glucose from glucogenic amino acids and glycerol and therefore require no dietary carbohydrates, hence are referred to as true carnivores (Buffington et al,2004). Carbohydrates can become conditionally essential if energy needs are high such as in growth, lactation and

gestation in cats (Buffington et al, 2004). Carbohydrates are not essential in the diet when ample protein and fats supply glucogenic amino acids and glycerol. Properly cooked non fibrous carbohydrates are well utilized in the dog but uncooked starches are poorly digested and may result in diarrhea.

Fibre

Fibre is the edible part of plants or analogous carbohydrates that are resistant to digestion and absorption in the small intestine and has complete or partial fermentation in the large intestine. There is no dietary requirement for fibre in dogs and cats but there are certain health benefits of having fibre in the diet (Carey and Hirakawa, 1995).

Fibre is classified according to its solubility and its rate of fermentability. Soluble fibres have a better water holding capacity than insoluble fibres which include cellulose and rice bran. Examples of soluble fibres are gum Arabic and inulin (Carey and Hirakawa,1995). Fermentation of fibres is important because it produces short chain fatty acids: acetate, butyrate and propionate which have numerous benefits including provision of energy to the large intestine epithelial cells therefore stimulating intestinal sodium and water absorption.

Dietary fermentable fibres function as prebiotics in dogs and cats(MVM,2010). Prebiotics are non digestible food ingredients which selectively stimulate growth and activity of beneficial intestinal bacteria and inhibit colonization of pathogenic bacteria. The beneficial bacteria also produce nutrients such as vitamin B and vitamin K (BVD, 2005). Dietary fibre also acts as a dietary diluents that decreases the total energy density of the diet (Mccay, 1949).

Vitamins

Vitamins are organic molecules that are needed in the body in very small amounts for different functions. They are neither energy sources nor structural compounds. Most vitamins cannot be synthesized by the body and must therefore be supplied in diet.

Vitamins are either fat soluble or water soluble. Fat soluble vitamins are A, D E and K. Water soluble vitamins include B complex and vitamin C. There are no dietary requirements for vitamin C because it is synthesized in the liver by dogs and cats (Pond W.G, 1995). Despite this, supplementation is important because it provides additional health benefits because it functions as a radical scavenger and an antioxidant in the body.

Vitamin K is synthesized by intestinal bacteria; there is therefore no dietary requirement for it. However, deficiency occurs when there is an alteration in the intestinal bacteria such as in antibiotic therapy. NRC therefore recommends that 0.33mgof vitamin K/100kcal ME in puppies, 0.45mg of vitamin K/1000 kcal ME in adults and 0.25mg/1000 kcal ME in cats is given in the diet (MVM, 2010).

Vitamin A includes retinal, retinol and retinoic acid retinol being the most biologically active form..Vitamin A is important for vision, reproduction, bone growth and maintenance of epithelial tissue . ɓ -carotene is the precursor of Vitamin A. Cats cannot convert ɓ-carotene into vitamin A due to lack of enzyme dioxygenase (Greaves et al, 1960). They therefore require a preformed source in their diet such as supplied by liver or fish oils. Retinol at 9000 IU/kg of diet should meet dietary needs during lactation, gestation and growth in cats.

Vitamin D has provitamin forms which are vitamin D_2 (ergocalciferol) and Vitamin D_3 (cholecalciferol).Vitamin D_3 is of more nutritional importance in cats and dogs.It regulates calcium and phosphorus metabolism in the body. Vitamin D is stored in the Liver, muscles

and adipose tissue. Hypovitaminosis D results in rickets in young animals and osteomalacia in old animals Hypervitaminosis D results in calcification of soft tissues

Vitamin E is important in the diet as it is a potent antioxidant in the body. It is obtained from plant oils such as corn oil and Soy bean oil (Carey and Hirakawa, 1995)

B-complex vitamins include: Thiamine, niacin, riboflavin, pyridoxine, pantothenic acid and biotin. They act as coenzymes, are involved in the use of food energy and are important for cell maintenance and growth and blood cell synthesis.

Minerals

Minerals are classified into macrominerals and trace minerals. Macrominerals are sodium potassium, calcium, phosphorus and magnesium and are required in larger amounts than the trace minerals like Iron, copper, .zinc and selenium.

Minerals have a variety of functions in the body. They activate enzymatically catalyzed reactions, provide skeletal support aid in nerve transmission and muscle contraction and function in water and electrolyte balance.

Mineral deficiency is rare in well balanced diets. Manipulation of dietary intakes of calcium phosphorus, sodium and magnesium in dogs and cats and copper in dogs for therapeutic effect is common (Bauer et al, 2004).

In both dogs and cats, the requirements for dietary calcium and phosphorus are increased over maintenance during growth, pregnancy and lactation. In dogs the optimal calcium: phosphorus ratio is 1.2-1.4:1. Minimum and maximum ratios by AAFCO are 1:1 and 2.1:1 (MVM, 2010) Excess phosphorus decreases calcium absorption leading to deficiency that is manifested by demineralization of bone. Excessive supplementation of calcium (> 3% DM basis) is a problem for growing, large and giant breeds of dogs.

Magnesium is important in intracellular metabolic enzyme pathways. Its deficiency comes about from excessive supplementation of calcium and phosphorus. Magnesium deficiency in puppies is manifested as lethargy and muscle weakness In cats Magnesium levels> 0.3% is detrimental due to alkalinity.

Iron and copper found in meats are well utilized in dogs and cats. Nutritional deficiencies are rare except in cases where the animals are fed almost entirely on vegetables or milk. Deficiencies result in anaemia andlesions of the haircoat and skin.

2.2 NUTRIENT REQUIREMENTS FOR DOGS AND CATS

Nutrient requirements of dogs are summarized on Table2.1 while those of cats are shown on Table 2.2.

