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FVR

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The effect of dietary treatment on some blood parameters of neutered cats.

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Farmina Vet Research Group (FVR) has the target to support Vets in the management of some common pet diseases through the proven efficacy of Farmina Vet Life diets.

Moreover FVR aims at solving nutritional problems and provides scientific professional advice through the joint work with the Animal Nutrition group of the University of Naples Federico II (Scientific Responsible Prof. Monica Isabella Cutrignelli)

Today Farmina Vet Research is able to establish a relationship with the veterinary world, dealing with medical and nutritional matters.

Farmina Vet Research is the Scientific department of the Company where authorities involved in different fields of investigation cooperate with the only purpose of providing professional advice.

Farmina VT works jointly with production studying technological innovations to improve food processing and to help the use of new products to take up the future challenge to improve health and the wellbeing of our faithful friends through the quality of its products.

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Study carried out in agreement with Department of Animal Science and Food control of the University of Naples "Federico II".

Introduction

The necessity to perform gonadectomy on pets, and the most suitable period to carry it out have been discussed for a long time (Spain et al., 2004a; Spain et al. 2004B; Reichler, 2009). It is mainly due to fact that the negative and positive effects of gonadectomy vary according to of the age at which it is performed, sex, species and breed, as well as the lifestyle adopted after the operation.

Contraception through surgical neutering is an irreversible operation, which prevents reproduction through gonad removal; in females it may include uterus removal as well (Davidson et al., 2004; Devitt et al., 2005).

Gonadectomy, besides modifying reproduction, leads to changes in sexual behaviour and increases diseases related to sex hormones, salpingectomy and vasectomy, instead, do not have any effects on the behaviour, nor on diseases caused by sex hormones, as they do not interfere with hormone production.

Nowadays gonadectomy is the best contraception technique in pets. In particular, as it is irreversible, it is the most suitable technique to prevent straying so that it is compulsory for pets without owners (law 281/8/14 1991) even if undesired populations of cats and dogs are increasing (New 2006). Some studies (Patronek et al., 1990a; Patronek et al., 1990b) have shown that unneuterd pets may be abandoned more often than neutered ones. Moreover Salman et al. (2000) have pointed out that some pets are neutered to limit behavioural problems although some owners, not seeing any improvements abandon them anyway. Alexander and Shane (1994) have reported that 34% of abandoned pets are among unwelcome broods and New et al in a research carried out in 2004 pointed out that every year, in the United States 56% of dog pregnancies and 68% of feline ones are not planned because of the pet owners' poor knowledge of the estrous cycles' characteristics in both the species.

Veterinaries and pet owners wonder about the most suitable age to perform gonadectomy, especially in these last years the average age of the operation has been lowered: at present most veterinaries consider the age between 6 and 9 months as the best period to carry out gonadectomy even if there is no scientific evidence that this is actually so.

Cultural and personal factors, such as religion, ethnic origin, urban or rural position of the family as well as literacy may affect the owner's decision to submit his/her pet to gonadectomy. Even the species and the sex of the pet play an important role in that choice: a cat is neutered more frequently than a dog (Manning et al.1995; New et al. 2000). This is partly due to the lower incidence of post-surgery complications (e.g. swelling of incision area, intestinal problems) after gonadectomy in cats (2.6%) rather than in dogs (6.1%) (Pollari et al., 1996).

The researchers from around the world are trying a contraceptive method which, through a simple and

single operation, allows complete contraception, greatly reducing the costs and side effects. In male dogs the solution could be an intratesticular injection of zinc gluconate (Levy et al.2008). In females gonadectomy is still indicated as the best instrument to reduce the density of stray animals and therefore the risks of zoonosis. The castration of male cats is recommended as epidemiological studies have shown that average life expectancy in neutered subjects is much higher than in unneutered cats (Kalz 2001).

The main and common long term effects of gonadectomy in cats are reported here below.

