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INVESTIGATING THE EFFECT OF A CANINE COMMERCIAL DRY DIET ON THE COMPLETE BLOOD PICTURE AND FECAL QUALITY IN DOMESTIC DOGS PREVIOUSLY KEPT ON HOME-PREPARED FOOD IN EGYPT

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ABSTRACT

In Egypt, dogs are routinely fed a home-cooked diet prepared by their owner (e.g. boiled chicken legs). The nutrition of pets is crucial to the health state of various body systems and that can be reflected in the complete blood count picture as well as general health of the animal. Poor nutrition can result in various nutritional deficiency disorders such as nutritional deficiency anemia. Nine native breed puppies were screened at regular intervals using a general health physical examination including monitoring their temperature, general inspection, heart and respiratory rate measurements before changing their diet in a controlled experiment. The dogs were kept indoors and their diet was changed from the traditional home cooked food into a commercially available dry diet. Blood samples were also collected for a complete blood count on day one before starting the commercial diet and day 30 at the end of the experiment. The complete blood picture was monitored on set days throughout the experiment and the fecal score was assessed using a fecal scoring system of Royal Canine on day 1 before starting the commercial diet and day 30 at the end of the experiment. There was a significant difference in most blood parameters following the change in diet. Those that were significantly higher were: the total RBCs count, hemoglobin concentration, hematocrit value, mean corpuscular volume, mean corpuscular hemoglobin and the mean corpuscular hemoglobin concentration ($p<0.05$). The fecal score also improved from loose stool into clearly defined shape and that change was statistically significant ($p<0.05$).

Keywords: Home prepared diet, Commercial dry diet, Nutritional deficiency anemia, Native breeds, Baladi or balady dogs, Egyptian street dogs, dietary responsive diarrhea, fecal quality, fecal score

INTRODUCTION

Maintaining the health of dogs by feeding wholesome nutritional diets is an important component of both a responsible and a rewarding pet ownership. Numerous improvements in companion animal nutrition have resulted in a wide array of foods providing complete and balanced nutrition. Despite these developments, some pet owners still prefer preparing food at home for their animals (Freeman and Michel, 2001).

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There are a large number of research studies that confirms that pets fed homemade raw meat diets shed viable organisms in their feces the same as those isolated from their diets. Furthermore, dogs that are fed contaminated raw meat diets are considered to be a potential source of household environmental contamination to their owners and other pets as well (Cantor *et al.,* 1997; Hald and Madsen, 1997) (O'Rourke, 2005) (Stone *et al.,* 1993; Varga *et al.,* 1990).

Since most owners may be unable to recognize the critical nutritional needs of their dogs, home prepared diets poses a risk that is translated into nutritional deficiencies, excesses and imbalances that can affect the animal's health status (Streiff *et al.,* 2002).

It is already established that homemade foods for dogs are seldom balanced for micro-minerals such as iron, copper, zinc, iodine; and most essential vitamins (Remillard, 2008). It could, therefore, be expected that keeping a dog on a home-prepared diet can result in nutritional deficiencies and other adverse health conditions.

Many dietary factors have an impact on the fecal output and consistency including digestibility and fiber, so that dietary change can affect their fecal characteristics and also their microbiome (Wakshlag *et al.,* 2011).

Since in Egypt it is customary for dog owners to feed their dogs a home prepared food, this experiment was designed to assess the health status of a group of native breed dogs that were kept in similar circumstances to those owned by people and to examine whether there was a potential advantage to changing their diet into a commercially available and nutritionally efficient dog food.

Animals and methods:

Animals

A group of four months old Baladi dogs (n=9), were used in this study. Both male (n=4) and female (n=5) dogs were included, ranging in weight between 8 to 12,300 kg and all of them were previously fed home-prepared diet. A full physical examination on day 1 and day 30 was carried out. The examination included measuring the temperature, respiratory and heart rates. Body weight was also measured and recorded.

The dogs were up to date on deworming and ectoparasitic program, did not receive any antimicrobial drugs and did not suffer from any gastrointestinal diseases. The dogs were fed a commercial diet for a period of 30 days.