Table 2.1 Nutrient requirements for dogs

Nutrient	Adult maintenance		Growth and reproduction	Puppies	
	Minimum	Maximum	Minimum	4-14 wks (g/1000 kcalME)	Ó14 wks (g/1000 kcalME)
Protein(%)	18.0		22.0	45	35
Arginine	0.51		0.62	1.58	1.33
Histidine	0.18		0.22	0.78	0.50
Isoleucine	0.37		0.45	1.30	1.00
Leucine	0.59		0.72	2.58	1.63
Lysine	0.63		0.77	1.75	1.40
Methionine	0.43		0.53	0.70	0.53
Phenylalanine	0.73		0.89	1.30	1.00
Threonine	0.48		0.58	1.63	1.25
Tryptophan	0.16		0.20	0.45	0.35
Valine	0.39		0.48	1.35	1.13
				Max(g/1000 kcalMe)	max(g/1000 kcalMe)
Fat (%)	5.0		8.0	330	330
Linoleic acid	1.0		1.0	65	65
Minerals				Min(Amt/1000 kcalME)	Min(Amt/1000 kcalME)
Calcium(%)	0.6	2.5			
Phosphorus(%)	0.5	1.6	1.0	1.0 g	2.0g
Potassium(%)	0.6		0.8		
Sodium(%)	0.06		0.6		
Chloride(%)	0.09		0.3		
Magnesium(%)	0.04	0.3	0.45	45mg	45mg
Iron(mg/kg)	80	3000	0.04	18mg	18mg
Copper(mg/kg)	7.3	250	80		
Zinc(mg/kg)	120	1000	7.3		
			120	10	10
Vitamins					
Vitamin A(IU/kg)	5000	250000	5000		
Vitamin D	500	5000	500		
Vitamin E	50	1000	50		
Thiamine(mg/kg)	1.0		1.0		
Riboflavin	2.2		2.2		
Pantothenic acid	10		10		
Niacin	11.4		11.4		
Pyroxidine	1.0		1.0		
Folic aci	0.18		0.18		
Vitamin B_{12}	0.022		0.022		
Choline	1200		1200		

Table 2.2 Nutrient requirements for cats

Nutrient	Growth and reproduction (min)	Adult maintenance and Growth		Kittens (Amount/1000 kcal ME)	
		Min	Max	Min	Max
Fats (%)	9.0	9.0			82.5g
Linoleic acid(%)	0.5	0.5			13.8g
Arachidonic acid(%)	0.02	0.02			
		Min	Max	Min	Max
Minerals				(Amt/1000 kcal ME)	
Calcium(%)	1.0	0.6		1.3 g	
Phosphorus(%)	0.8	0.5		1.2g	
Potassium(%)	0.6	0.6		0.67g	
Sodium(%)	0.2	0.2		310mg	
Chloride(%)	0.3	0.3		190mg	
Magnesium(%)	0.08	0.04		40mg	
Iron(mg/kg)	80	80		17mg	
Copper(mg/kg)	5	5		1.1mg	
Zinc(mg/kg)	75	75		12.5mg	
Vitamins				(Amt/1000 kcal ME)	
Vitamin A(IU/kg)	9000	5000			20000
Vitamin D(IU/kg)	750	500		0.70ug	188ug
Vitamin E(IU/kg)	30	30			
Vitamin K(IU/kg)	0.1	0.1			
Thiamine(mg/kg)	5.0	5.0		1.1mg	
Riboflavin(mg/kg)	4.0	4.0			
Pyridoxine(mg/kg)	4.0	4.0			
Niacin(mg/kg)	60	60			
Folic acid(mg/kg)	0.8	0.8		150ug	
Vitamin B_{12}(mg/kg)	0.02	0.02			

Table 2.3 Energy requirements for Dogs and cats

Animal	MER(kcal/day)
Healthy adult dogs	
Intact	1.8xRER
Neutered	1.6xRER
Obese prone	1.4xRER
Healthy Puppies	
<4 mo old	3xRER
>4 mo old	2xRER
Healthy adult cats	
Intact	1.4xRER
Neutered	1.2xRER
Obese prone	1.4xRER
Healthy Kittens	2.5xRER

2.3 TYPES OF DOG AND CAT FOODS

Commercial dog and cat foods are available in 3 forms depending on the processing method and water content.

- Canned foods
- Dry foods
- Semi moist

Dry foods contain å 10% moisture and 90% dry matter. Dry foods are more economical to feed and they store well due to their low moisture content and they have a long shelf life. They also offer dental hygiene advantages because the chewing and drying off the dry foods helps to prevent plaque and calculus (Bren L, 2001). Dry foods tend to be less palatable than canned or semi moist foods. Harsh or improper drying of foods can cause a reduction in nutrient availability and loss of the nutrient(Carey and Hirakawa,1995)

Canned foods contain 68-78%water and 22-32% dry matter. They typically contain higher amounts of fresh and frozen meat, poultry and fish and animal byproducts. Most canned foods contain a relatively small proportion of digestible carbohydrates but have protein of upto 50% and fat of upto 32% .Advantages of canned foods include, long shelf life in a durable container and high palatability, the main disadvantage is they are more expensive. Dogs and cats that have moderate to low energy requirements are predisposed to obesity when fed on canned foods due to their high palatability resulting in overconsumption (Carey and Hirakawa,1995).

Semi moist foods contain moisture content of 25-30% water and 60-75% dry matter. They do not require refrigeration and are preserved using humectants which are substances that bind water making it unavailable for bacteria and mould. They contain high levels of simple

sugars which contribute to their high palatability and digestibility. Dogs tend to enjoy the taste of simple sugars but cats are less likely to select sweet foods.

2.4 FEEDING MANAGEMENT THROUGH LIFE STAGES

2.4.1 Growth

Growth greatly increases nutrient demands over those of maintenance. Growth diets should have increased nutrient densities,digestibilities and bioavailability to provide nutrients in smaller volumes of food. Complete and balanced diets designed for growth have enough Calcium, Phosphorus and vitamin D such that supplementation beyond these is rarely necessary. Overfeeding increases growth rate but is incompatible with skeletal development and increases susceptibility to obesity later in life. Puppies between the age of weaning to 6 months should be fed 3 times a day, those between 6-12 months should be fed twice a day. Small breeds of dogs may have to be fed more than three times a day. A slow growth rate is preferable to a fast one and weight gain should be closely monitored. The size of food particles is very important in feeding puppies and kittens.