Positive and negative effects of gonadectomy on behavioural disorders

Behavioural disorders due to sexual dimorphism are several; the most common ones are attempts to mount and emission of urine splashing to define the territory (Hart and Eckstein, 1997). Even aggression may be considered a behaviour due to sexual dimorphism at least in the forms associated with the presence of females in season (aggression among females or males living with estrous females). Gonadectomy and therefore the reduction of circulating gonad steroid hormones are related to a reduction of sexual dimorphism behaviours (Patronek et al., 1996; Stubbs et al., 1996; Hart et al., 1973). The impact of the gonadectomy on behavioural disorders is not related to the duration of behavioural problems and may or may not be associated to the first personal experience in the animal affected by the problem (Hopkins et al.1976; Nielsen et al., 1997; Hart and Cooper, 1984; Sakata et al, 2002). The sexual behaviour of male cats makes them undesirable and often dangerous to their owners (Root Kustritz, 1996). A reduction of sexual dimorphism behaviour after castration is an extremely important benefit of gonadectomy (Root Kustritz, 2007).

Positive and negative effects of gonadectomy on the female reproductive system

In few countries the ovary-hysterectomy is the sterilization technique preferred for bitches because of its alleged prophylaxis towards uterus diseases, even if most epidemiological investigation on long- and medium- term effects of sterilization have not shown any benefits related to uterus removal in healthy bitches (Okkens et al. 1997; Van Goethem et al. 2006).

The incidence of pyometra in female cats ranges from 23 to 24% in females between 4 and 10 years of age, respectively (Fukuda 2001; Egenvall et al., 2001) the highest risk is in females, which have never reached a full-term pregnancy (Niskanen et al., 1998). In neutered female cats uterus diseases are less frequent than in unneutered ones treated with progestin. Hagman (2004) pointed out that about 25% of unneutered female cats older than 10 years of age shows pyometra. Potter et al. (1991) reached the conclusion that females of 5 years old or more have a high risk of developing uterine pathologies. Generally the cancers of the genital tract are quite unusual in neutered cats. Most uterine, vaginal and vulvar tumors in female cats are leiomyoma (Wolke 1963; Stein 1981; Thacher and Bradley1983; Kydd and Burnie 1986). It is very likely that the development of such neoplasms is due to hormones. Moreover ovary-hysterectomy applied simultaneously with the removal of the tumor may have beneficial effects. Gonadal hormones are responsible for the normal development of external genitals. The ovaryectomy and particularly the age at which it is performed significantly affect the size of the vulva significantly. Salmeri et al. (1991) and Root et al. (1997) tested three groups of female cats and dogs highlighting the following: gonadectomised subjects at an early age (7 weeks-7 months) have a smaller vulva with a more infant morphology, they may present early vaginitis due to vaginal atrophy following gonadectomy.

The effects of gonadectomy on breast tissue.

In female cats the incidence of mammary cancers is about 10%, yet it incidence corresponds to 17% of the whole of neoplastic diseases affecting the females of the species (Schmidt and Langham 1967; Dorn et al. 1968; Patnaik et al. 1975; Hayes et al. 1981; Hampe and Misdorp, 1974). The incidence of metastatic processes is 77% of cases of breast cancer; lungs represent the metastatic site of choice (30.8% of cases) (Moulton et al., 1986; Misdorp and Hart, 1979).