Study design

Over a 30 day period the animals were housed in three rooms, and were fed a commercial dry diet. Physical examination was done on day one before starting the diet and on day 30 at the end of the experiment. Blood samples were collected on day 1 before starting the diet and day 30 at the end of experiment. Fecal matter was assessed using the Royal Canin fecal scoring system (as shown in table 2) on day 1 before starting the diet and day 30 at the end of experiment a summary of the study design is illustrated in figure 1.

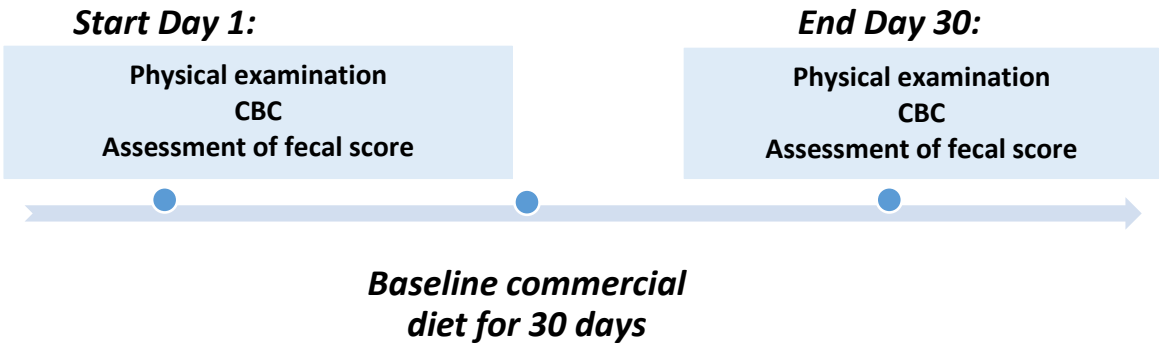

Fig 1. Study design.

Owner's feeding habits of owned dogs

A poll was carried out in the Small Animal Clinic, Assiut University clinic where clients (dog owners) were questioned on the type of food they fed to their dogs. The trial was carried out over a period of 8 months (February 2022- October 2022). Thirty participants, consisting of residents of owner dogs in Assiut, consented for the data collection for scientific purposes, and data protection was achieved by excluding personal information (owner's name, address, telephone number) from the analysis. The poll was limited to establishing what type of diet was fed to the dog (commercial diet and / or home prepared diet).

Blood samples

Whole blood samples were collected from experimental dogs on day 1 before starting the diet and day 30 at the end of experiment. The blood was collected using standard cephalic venipuncture (An et al., 2019). Blood was collected on EDTA blood tubes (VACO lab). Blood samples were kept refrigerated till the time of posting to the central lab of Animal Pathology Department, Faculty of Veterinary Medicine, Assiut University for complete blood count (CBC) that was measured automatically using automatic cell counter (Exigo, Boule medical AB, Sweden) (Athanasiou et al., 2016).

Baseline diet:

Dogs were fed a commercial diet for 30 days. The constituents of the used diet are presented in table 1. Data of constituents (product book) were sent by representative of the commercial diet company per our request. The composition of the diet used is shown in Table 1.

Table 1: Shows the analytical constituents of the diet*

Constituents of the diet	
Protein	32%
Fat content	20%
Crude fiber	1.6%
Crude ash	7.9%
NFE	30.5%
Amino acids	
Taurine (%)	0.21
Arginine (%)	1.73
Lysine (%)	1.29
Methionine (%)	0.68
Methionine (%) + Cysteine (%)	1.26
Trptophane (%)	-
Minerals	
Calcium (%)	1.29
Phosphorus (%)	1.09
Sodium (%)	0.4
Chloride (%)	0.91
Potassium (%)	0.7
Magnesium (%)	0.08
Sulphur (%)	0.4
Copper (mg/kg)	15
Iron(mg/kg)	243
Manganese(mg/kg)	75
Zink(mg/kg)	167
Selenium(mg/kg)	0.39
Iodine(mg/kg)	5.2
Vitamins	
Vit.A (IU/kg)	17500
Vit. D3 (IU/kg)	1000
Vit. C (mg/kg)	520
Vit. E (mg/kg)	410
Vit. B1 (thiamin) (mg/kg)	4.3
Vit. B2 (riboflavin) (mg/kg)	6.7
Vit. B5 (pantothenic acid) (mg/kg)	26.1
Vit. B6 (pyridoxine) (mg/kg)	8.4
Vit. B12 (cyanocobalamin)	0.07