2.4.2 Gestation

Feeding recommendations of pregnant bitches through the first two trimesters are like those of maintenance because fetal growth in these 2 trimesters is minimal. This is the opposite for pregnant queens as their nutrient requirements increase almost immediately after becoming pregnant. In the last trimester, the amount of food should be increased 20-30% over that of maintenance.

2.4.3 Lactation

The energy requirements for lactating bitches and queens depend on the litter size. Energy levels 2-4 times those of maintenance should be given to avoid loss in body condition. Adlib feeding with a diet containing 10-20% fat is recommended for lactating bitches.

Lactating queens tend to loss condition despite the type of diet fed therefore net tissue reserves should increase in preparation for lactation. A diet containing 10-35% fat, 30-40% protein and low fibre(<5%) should be fed. Supplementation is not necessary in a well balanced and complete diet.

2.4.4 Geriatrics

Older dogs and cats may require different nutrient profiles with respect to fat, fiber and protein in order to maintain optimal body condition. Aged animals have poor appetite, degenerating teeth and gums and reduced gut motility. Fibre in diet can be increased and a concentrated source of nutrients should be fed.

2.4.5 Work or stress

Working dogs require upto 50% more energy than pets depending on the nature and amount of work the dog is subjected to. Most diets designed for work and stress have increased levels of animal fats with the other nutrients appropriately balanced to the increased energy density. Increase in protein is also necessary with minimizing the carbohydrate contribution. Feeding a small portion of the daily ration before the work shift is recommended. Dietary energy should be reduced during inactive periods to avoid obesity.

2.5 NUTRITION IN DISEASE MANAGEMENT

Nutrition is an important aspect of disease management. The nutritional requirements of sick dogs and cats are qualitatively the same as those of healthy ones but only differ in amount.

2.5.1 Cachexia

Cachexia appears as a response increased catabolism with either normal or decreased appetite. Cachexia is common in cancer, chronic renal or cardiac disease patients. The dietary goal is to increase the caloric density and the palatability of the food. Smaller amounts of more calorically dense foods (higher fat content) are fed.

2.5.2 Diarrhoea

Dietary requirements in patients with diarrhea vary depending on where the diarrhea is localized and the underlying cause. Animals with small intestine diarrhea benefit from diets that are highly digestible and those suffering from large intestine diarrhea require diets that contain probiotics.

2.5.3 Constipation

The objective of dietary management in patients suffering from constipation is to increase the amounts of insoluble fibre(10-25%DM basis) or moderately fermentable fibres in dogs or a highly digestible balanced diet in cats. The patients should be fed 2-4 times a day.

2.5.4 Diabetes mellitus

Dietary requirements for diabetic dogs without concurrent disease include feeding a diet that contains a moderate amount of a blend of soluble and insoluble fibre e.g beet pulp and

cellulose at 3.5g/100 kcal/day(MVM,2010). It is imperative that the type and quantity of nutrients as well as ingredients in diabeticsôô diets remain constant. Semi moist foods are not appropriate for diabetic patients due to an increase in postprandial blood glucose levels due to the high simple carbohydrate levels found in semi moist foods. Dry foods are best suited for diabetic patients because they contain high levels of both complex carbohydrates and plant fibres which require enzymatic digestion hence slowing the rate of glucose delivery to blood.

2.5.5 Congestive heart failure

Reduction of water retention, restriction of sodium intake and lowering of sodium levels to encourage dieresis are objectives of managing CHF. Typically commercial dog and cat foods contain 0.45%-0.90% (450-900mg sodium/100g diet dry matter). Dietary sodium restriction is classified as mild (400mg sodium/100g diet dry matter) to severe (240mgsodium/100g diet dry matter) Therefore commercially prepared dog and cat foods do not supply the requirements of CHF patients. Ingredients such as liver should be avoided as they contain high levels of sodium but rabbit, chicken and fish have reasonably low sodium levels and should therefore be embraced when preparing a well balanced diet for CHF patients. Taurine supplementation in both dogs and cats with CHF is necessary to avoid cardiomyopahty associated with taurine deficiency.

2.5.6 Kidney disease

The objective of dietary management in renal failure is to lessen the metabolic demands on the kidney and to diminish the metabolic end products that cannot be readily excreted. Water should always be readily available and increased BUN is lowered by decreasing dietary protein. Energy should be supplied primarily via more digestible fats and carbohydrates. Feeding a highly digestible protein source facilitates meeting protein requirements using smaller amounts of dietary protein. Phosphorus intake should also be limited.

Protein of high biological value of 15-20% in dogs and 28% in cats is recommended. Phosphorus should not exceed 0.4-0.6% (DM basis) Water soluble vitamins and minerals should be supplemented. Moderately fermentable fibers should be given in the diet to facilitate enteric dialysis and facilitate a non renal route of urea excretion. In advanced renal failure, more energy should be provided through fats

2.5.7 Feline lower urinary tract disease

Urine dilution in FLUTD is helpful as it reduces the concentration of substances in urine which lead to irritation of the urinary bladder mucosa. The most effective and safest method of urine dilution in cats is feeding canned diets (Elliott J et al, 2000). Other dietary modifications include supplementation with sodium. Water intake should also be encouraged.

2.5.8 Fever

Fever increases energy requirements because of increased metabolic activity. A highly palatable diet should therefore be fed and caloric density should be increased by feeding a higher fat diet, offering smaller meals more frequently due to the lack of appetite.

2.5.9 Pancreatitis in dogs

A standard treatment of pancreatitis in dogs is nothing per os (NPO) until vomiting ceases. When oral feeding can be resumed, a commercially prepared easily digestible diet with moderate fibre 10-15% dry matter basis and low in fat 5-10% should be fed in small frequent meals 3-6 times a day (Whittemore et al,2005). Feeding a complete and balanced low fat diet is recommended for long term management of pancreatitis in dogs

2.5.10 Obesity

Obesity is the most common nutritional health problem in dogs and cats. Obesity occurs when there is an increased energy intake which exceeds utilization. Breeds predisposed to obesity include Labradors, retrievers, daschunds and beagles. Caloric restriction with exercise itôs the best method of combating obesity in dogs and cats. Maintenance diets should not be fed in obese animals because they are primarily designed for moderately active adults (FEDIAF, 2010). Therapeutic weight loss diets should include adequate amounts of protein with increased fibre in the diet. Generally dog and cat treats should be avoided or restricted to <10% of the total caloric intake.