The increasing age and breed are risk factors for the development of mammary gland tumors, with a mean age at diagnosis of about 10 years of age for cats and dogs (Verstegen and Onclin, 2003; Cohen et al., 1974; Johnston et al., 2001). There is evidence of a breed predisposition: Siamese and short hair cats prove to be more susceptible (Verstegen and Onclin, 2003; Johnston et al., 2001; Sorenmo, 2003). The non-sterilization is the main risk factor for cats and dogs (Misdorp,1988; Hayes et al., 1981). On average, unneutered cats and dogs are 7 times more likely to develop mammary gland tumors with aging, if compared to the neutered ones (Dorn et al., 1968). An exact cause and effect relationship between the missed sterilization and the development the non-sterilization and the development of mammary gland tumors has not yet been identified, though it is likely that direct and indirect stimulation induced by estrogens and progesterone on breast tissue are responsible for the above mentioned neoplastic forms (Verstegen and Onclin, 2003; Hamilton et al., 1977). The risk of developing breast cancer is reduced by 91, 86 and 11% in neutered female cats in the first 6, 12 and 24 months of life, respectively (Overley et al. 2005). Instead the preventive effect of sterilization does not exist when it is performed on animals older than 2.5 years. Regardless of the age at which it is performed gonadectomy proves to have preventive effects on the development of benign breast tumors (Phillips 2002).

On the contrary some studies have not shown any effects on survival times after ovariectomy and/or the removal of a malignant breast cancer (Schneider et al.1969; Yamagami et al, 1996; Morris et al. 1998; Philibert et al. 2003) other scholars suggest this practice in order to increase the possibility of survival (Sorenmo et al. 2000).

Positive and negative effects of gonadectomy on the male reproductive system

Besides permanent effects on reproduction, bilateral orchiectomy has prophylactic and therapeutic effects on all diseases deriving from androgenic hormones such as benign prostatitis, propstatic hyperplasia and perineal hernia.

Either in males or in females the effects of gonadectomy on genital development depends on the age at which it is carried out. In particular Salmeri et al. (1991) and Root et al. (1997) checked the effects of gonadectomy by comparing unneutered cats and dogs

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with those which were gonadectomised, as they were 7 weeks or 7 months old. The most striking difference is the lack of development of the prepuce, penis and penile bone in neutered dogs since puppies and lack of penile prominence in cats.

Orchiectomy prevents testicular and epididymis disorders, such as tumors and twisting of the spermatic duct, orchitis and epididymis. Such disorders are rather unusual in cats, while in dogs the testis is the second atomic site of neoplastic development (Hayes and Pendergrass, 1976).

Prostatic cancer is quite unusual in dogs (less than 0.6% in post-mortem examinations) and much more in cats, though in both the species when it occurs, it is highly malignant (Weaver 1981). Castration has been identified as a treatment in human species seeing thet gonadectomy reduces the circulating levels of testosterone therefore may limit the evolution of the prostatic tumor, however, though prostatic cancer is an androgen dependent neoplasia, the effects of gonadectomy are only temporary and the prognosis is unfavourable. In 1987 an investigation pointed out that neutering at any age does not have any prophylactic effect on prostatic cancer in dogs (Obradovich et al.1987). Furthermore 8 cases of cat prostatic cancer have been analysed, whose one was neutered (Hawe 1983; Carpenter et al., 1987; Hubbard et al. 1990; Caney et al. 1998; LeRoy and Lech 2004).

Positive and negative effects of gonadectomy on the lower urinary tract

Several studies have shown that gonadectomy affects urinary incontinence from 3 to 21% (Joshua 1965; B.S.A.V.A. 1975; Ruckstuhl 1978; Osborne et al. 1980; Okkens et al., 1981, 1997; Holt 1985; Thrusfield 1985; Arnold et al. 1989; Blendinger et al. 1995B; Stocklin-Gautschi 2000; Stocklin-Gautschi 2001; Angioletti et al., 2004; Reichler et al. 2005). In most cases incontinence is due to the reduction of urethral lumen (Arnold 1997). Neutered subjects shortly before puberty seem to be less at risk (Arnold et al.1989; Stocklin-Gautschi 2000; Reichler et al. 2005). In females instead the risk of developing urinary incontinence seem to be much higher when they are neutered before three months of age compared to those neutered between 3 months and one year old (Spain et al. 2004b). Urinary incontinence etiopathogenesis is unclear. The change in GnRH, FSH and LH circulating levels after gonadectomy (Reichler et al. 2003, 2004, 2005, 2006a,b, 2007; Ponglowhapan et al. 2007) may be involved in its incidence. In many cases urinary incontinence after neutering can be checked by using alpha adrenergic substances (Awad et al. 1978; Blendinger et al. 1995a)