(mg/kg)	
Vit. B3 (niacin) (mg/kg)	44.4
Biotin (mg/kg)	1.11
Folic acid (mg/kg)	0.9
Choline (mg/kg)	2600
Other guarantees	
Starch %	24.3
Dietary fiber %	7.8
Lutein (mg/kg)	5
Betacarotein (mg/kg)	5
Arachidonic acid %	0.09
Linoleic %	3.07
Omega6%	3.33
Omega3%	0.75
EPA +DHA %	0.3
L-carnitine (mg/kg)	-
Glucosamine+chondroitin (mg/kg)	-
Calculated metabolisable energy	
Energy_NRC 85(kcal/kg)	3888
Energy_NRC 2006(kcal/kg)	4121

*Composition of the used diet were obtained through a personal communication with the company's representative in Egypt.

Assessment of fecal quality:

The fecal quality was assessed using a fecal scoring system of Royal Canin on day 1 before starting the commercial diet and day 30 at the end of the experiment. The scoring system is shown in Table 2.

Table 2: Royal Canin fecal scoring system.

Fecal scoring system for dogs	
Fecal score	Consistency
Score 1	Entirely liquid stool (no texture)
Score 1.5	Liquid stool with minimal consistency
Score 2	Very wet, but not liquid, stool. Cow pattylike texture with no defined shape.
Score 2.5	A moist stool, with little consistency and no real shape. No visible liquid.
Score 3	A moist stool with no cracks. It does have a distinct shape
Score 3.5	A moist stool with a more distinct shape.
Score 4	This stool has a clearly defined shape with visible cracks. It leaves very little residue on the ground when picked up.
Score 4.5	This stool has very clearly defined cracks. The outside is very dry and the inside is almost dry. Leaves no residue on the ground when picked up.
Score 5	Hard, dry, crumbly stool. Difficult for dogs to pass.

Statistical analysis

All data were assessed for normal distribution using Shapiro Wilk Test. Data of the complete blood picture were analyzed using a paired T test parametric analysis and that of fecal score, heart rate, respiratory rate and body weight were not normally distributed so a Wilcoxon signed rank test was carried out using the statistical package for social sciences (spss) software version 26 with the level of significance set at P≤.05.

RESULTS

The poll revealed that the majority of dog owners fed their dogs home prepared diet (93%), in contrast, a 7% of owners fed commercial diet and owners of food prepared diet in Assiut keep the dogs on leftovers, chicken legs and heads, bread and rice as shown in fig 2.

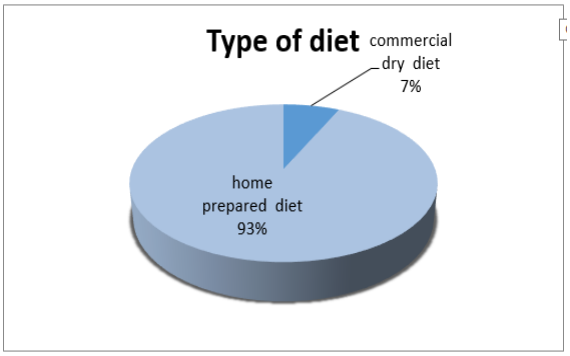

Figure 2: Type of diet (commercial diet and / or home prepared diet) to dogs in Assiut.
A pie chart representing percentage of pet sample fed on home prepared diet Vs commercial dry diet in Assiut.

Physical examination:

The temperature in all dogs was within the normal range on days 1 and 30. The average heart rate on day 1 was 102±8.02 (mean ±SD); while the average heart rate on day 30 was 98.6±6.08) and a standard deviation. The mean of respiratory rate on day 1 was 25.3±3.04. The average respiratory rate on day 30 was 27.2± 2.22.

The average body weight on day 1 was 9.4± 1.76 while that of the body weight was 11.26± 1.37 on day 30. Results of the measured health parameters are summarized in table 3.

The changes in the measured HR, RR was not statistically significant (P>0.05). However, there was a significant difference in body weight of experimental dogs on day 1 and 30 (p=0.008).

Table 3: Heart rate, respiratory rate and body weight results on days 1 and 30 for experiment dogs.