CHAPTER THREE: MATERIALS AND METHODS

3.1 STUDY AREA

The study was done in Nairobi the capital and largest city in Kenya. Nairobi is a populous city with an increase in pet ownership and demand for quality pet food especially in the suburbs.

3.2 SAMPLING

Food samples were collected from the supermarkets, different small animal veterinary clinics as well as from pet ownersô homes. A total of 10 food samples from different manufacturers (both local and imported) were collected.

3.4 LABORATORY ANALYSIS

All samples were subjected to the proximate analysis method (Maina.J.G, 2007-2008).

a) Dry Matter was determined through drying the samples by placing in an oven set at 105ęC.
b) Moisture is determined by heating the sample in an oven set at 105ęC to remove the water present.
c) Ash is the non combustible inorganic fraction of the sample. The combination of minerals in biological samples is variable so this value does not give information on the amount of any specific element. The ash percentage is used in calculating the organic matter by difference. Ash is used to determine specific minerals e.g. calcium, phosphorus

d) Ether extract is extracted with diethyl ether. Ether extract includes simple lipids, fat soluble vitamins, fat soluble hormones and hydrocarbons. Ether extract varies from feed to feed because of variation in neutral fat content of the extract

e) Crude fibre is the portion of carbohydrates that resists digestion when boiled in dilute sulfuric acid for 30 minutes. It is filtered and the residue boiled in dilute potassium hydroxide. Crude fibre includes cellulose and a portion of other polysaccharides but no glycogen or starch.

f) Crude protein is determined through kjedahl nitrogen method in which the nitrogen is multiplied by a factor of 6.25 this method gives no information on the amount and kinds of amino acids.

g) Nitrogen free extract. This portion includes monosaccharides, oligosaccharides and glycogen or starch. It is obtained by subtracting the percent of 1-5 from 100% thus giving the NFE

h) Phosphorus determination is done using colorimetry which is the use of color spectrophotometer.

i) Calcium determination was through use of a flame photometer (AOAC,2012).

CHAPTER FOUR: RESULTS

4.1 Brands of dog and cat food available in the market

In Nairobi, in the different supermarkets, pet stores and clinics several dog and cat foods brands were available. The imported brands of pet food were 13 while the local brands were 8.The imported brands were available in all the supermarkets and in all the veterinary small animal clinics visited. Local brands of food were available in all the supermarkets visited and only in one clinic. There were no local brands of cat foods in the supermarkets or clinics. The types of food that were readily available in the market were the dry foods. Canned dog and cat food brands were only 4 and available in selected supermarkets. The following table is a summary of the types of foods and where they were found.

Table 4.1 Location, Brand of food, Imported or local

Location	Brand name	Imported/Local
Davis and Ghalay clinic	Madra	Imported
	Whiskas	Imported
	Go cat	Imported
	Pedigree	Imported
	Alpo	
KK security Firm	Golden can	Imported
	Pedigree	Imported
Small Animal Clinic-CAVS	Besbix	Local
Sercombe Veterinary clinic	Royal Canin	Imported
Nakumatt Prestige	Felix	Imported
	Cat cuisine	Imported
	Go Cat	Imported
	Whiskas	Imported
	Catmor	Imported
	Simba	Imported
	Rufus	Imported
	Pedigree	Imported
	Madra	Imported
	Alpo	Imported
	Special Dog	Imported
	Supreme dog food	Imported
	Top dog	Local
	Shepherds dog	Local
	Fido	Local
	Goldstar	Local
Uchumi Ngong road	Omena perfect mix	Local
	Scooby	Local
	Topdog	Local
	Besbix	Local
	Gold star	Local
	Gilani	Local
	Shepherds dog	Local
	Pedigree	Imported
Nakumatt Lifestyle	Top dog	Local
	Fido	Local
	Shepherds dog	Local
	Scooby	Local
	Goldstar	Local
	Go cat	Imported
	Special dog	Imported
	Felix	Imported
	Simba	Imported
	Supreme dog food	Imported
	Rufus	Imported
	Cat cuisine	Imported
Tuskys	Top dog	Local
	Fido	Local
	Gilani	Local
	Pedigree	Imported

4.2 Nutrient content indicated on the packaging

Most dog and cat foods available in the market, had labels from which the pet owners can get important nutritional information. This information includes the ingredients, composition guaranteed nutrient content and recommended feeding (Preparation and amount).

Table 4.2 Nutrient content and recommended amount for various brands of pet food.

Brand of food	**Guaranteed analysis**							**Recommended feedings(g/kg bwt)**
Pedigree medium to large Adult	C.P 25%	Moisture 10%	C.F 3%	Ash 6%	Fat 13%	Ca N/A	P N/A	15-20kg=250-300g 20-30kg=300-410g 30-40kg=410-500g 40-60kg500-700g
Madra Adult	25%	10%	2%	8.5%	8%	2%	N/A	2-5kg=50-100g 5-12kg=100-250g 12-25kg=250-350g 25-35kg=350-500 35+kg=500-1200g
Alpo Puppy	24%	10%	3%	9%	12%	1.75%	0.9%	Wean-3 mos=94g-348g 4-5 mos=201g-416g 6-8mos=234g-380g 9-12 mos=181-304g
Golden can Adult	26%	12%	4%	6%	12%	1%	0.8%	5kgs=1/3 -1 ¼ cups 5-12kg=1 ¼- 2 1/3 ñ 12-25kg=2 1/3-4 ñ 25-37kg=4-5 ½ò 37-75kg=5 1/3 -9ò
Golden can puppy	27%	12%	3%	7%	11%	1.1%	0.9%	<3 mos=4-6 ¼ cups 3-6mos=1/3-5 1/3 ñ 6-9 mos=2 ¾ -4 ½ ñ 9-12 mos=2 ¼ -3 ¾ò
Besbix	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Top dog	20%	N/A	5%	N/A	5%	N/A	N/A	Ò10kg=170g 10-20kg=250g >20 kg=330g
Omena perfect mix	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Up to 20 kg=250 g >20 kg=330g
Go cat	30%	10%	2.5%	7.5%	10%	1.3%	1%	2-3kg=40-50g/day 3-4kg=50-605g/day 4-5kg65-80g/day 5-6kg=80-90g/day
Whiskas	28%	10%	3%	8%	11.5%	N/A	N/A	3kg=45g 4kg=55g 5kg=65g

4.3 Laboratory analysis using proximal analysis

The samples were analyzed in the laboratory using the proximate analysis method which determined the crude protein, crude fibre, moisture, ash and ether extracts (fats). The ash was then further analyzed for the amount of calcium and phosphorus as well as silica content within the samples.