Spain et al. in a veterinary surgery literature review have pointed out a higher incidence of FLUTD (Feline Lower Urinary Tract Disease) in subjects submitted to gonadectomy at an early age. Several studies have been carried out in order to evaluate the effects of gonadectomy on the low urinary tract in cats, most of them do not result in any outstanding effects of gonadectomy nor the age when it is performed on the development of FLUTD or other low urinary tract diseases. Gonadectomy has no effects on urethral function in cats, as urethral pressure is determined by urethral profile (Stubbs et al.1996). Moreover they have not found changes in urethral diameter, neither at a pre-prostatic level nor in the penis in neutered cats at the age of 7 weeks, 7 months if compared to those not neutered (Root et al.1997).

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Howe et al. (2000) likewise in a study on long term effects (3 years) of gonadectomy before and after puberty have not found a higher risk of developing FLUTD in neutered cats at an early age. Yet, a study performed on a population of neutered obese male and female cats has pointed out that these two factors if combined may increase the risk of developing FLUTD (Lekcharoensuk et al. 2001).

The effect of gonadectomy on metabolism

OBESITY

Obesity is the most common nutritional disorder in cats and dogs (Mondelli et al., 2004). It is considered a multifactorial disease and risk factors include: breed, pet and owner's lifestyle, age and sex. Gonadectomy is considered one of the main predisposing factors in cat obesity (Stubbs et al. 1996; Sloth 1992, Nguyen et al., 2004; Scarlett and Donoghue, 1998; Harper et al. 2001). The effects related to the age at which gonadectomy is performed are not clear yet. A 15 month perspective study to evaluate differences between unneutered and late neutering has actually shown no statistically significant differences concerning voluntary ingestion, weight gain or adipose tissue accumulation between intact and neutered pets. Although the results of an epidemiological study by Spain et al. (2004b) point out that gonadectomy in the first 6 months of age is associated to a lower incidence of obesity compared to that performed iat the later age.

Gonadectomy does not necessarily result in obesity, but what is clear is the importance to check the body weight of neutered pets because of its association with the risk of other diseases (Lekchroensuk et al.2001) and its negative effects on life expectancy (Greer et al.2007). Obesity can be prevented by simple means. It still has not been verified if the age when gonadectomy is performed affects predisposition to obesity, even if cats are more subject to obesity, there have not been found correlations between the age of surgery and the body composition of adult cats (Spain et al., 2004). Particularly an increased voluntary food intake has been observed

(Flynn et al., 1996; Root et al. 1996; Fettman et al., 1997), moreover this variation is established fairly rapidly in cats (Kanchuk et al., 2003). The mechanism by which gonadectomy affects voluntary food intake is still not clear yet, even because there have not been significant and sudden variations of insulin and leptin circulating levels following gonadectomy. Oestrogens may act as a satiety factor.

There is evidence that neutered cats fed with high in fat and low carbohydrates diets have a tendency to put on weight if compared to those fed with isoenergetic diets, but richer in carbohydrates than in fat (Backus et al 2007). However the use of hypolipidic diets is not enough to prevent obesity after gonadectomy, as it is not possible without a proper rationing (Nguyen et al. 2004).

DIABETES MELLITUS

In cats diabetes mellitus incidence is 0.4%. As for its risk factors the Burmese cat is the most predisposed; for what concerns sex and age, there is a higher incidence among males (McCann et al., 2007; Rand et al., 1997). Neutered cats are not only at risk of developing obesity, but they are also twice as likely to get diabetes if compared to the unneutered ones (Panciera et al. 1990; McCann et al. 2007; Prahl et al.2007). The increased probability in neutered cats to develop diabetes and obesity after gonadectomy may be due to lower insulin sensitivity (Hoenig and Ferguson 2002; Kanchuk et al.2002).