Day of experiment	Parameters		
	Heart rate (beats / minute)	**Respiratory rate (breaths / minute)**	**Body weight (kg)**
D 1	102±8.02	25.3±3.04	9.4±1.76
D 30	98.6±6.08	27.2±2.22	11.26±1.37

D1, Day 1of the experiment, D30, Day 30 of the experiment; SD, Standard Deviation. Numbers represent mean ± standard deviation of each variable.

CBC Results:

The results of the complete blood picture (CBC) on day 1 showed that the majority of dogs (n=8; 89%) suffered from microcytic normochromic anemia.

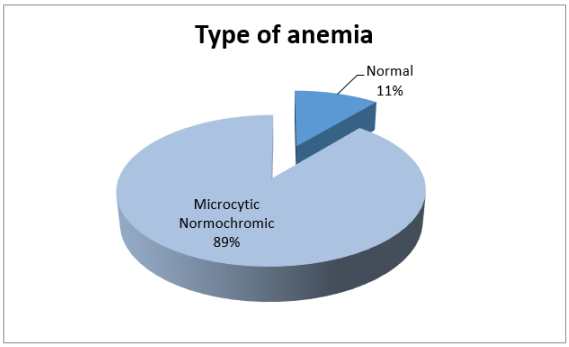

Figure 3: Percentage of anemic and normal dogs on day 1 of experiment.

On day 30, 7 of the 8 anemic dogs had a normal mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) within normal range as shown in fig 4.

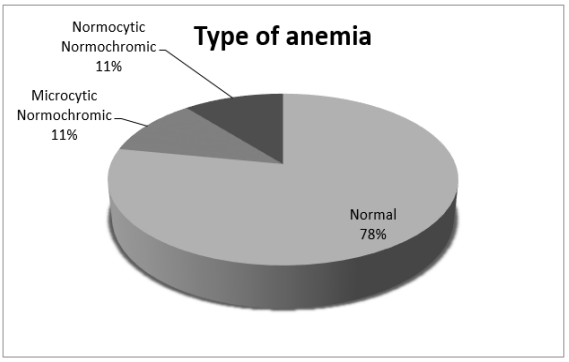

Figure 4: Percentage of anemic versus healthy dogs at day 30 of experiment.

The CBC findings showed some significant changes after 30 days on the commercial diet. There were significant differences in total red blood cells count (TRBCs), hemoglobin (Hb), hematocrit (Hct), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) between two time points increased significantly (p<0.05).

Blood samples were collected from 9 dogs on days 1 and 30 and a CBC was analyzed. The total red blood cells count (TRBCs) increased significantly between two time points as shown in fig 5.

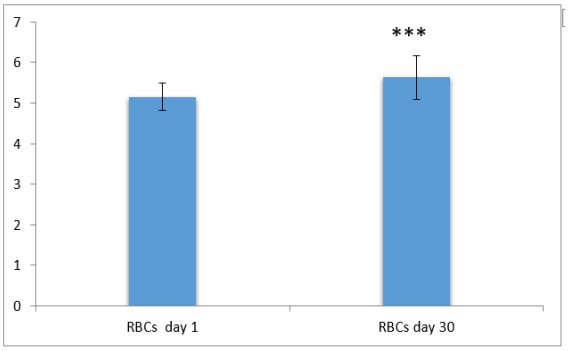

Figure 5: Total red blood cell counts on days 1 and 30 of experiment.

Hemoglobin (Hb) increased significantly between two time points as shown in fig 6.
Hematocrit (Hct) increased significantly between the measured two time points (i.e, days 1 and 30) as shown in fig 7.

Mean corpuscular volume (MCV) increased significantly between two time points as shown in fig 8.

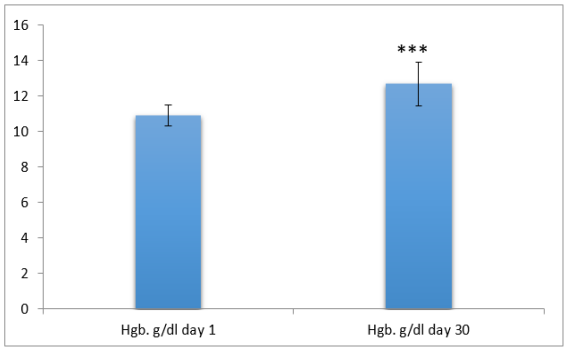

Figure 6: Hemoglobin concentration of experimental dogs on days 1 and 30 of experiment. *Columns represent mean ± SD of hemoglobin at day 1 and day 30 of the experiment*.