Table 4.3 Proximate composition of various brands of pet food

Brand	Moisture	Ash	CF	EE	C.P	Ca	P	NFE
Dog food 1	6.2%	6.3%	5.1%	8.7%	22.9%	0.8%	0.2%	50.8%
Dog food 2	12%	14.2%	4.2%	5.9%	19.7%	1.1%	0.5%	44%
Dog food 3	7.1%	9.2%	4.1%	9%	22%	0.4%	0.2%	48.6%
Dog food 4	7.2%	7.3%	5.6%	10.1%	20.9%	1%	0.3%	48.9%
Dog food 5	7.8%	6.8%	5.1%	8.5%	21.7%	1.2%	0.6%	50.1%
Dog food 6	9.1%	5.1%	7%	5.3%	18.8%	0.7%	0.6%	54.7%
Dog food 7	10%	7.3%	6.2%	8.2%	20.2%	1%	0.4%	48.1%
Dog food 8	6.9%	5.3%	4.1%	8.6%	20.4%	0.5%	0.5%	54.7%
Cat food 1	6.5%	7.2%	5%	7.3%	24.4%	1.3%	0.4%	49.6
Cat food 2	5.2%	7%	3.9%	8.3%	24.1%	1%	0.6%	51.5%

Table 4.4 Acid in soluble ash (% of Total ash)

Acid in soluble ash indicates the amount of silica present in a sample and is shown in

Table 4.4

Brand	**Acid in soluble ash(%)**
Dog food 1	13.9%
Dog food 2	8.4%
Dog food 3	9.4%
Dog food 4	12.9%
Dog food 5	9.3%
Dog food 6	17.5%
Dog food 7	15.5%
Dog food 8	24.5%
Cat food 1	13.7%
Cat food 2	11.7%

4.4 Comparison between the declared nutrient content and the analysis

The declared nutrient content and the results of the analysis were compared for different brands and different nutrients and results are shown in Figure 1- Figure 3