HYPOTHYROIDISM

Two studies have shown that neutering is the main associated risk factor in developing hypothyroidism in dogs and cats (Milne and Hayes 1981; Panciera 1994; Panciera 1997). Although other studies, comparing age with hypothyroidism, revealed that neutered subjects are not likely to develop the disease (Dixon and Mooney 1999; Dixon et al.1999).

The effects of gonadectomy on the musculoskeletal system

GROWTH

Several studies have assessed the effects of gonadectomy and the age at which it is performed on growth, without pointing out any effects on the growth rate even if the closing of epiphyseal discs is delayed in neutered subjects compared to the whole ones. In reality, in both cats and dogs actually gonadectomy performed before the closing of epiphyseal discs may delay this process and it is associated with a significant lengthening of the long bones Spain et al., 2004; Salmeri et al.1991; McNicholas et al. 2001). This is particularly evident in male cats: if they are neutered at the age of 7 months or 7 weeks, their radial bone length is 13% more than unneutered females (Root et al 1997) though the effects of such variation on bone strength are unknown. The long bone epiphyseal closure time is partly controlled by sex hormones. However they have not found a correlation between the age of gonadectomy and incidence of long bone fractures (Hopkins et al., 1976). A study has shown an increased incidence of femoral fractures in neutered male cats; however cats with fractures were overweight too. In cats, the spontaneous fracture of the femoral head seems to be the result of delayed epiphyseal disc closing in neutered subjects. In retrospective studies 39 cats with 47 fractures were examined (Craig 2001; McNicholas et al. 2002; Fischer et al.2004). The investigation showed 4 risk factors for the spontaneous femoral head fracture in cats older than 1 year: sex and reproductive status, delayed closing of epiphyseal disc and obesity. Neutered and obese male cats are highly susceptible to spontaneous femoral head fracture, a further evidence of the need to ration neutered cats. Epidemiological studies have found no relation between the age of gonadectomy and spontaneous fracture, neither in dogs nor in cats (Spain et al. 2004a, b).

The effects of gonadectomy on other matters

FeLV and FIV may spread through the coupling or other contacts. It is known that neutering affects territorial behaviour (Kalz 2001), but such diseases may spread even by feeding animals with the same tools. Gonadectomy does not affect the development of the diseases above mentioned. (Howe et al.2000).

LIFE EXPECTANCY

There is evidence that neutered animals can live longer than the unneutered ones (Kraft 1998; Greer et al.2007). The increased life expectancy may be due to preventive effects of gonadectomy on reproductive system diseases and/or to less risk related to aberrant behaviours.

Yet increased life expectancy may be thanks to the greater care the pet's owners take of their neutered animals.

From what has been said it is clear that contraception through surgery entails a number of beneficial effects on the health and wellbeing of animals, though risks and contraindications are to be taken intoaccount when gonadectomy is being considered.

Furthermore, neutered animals must receive special care cosidering the incidence of the most recurring diseases in neutered subjects, compared to the intact ones. For this reason, over the last years, the main pet food companies have worked out specific diets aimed at neutered animals.

The purpose of this research has been to evaluate the effects of three different diets through the essential blood parameters of neutered adult cats.

MATERIALS AND METHODS

Fifteen adult cats (7 males and 8 females) previously gonadectomized (orchiectomy and ovariectomy) at the age of 9 months have been tested.

At the first medical control the average weight, the body condition score and average age of the cats were 3.75 ± 0.34 kg; 5.7/7 ± 0.47; and 2.5 ± 0.26 years.