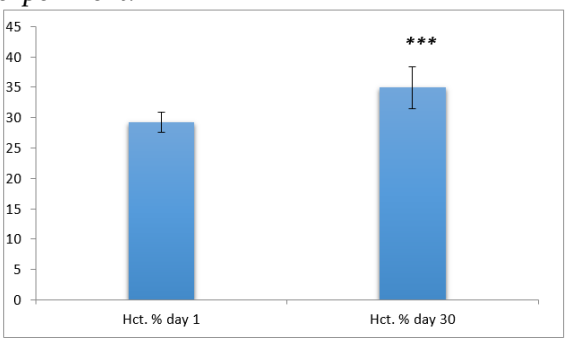

Figure 7: Average hematocrit percentage on days 1 and 30 of the experiment. *Columns represent mean ±SD of Hct % at day 1 and day 30 of the experiment*.

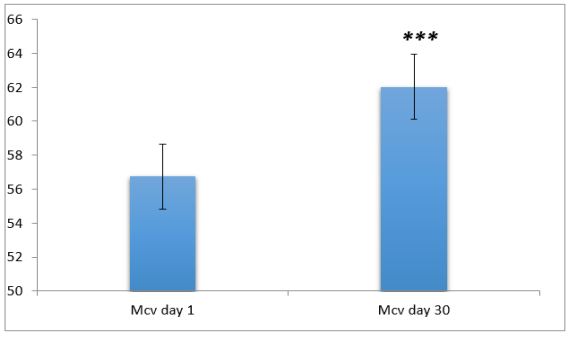

Figure 8: MCV of experimental dogs as measured on days 1 and 30 of the experiment. *Data are presented as mean ±SD mcv fl on days 1 and 30 of the experiment*.

Mean corpuscular hemoglobin (MCH) increased significantly between two time points as shown in fig 9.

There was a significant change in Mean corpuscular hemoglobin concentration (MCHC) between two time points as shown in fig 10.

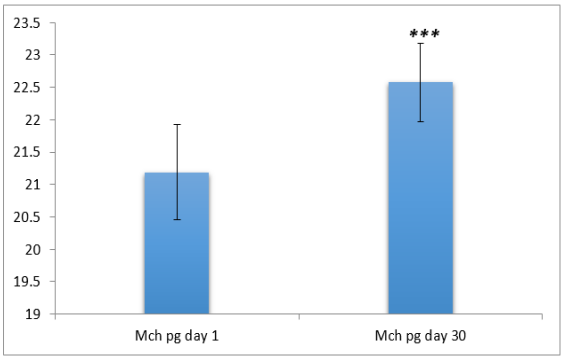

Figure 9: MCH on Days 1 and 30. *Columns represent mean ±SD MCH pg at day 1 and day 30 of the experiment*.

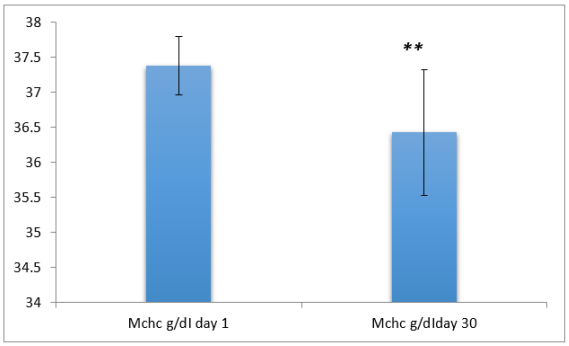

Figure 10: MCHC on days 1 and 30 of the experiment**.** *Columns represent mean ±SD MCHC g/dl at day 1 and day 30 of the experiment*.

There were no significant change of total WBC count before and after the change of diet (white blood cell count), differential leukocyic count and Platelets (p>0.05).

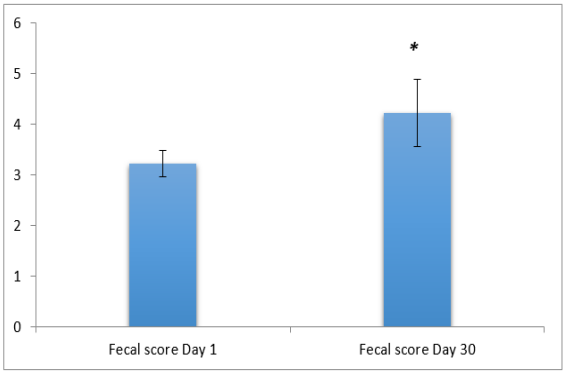

Fig.11: Columns represent mean ±SD of fecal score at day 1 and day 30 of the experiment.