Figure 1 Comparison of guaranteed and laboratory analysis of protein

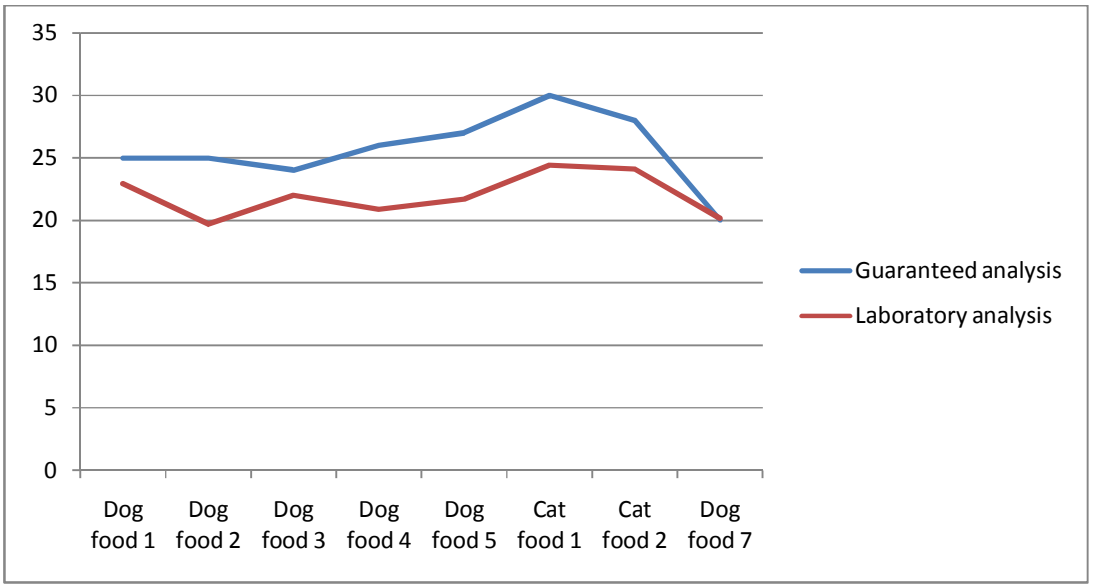


Figure 2 Comparison of guaranteed and laboratory analysis of fats

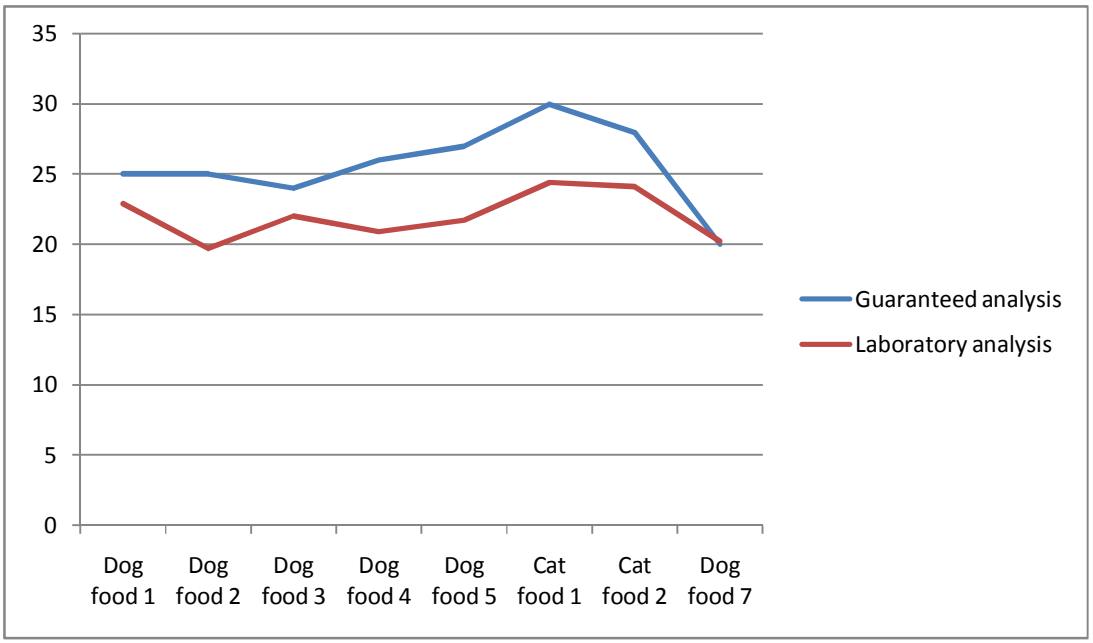
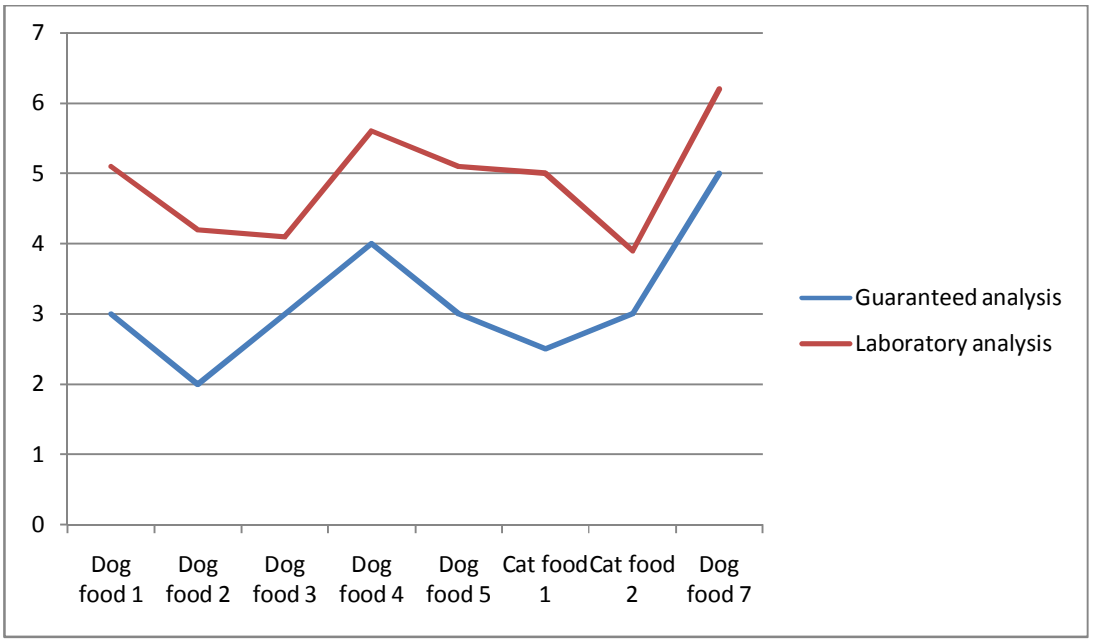


Figure 3 comparison of guaranteed and laboratory analysis of crude fibre



4.5 Comparison between nutrient requirements and Laboratory analysis

The nutrient requirements of dogs and cats and the results of the analysis were compared for different brands results are shown in Figure 4- Figure 8

Figure 4 Nutrient requirements for proteins vs. Lab analysis of protein for adult maintenance and growth and reproduction

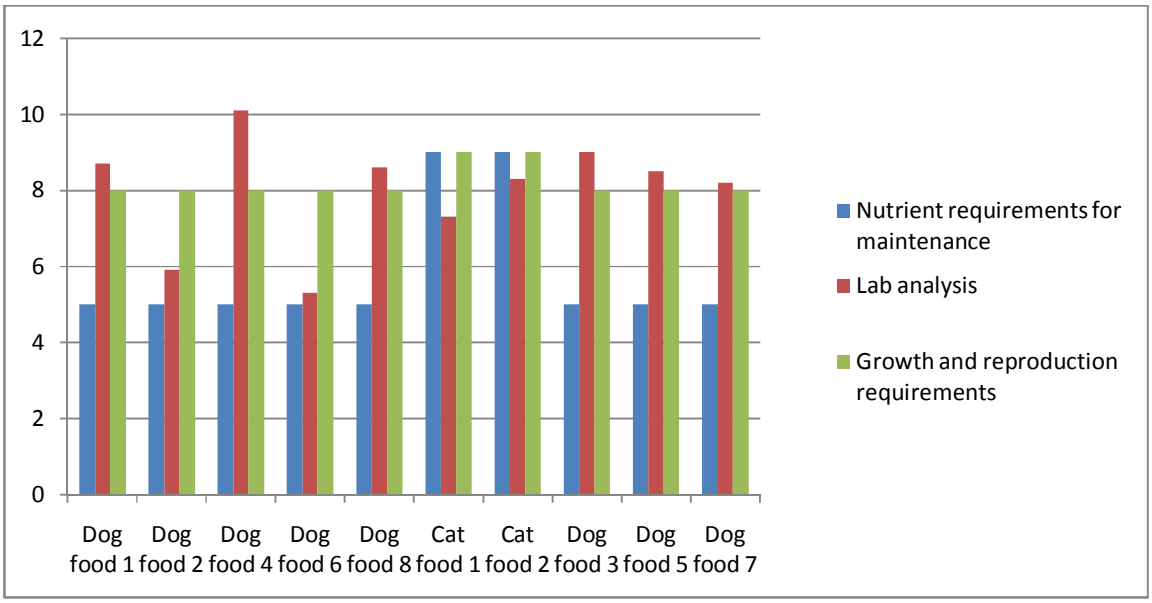


Figure 5 Nutrient requirements for fats vs. Lab analysis of fats for adult maintenance and growth and reproduction