Throughout the whole test the cats were raised and kept in a small colony, near Naples where the animals were subdivided into three groups (A, B and C) and fed separately. Using a Latin square design (3 groups of 5 cats x 3 diets x 3 period of 3 months) they fed ad libitum three different commercial diets (1, 2 and 3).

All the diets are designed to satisfy the requirements of adult cats, in particular diet 1 does not show specific indications, while diets 2 and 3 are specifically indicated for the maintenance of neutered cats.

Once a month, a decision was made to perform a sample of each diet which was been subjected to the following determinations: dry matter, ash, ether extract after hydrolysis in hydrochloric acid at boiling temperature, crude protein and crude cellulose according to the indications of AOAC (2006).

At the end of each period, fasting cats were weighed and, by means of an automated analyser, a blood test was done to determine the following

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biochemical parameters: glucose, azotaemia, creatinine, cholesterol, triglycerides, AST aspartate aminotransferase (AST), GTP alanine aminotransferase (ALT), gamma-GT, alkaline phosphatase, total protein content.

It was also done to assess blood count and protein pattern.

All data obtained were subjected to analysis of variance using the SAS PROC GLM (2000) in order to assess the effect of food used, using the following model:

$$Y_{ij} = \mu + \beta_i + \varepsilon_{ij},$$

where μ = average; β_i = effect of diet (i =1, 2 e 3); ε = error

Results and discussion

In table 1 and 2 are shown respectively the ingredients and the mean values of chemical composition (n=9) of the diets are shown respectively.

Table 1- Ingredients of the diets

Diet	Ingredients
1	Dehydrated chicken, rice, corn, dehydrated fish, chicken fat, corn gluten meal, linseed, hydrolysed animal proteins, dried whole egg, vegetable fiber of pea, beet pulp, fish oil, vegetable oil, dried brewer's yeast, FOS, MOS, potassium chloride, calcium sulphate bidratated, monosodium phosphate.
2	Dehydrated chicken, rice, corn gluten meal, linseed, hydrolysed animal proteins, dried whole egg, vegetable fiber of pea, beet pulp, fish oil, vegetable oil, dried brewer's yeast, FOS , MOS, psyllium, potassium chloride, calcium sulphate bidrated, monosodium phosphate, soy extract (source of isoflavones 600 mg/kg), chondroitin sulfate.
3	Dehydrated chicken, rice, corn gluten meal, linseed, hydrolysed animal proteins, dried whole egg, vegetable fiber of pea, barbabiotola dried pulp, fish oil, vegetable oil, dried brewer's yeast, FOS , MOS, psyllium, potassium chloride, calcium sulphate bidrated, monosodium phosphate, soy extract (source of isoflavones 500mg/kg), chondroitin sulfate.

An examination of the tables shows that the two diets formulated for the maintenance of neutered cats showed levels in crude proteins and crude fiber significantly (P <0.05 and P <0.01, respectively) higher than those in the first feed. Included the percentage of carbohydrate reserves estimated for the three diets (nitrogen free extract: 34.6, 34.1 and 29.9% as feed for 1, 2 and 3,

respectively) was different.

The analytical levels observed are in line with the most striking differences existing between the lists of ingredients, in fact the presence in the two diets formulated for neutered cats (diets 2 and 3) as a third source of oat starch and the presence of hydrolysed proteins seem to be the basis of the lowest levels in

Table 2- Mean (n=9) values of chemical composition (% as feed) of the 3 diets

Diet	M	CP	EE	CF	ashes
1	8±0.51	32±1.4 b	15±0.7 A	3.4±2.3 B	7.0±0.4
2	8±0.43	34±2.0 a	10±0.9 B	6.4±1.2 A	7.5±1.1
3	8±0.47	38±1.7 a	10±1.1 B	6.5±2.1A	7.6±1.5

M: moisture; CP: crude proteins; EE: ether extract; CC: crude fiber. A, B: P<0.01; a, b: P<0.05

Nitrogen free extract and higher protein level than those recorded by the latter diet.