Fecal Quality Results:

At the start of the trial when the stool quality was assessed it was found that the fecal matter was moist and unformed (Mean±SD; 3.1± .2635) on D1 (i.e, before introducing the commercial diet). However, on D 30 the quality improved, and the dogs' stool was clearly defined and well formed (mean ±SD; 4.2± .6). The fecal quality changed significantly as represented by the change of the fecal score from day 1 to day 30 ($p=0.01$) as shown in fig 11.

DISCUSSION

The current study attempted to investigate the effect of feeding a highly balanced commercial diet in domestic dogs previously kept on home-prepared food. A poll was carried out on dogs referred to the small animal clinic, Animal Medicine Department, Assiut University, where owners were questioned on the type of food they provided for their dogs.

The results of the poll showed that the majority of dog owners (93%) fed their dogs some form of a home-prepared food such as boiled chicken legs and leftover.

The complete blood picture on day 30 revealed that: 7 of microcytic normochromic dogs become normochromic. So when we used balanced diet, there were significant change in most measured parameters ($p<0.05$). The red blood cell count (TRBCs), hemoglobin (Hb), hematocrit (Hct), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) were significantly improved. It is well established that nutritional deficiency anemias develop when the nutrients needed for red blood cell production are not present in adequate amounts. Anemia develops gradually and may initially be regenerative, but ultimately becomes non-regenerative. The deficiencies most likely to result in anemia are iron, copper, vitamin B12, vitamin B6, riboflavin, niacin, and vitamin E (Dillitzer *et al.*, 2011; Stanley *et al.*, 2019). Most dog-owners may lack the scientific knowledge to prepare a home cooked diet that will cover the daily dietary requirements of their animals (Streiff *et al.*, 2002), and although many resources are readily available online, it is rarely researched by our clients due to their busy life styles.

There was a significant difference between two time points of body weight. The improvement of food quality and the change in palatability could have attributed to this change; furthermore, the overall improvement in blood parameters would also result in the overall assimilation of nutrients and consequently the body weight of tested animals (Alegría-Morán *et al.*, 2019).

It is difficult to specifically characterize homemade diets designed by pet owners because each recipe is unique and variable (Remillard, 2008). Homemade foods for both dogs and cats have been reported to be rarely balanced for micro-minerals (iron, copper, zinc, iodine) and most essential vitamins (Remillard, 2008). Less than half of the recipes utilised by pet owners provide a complete and balanced source of the nutrients, according to published reviews of the nutritional adequacy of home-prepared (cooked and raw) diet recipes (Weeth, 2012). Nutritional deficiency anemias develop when micronutrients needed for RBC

formation are not present in adequate amounts and we noticed that many dogs which come to our clinic suffer from anemia and the majority of these dogs fed homemade foods.

From the above, it comes as no surprise that the majority of dogs in this trial suffered abnormal CBC values as they were previously kept on random home-prepared food. Once these dogs' diet was changed into a balanced commercial dry food for 30 days, their blood parameters improved significantly which further confirms that their previous diet may have caused their anemic status.

The fecal score also improved from loose stool into clearly defined shape and that change was statistically significant ($p<0.05$). Dietary hypersensitivity can result in a variety of gastrointestinal signs and it is manifested by Acute attacks of diarrhea and, or, vomiting are likely related to dietary allergy. The primary goal of treatment is on elimination of the causative agent from the diet (Halliwell, 1992).

Dietary protein, carbohydrates, fats and fiber have marked influences on gastrointestinal tract function and dysfunction. There is clear evidence that dietary management plays an important role on improvement of fecal quality resulting from poor diet (E WALY *et al.,* 2010; Guilford and Matz, 2003).

Another factor that affects the gastrointestinal health and stool quality is dietary fiber. Dietary fiber affects the gastrointestinal tract by physically altering the digesta, regulating appetite and satiety, regulating digestion, and serving as a microbial energy source through fermentation (Moreno *et al.,* 2022).