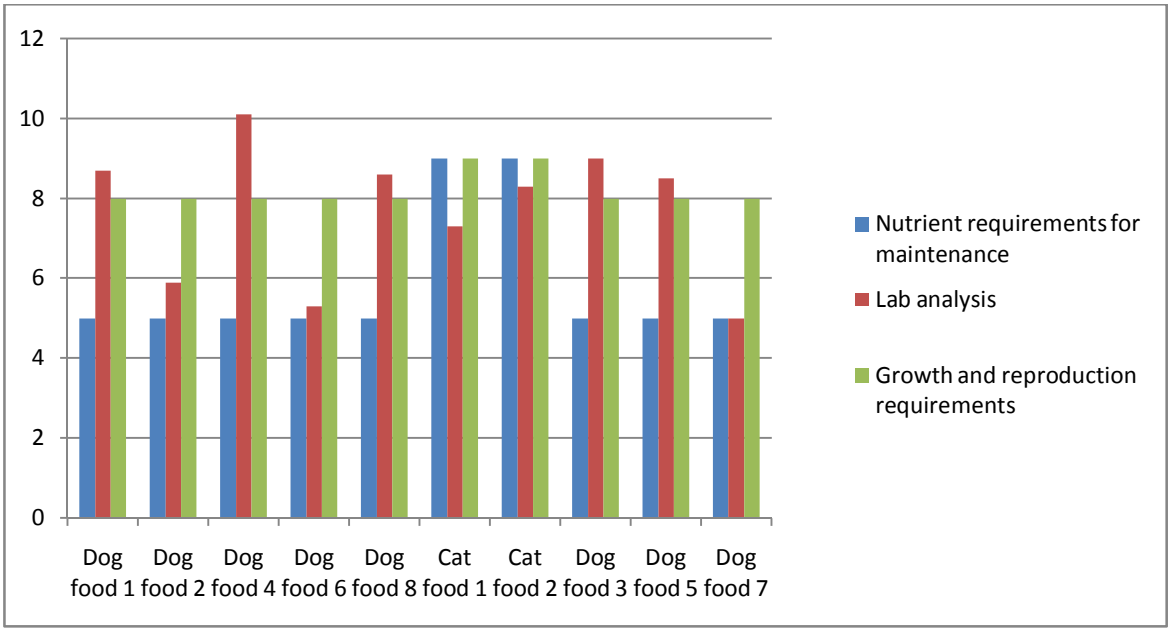


Figure 6 Nutrient requirements for calcium Vs. Lab analysis of Calcium for adult maintenance and growth and reproduction

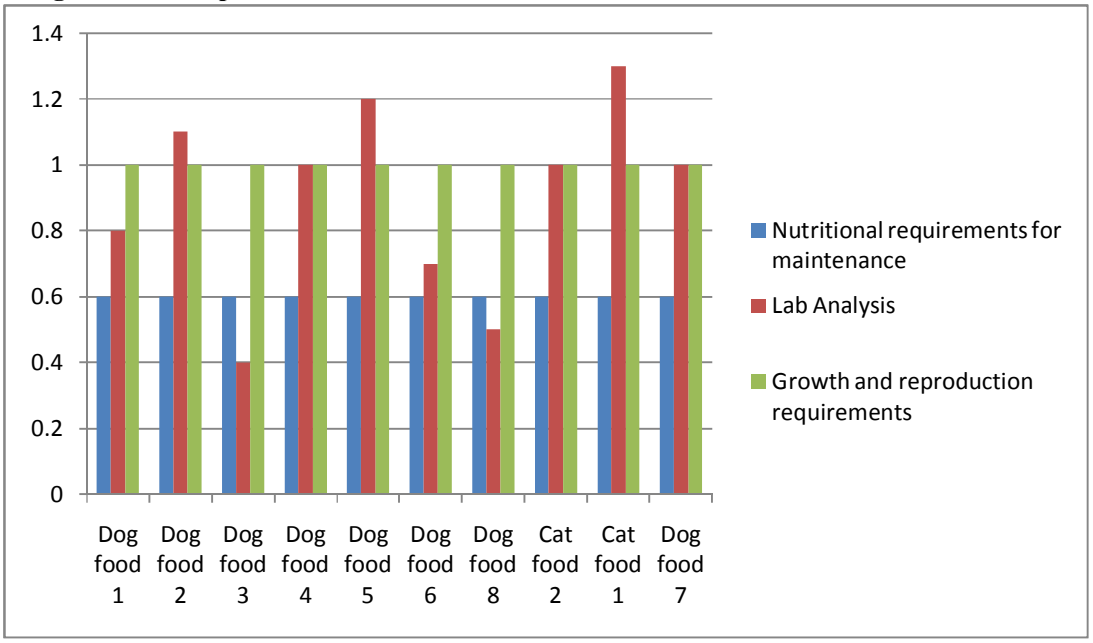


Figure 7 Nutrient requirements for phosphorus vs. Lab analysis of Phosphorus for adult maintenance and Growth and reproduction