All feed seem to be characterized by a good mixture of soluble and insoluble fiber, but the diets 2 and 3 would seem to be the richest in the insoluble component as the beet pulp and pea fiber are placed on the lists of these two diets position priority than indicated in the list of diet 1.

Depending on the chemical composition determining significant differences (P <0.01) even in relation to the estimated energy density (kcal ME / kg: 3606A vs. 3233B and 3262B for diet 1 vs 2).

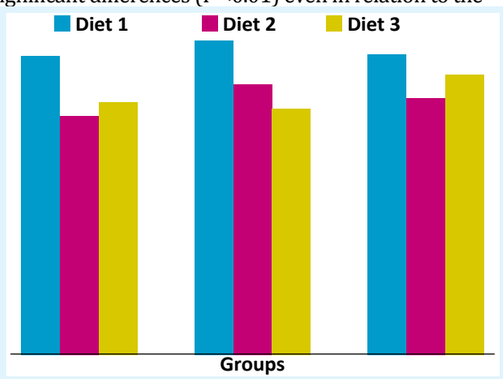

Figure 1 - Body weight changes recorded during the clinical trial according to the diets treatment.

In Figure 1, one can see the weight change observed in the three groups of animals according to the diet used.

An examination of the figure highlights how diet 1, characterized by higher lipid levels and energy density has shown a significant body weight increase in all groups (4, 11 ± 0.52, 4.3 ± 0, 19 and 4.14 ± 0.47 kg, for groups A, B and C respectively), while with both diets formulated for the maintenance of neutered cats body weights were lower, but with a variable trend: groups A and C showed a lower weight when fed diet 2 and group B showed the lowest weight with diet 3. While during the trial all cats always had free access to food, any significant difference on voluntary intake was registered; it is possible that the differences in weight recorded in different periods are due to be ascribed to the increased concentration of soluble fiber in diets 2 and 3.

In fact, the soluble polysaccharides have the characteristic of absorbing water and swelling forming a mucilaginous mixture, which besides slowing down the intestinal transit is to facilitate the absorption of nutrients, helps to achieve more rapidly the sense of satiety more rapidly.

In Tables 3, 4 and 5 the average data of complete blood count (CBC), the biochemical profile, and the framework of protein, are reported respectively. It should be specified that in all cases the blood levels found are indicative of a health condition of the animals. However, according to the dietary treatments adopted there were some statistically significant differences with respect to the biochemical profile demonstrating the direct influence of the diet on the metabolism of proteins, carbohydrates and lipids.

In particular the levels of blood urea nitrogen (56.87; 65.66 and 62.00 mg/dl with diets 1, 2 and 3, respectively)

Table 3 - Mean values of complete blood count (CBC) recorded with the three diets

Diet	WBCs Mmc	RBCs Mmc	Hemoglobin g/dl	Hematocrit %	RDW %	Platelets Mmc	MCV fL	MCH Pg	MCHC g/d
1	14,010 (4,783)	8,930,00 (1,304,633)	11.71 (1.34)	39.07 (5.83)	18.85 (0.73)	200,800 (90,318)	43.82 (2.84)	13.61 (0.84)	31.12 (0.98
2	14,378 (5,977)	8,836,667 (2,504,331)	12.61 (1.01)	42.38 (6.18)	19.96 (1.03)	235,000 (71,464)	45.80 (1.62)	13.19 (0.46)	28.80 (0.51)
3	13,812 (4,036)	9,085,556 (1,189,749)	12.02 (1.36)	39.94 (5.66)	20.05 (1.75)	199,422 (71,312)	44.00 (2.85)	13.33 (0.90)	30.36 (1.49)

WBCs: white blood celles; RBCs: red blood cells; RDW: Distribution Index vol. erythrocyte; MCV: Mean Corpuscular Volume; MCH: Average hemoglobin content; MCHC: Mean corpuscular hemoglobin concentration.