Dietary fiber may also relate to common enteropathies including acute diarrhea, chronic diarrhea, constipation, and hairball management (Moreno *et al.,* 2022). Therefore, using a diet that is deficient in fiber can lead to poor stool quality and dissatisfaction of the owner with may ultimately lead to abandonment of dogs with the added stress and sometimes grief of the owners.

GI microbiome dysbiosis is common in dogs (Hooda *et al.,* 2012). The process of changing dog diets has been associated with gastrointestinal disturbances that may cause diarrhea and fecal inconsistency due to changes in the fecal ecology (Wakshlag *et al.,* 2011). The fecal microbiome and metabolome differs between dogs fed Bones and dogs that are kept on commercial diets (Schmidt *et al.,* 2018). So that when dogs are fed a well-balanced diet, their fecal microbiota will change and their fecal quality may improve. As mentioned above, the poor quality of stool in the form of loose or sometimes watery stool is one of the reasons for owner dissatisfaction and may lead to loss of ownership with the consequences of stress, sadness and grief. Taken together, it is therefore, clear that the change from a home-prepared diet to a commercially-available, well-balanced dry food led to the significant improvement in both blood parameters in the form of anemia and fecal quality.

Analyzing the nutritional constituents of the original home-prepared diet was beyond the scope of this study. A more

comprehensive study of dietary components of home-prepared diets would add important information that can help change dog-owners attitudes towards feeding their dogs.

CONCLUSIONS

The findings in this study show that the majority of dogs that are fed a home-prepared diet were more likely to suffer nutritional deficiency anemia and poor stool quality. It also shows that feeding a well balanced, commercially available dry diet will significantly improve fecal quality and reverse anemic changes in a short time.

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التحقيق فى تأثير النظام الغذائى الجاف التجارى للكلاب على صورة الدم الكاملة وجودة البراز فى الكلاب المحلية التى كانت تتناول الأطعمة المعدة منزليا فى مصر

نشوى عصمت والى ، حنان كمال السيد ، الحسن سعد الدين

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في مصر ، يتم إطعام الكلاب بشكل روتيني نظامًا غذائيًا منزليًا أعده صاحبها (مثل أرجل الدجاج المسلوقة). تعتبر تغذية الحيوانات الأليفة أمرًا ضروريًا للحالة الصحية لأنظمة الجسم المختلفة ويمكن أن ينعكس ذلك في صورة تعداد الدم الكامل وكذلك الصحة العامة للحيوان. يمكن أن يؤدي سوء التغذية إلى العديد من اضطرابات نقص التغذية مثل فقر الدم الناجم عن نقص التغذية.

تم فحص تسعة من الكلاب البلدي على فترات منتظمة باستخدام الفحص البدني الصحي العام بما في ذلك مراقبة درجة حرارتهم والفحص العام وقياسات معدل ضربات القلب والجهاز التنفسي قبل تغيير نظامهم الغذائي في تجربة خاضعة للرقابة. تم الاحتفاظ بالكلاب في حجرات معدة خصيصا لذلك وتم تغيير نظامهم الغذائي من الطعام المطبوخ في المنزل التقليدي إلى نظام غذائي جاف متوفر تجارياً. تم أيضًا جمع عينات الدم لتعداد الدم الكامل في اليوم الأول قبل بدء النظام الغذائي التجاري واليوم ٣٠ في نهاية التجربة. تم تحليل صورة الدم الكاملة في أيام محددة طوال التجربة وتم تقييم درجة البراز باستخدام نظام تسجيل البراز من رويال كانن في اليوم الأول قبل بدء النظام الغذائي التجاري واليوم ٣٠ في نهاية التجربة.

كان هناك اختلاف كبير في معظم معايير الدم بعد التغيير في النظام الغذائي. تلك التي كانت أعلى بشكل ملحوظ كانت: إجمالي عدد كرات الدم الحمراء ، وتركيز الهيموجلوبين ، وقيمة الهيماتوكريت ، ومتوسط الحجم العضلي ، ومتوسط الهيموغلوبين في الجسم ($p < ٠,٠٥$). تحسنت درجة البراز أيضًا من البراز الرخو إلى شكل محدد بوضوح وكان هذا التغيير ذا دلالة إحصائية ($P < ٠,٠٥$).