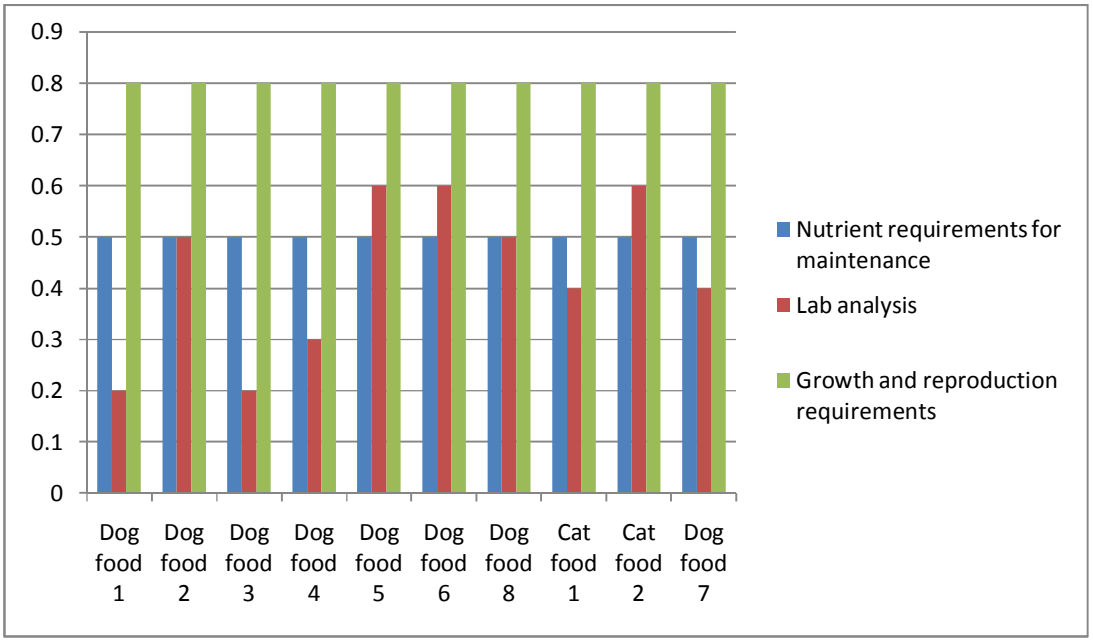
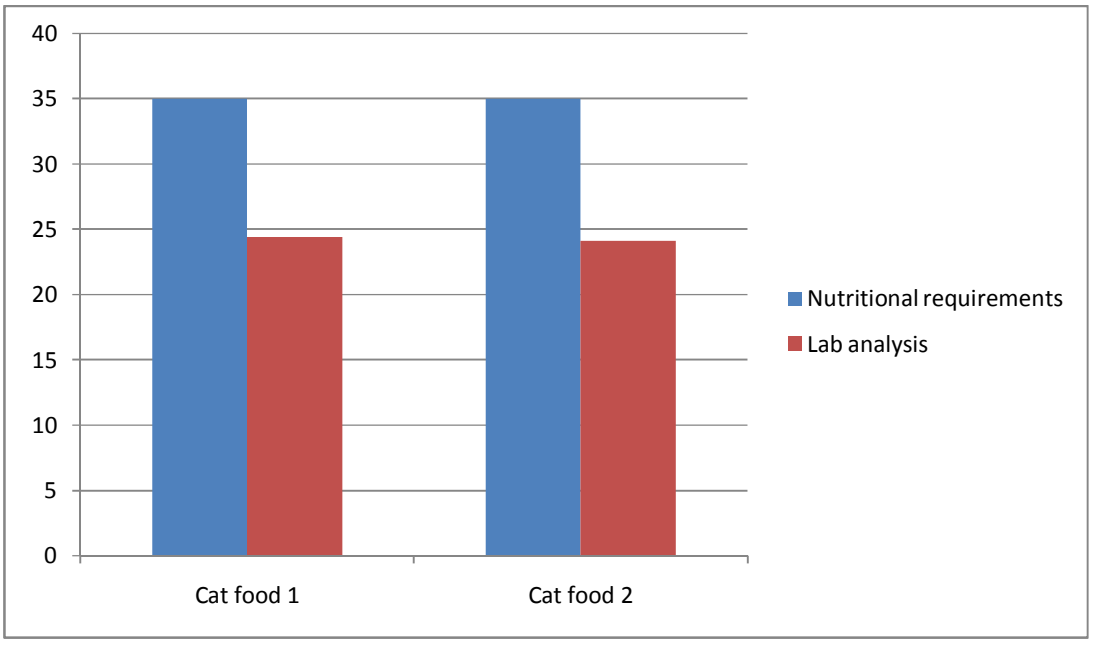


Figure 8 Nutritional requirements for proteins vs. lab analysis of Protein during lactation for queens.



CHAPTER FIVE: DISCUSSION

The survey revealed that the most common types of pet foods in the Kenyan market are dry foods. Canned foods are available but in very few selected retail outlets. There is a variety of dry foods currently available in the Kenyan market with majority being the imported brands. Local brands of dog food are available but no local brand of cat food currently exists. The imported brands all have guaranteed analysis and recommended feeding but most of the local brands did not, making it harder for the clients to purchase without information on how they should feed their pets.

From the laboratory results, it is clear that all the brands fell short of their declared protein and fat nutrient levels but all had levels of fibre that exceeded those declared. Dog food 4 was the only brand that was significantly close to the level of declared protein. Despite this, all the brands except the cat food brands satisfied the minimum protein requirements for adult maintenance. When it comes to growth and reproduction, the protein levels fell short in all the brands therefore making them unsuitable for use in gestating and growing animals without supplementation of protein

Fat levels for 4 of the brands superseded the nutrient requirements for maintenance as well as growth and reproduction, thereby making them very suitable for active, gestating and growing animals which require a higher level of energy.

Crude fibre levels in all the brands of food were way above the guaranteed analysis levels.

Further analysis of ash revealed that all the brands of food are contaminated with silica during processing. Of all the brands, one Dog food 8 was the most contaminated and should therefore be avoided for dogs with renal disease. The bulk of nutrients in the samples

consisted of the carbohydrates which supply the animal with energy. The high levels of carbohydrates (NFE) ensured a good supply of energy.

5.1 CONCLUSIONS

The results show that among all the nutrients, protein is the most limiting in the available pet foods (especially cat foods). This is because protein ingredients used in commercially available diets are expensive especially if they are of animal origin. From the analysis, it is clear that non specific diets should be avoided for dogs and cats with specific needs as most of the time they tend not to meet the minimum requirements. Local brands of dog food are not specific for puppies or working dogs and should therefore only be used in adults for maintenance. Clients looking for the best for their animals are more likely to settle on imported brands of food due to their aesthetic packaging and availability of information regarding the nutrients found in the food.

5.3 RECOMMENDATIONS

Dry foods have very low moisture levels, ample water should therefore be provided during feeding. Dry foods can also be given with milk for puppies and cats in order to increase the moisture content of diet and improve palatability. Commercially prepared foods should be supplemented especially with proteins and minerals if they do not satisfy the required demands. Supplementation of nutrients (especially minerals) is necessary in order to avoid deficiencies and reduce susceptibility to disease.

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