and creatinine (1.17; 1.31 and 1.39 mg/dl, respectively) were significantly (P <0.01) higher when cats were fed in higher protein diets (2 end 3) compared to when they received the most caloric diet 1. With diets 2 and 3, also, were recorded values of GOT (21.0; 36.2 and 36.1 IU, respectively with diets 1, 2 and 3, respectively, P <0.01) and GTP (49.9; 53.9 and 56.1 IU with diets 1, 2 and 3, respectively, P <0.05) were higher. These parameters being included in the physiological range of the species would be indicative of a greater activity of the liver

Table 4 - Mean values of the biochemical parameters

Diet	Glycemia mg/dl	Azotemia mg/dl	Creatinine mg/dl	Cholesterol U.I.	Triglycerides U.I.	GOT U.I.	GPT U.I.	γ GT U.I.	ALKP U.I.	Proteins g/dl
1	90.25±4.27a	56.87±2.83B	1.17±0.04B	135±10	50.75±5.8	21.00±2.29B	49.87±5.98ab	1.87±0.26	64.50±6.73	7.05±0.18
2	78.17±4.93ab	65.66±2.68A	1.31±0.04A	156±10	64.33±5.47	36.22±2.16A	53.89±5.64a	1.78±0.25	50.89±6.35	6.60±0.17
3	72.71±4.58b	62.00±3.02A	1.39±0.04A	149±11	56.28±6.20	36.12±2.46A	56.14±6.39b	1.71±0.28	46.00±7.20	6.64±0.19

ALKP: Alkaline phosphatase.

when cats were fed diets 2 and 3, which are less rich in carbohydrate and lipid and richer in proteins.
In addition to this observation we can also observe the performance of glucose levels, which were significantly higher (P <0.05) when cats were fed diet 1 compared to diets 2 and 3 (90.25, 78.17 and 72.71 mg/dl, respectively).
The use of low-calorie diets rich in protein would induce a greater use of hepatic gluconeogenesis, which allows the conversion of protein to glucose, as evidenced by rising transaminases. This change induces a metabolic reduction of blood glucose levels, as evidenced by several authors (Mazzaferro et al. 2003, Frank et al. 2001), so as to make this type of diets particularly suitable for the treatment of diabetic cats (Debraekekeer, 2007).
Although not statistically significant differences relative to indicators of lipid metabolism both the levels of transaminases (50.7; 64.3 and 56.28 mg / dl, respectively with diets 1, 2 and 3) and those of cholesterol (135; 156 and 149 mg/dl, respectively) registered with the diets 2 and 3 were higher. In our view this would be attributed to weight loss recorded whenever the two low-calorie diets

Table 5 - Mean values of the protein framework.

Diet	Neutrophils	NNS	Lymphocytes cell/mmc	Monocytes	Eosinophils
1	9,415±217	6.50±1.00	2,942±130	448±67	841±128
2	9,681±392	5.00±3.46	3,163±382	575±42	559±132
3	9,580±167	5.88±2.10	2,855±161	510±53	568±74

were administered.
There were no statistically significant differences attributable to dietary treatment relatively to the blood counts nor the protein framework that can depend both on the high variability observed among subjects, and by the fact that these parameters are less susceptible to the effects of the diet.

CONCLUSIONS

From the results of this trial it is clear that the different biochemical parameters such as blood urea nitrogen, creatinine, glucose and transaminases, while remaining within the physiological range, are significantly affected by dietary nutritional characteristics of the feed supply.
Considering the variations of weight and biochemical parameters encountered diets 2 and 3 appear to have more suitable characteristics for the dietary management of gonadectomised cats, because, given the increased susceptibility to obesity and endocrine disorders related to it, have proved particularly effective in weight management, even when administered ad libitum. They also allowed the animals to maintain blood glucose levels lower than those obtained with diet 1.

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