



**UNIVERSITI PUTRA MALAYSIA**

**PALATABILITY ASSESSMENT OF PRESCRIBED DIETS ON DOMESTIC  
SHORT HAIR CATS**

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FPV 2020 93**

**PALATABILITY ASSESSMENT OF PRESCRIBED DIETS ON DOMESTIC  
SHORT HAIR CATS**

**AHMAD HARRIS HAKIM BIN ZAKI**

A project paper submitted to the  
Faculty of Veterinary Medicine, Universiti Putra Malaysia  
In partial fulfilment of the requirement for the  
DEGREE OF DOCTOR OF VETERINARY MEDICINE  
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## CERTIFICATION

It is hereby certified that I have read this project paper entitled “PALATABILITY ASSESSMENT OF PRESCRIBED DIETS ON DOMESTIC SHORT CATS” by Ahmad Harris Hakim Bin Zaki and in my opinion, it is satisfactory in terms of scope, quality and presentation as partial fulfilment of the requirement for the course VPD 4999 - Final year Project.

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## DEDICATION

This project paper is dedicated to ALLAH SWT, who ease my journey and made everything possible.

To my family, Father and Mother whose affection, love, encouragement and prays are always there for me when I need.

To all the lecturers, staff and all my friend batch DVM21 who were involved directly or indirectly in this project.

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## **ABSTRAK**

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar bagi memenuhi sebahagian daripada kursus VPD 4999 - Projek Ilmiah Tahun Akhir

### **PENILAIAN KEENAKAN DIET PRESKRIPSI KE ATAS KUCING DOMESTIK**

#### **BERBULU PENDEK**

Oleh

**AHMAD HARRIS HAKIM BIN ZAKI**

2020

Penyelia: Dr Mohd Mokrish Md Ajat

Nilai industri makanan haiwan terutamanya diet yang ditetapkan terus meningkat dengan pesat sejak beberapa tahun kebelakangan ini. Ini disebabkan oleh peningkatan kesedaran di kalangan pemilik haiwan peliharaan untuk menyediakan gaya hidup sihat untuk haiwan kesayangan mereka. Keenakan diet preskripsi ini dapat dipengaruhi oleh banyak faktor termasuk aroma, rasa, tekstur dan bentuk makanan. Kajian ini dilakukan untuk mengetahui selera diet preskripsi untuk kucing Domestik berbulu pendek. Kaedah dua mangkuk untuk menilai rasa enak dilakukan pada lima kucing Domestik berbulu pendek selama enam hari. Empat jenis diet ditetapkan yang dinilai dalam kajian ini adalah Struvit, Buah Pinggang, Hipersensitiviti dan Usus. Kesesuaian makanan haiwan peliharaan dinilai

berdasarkan 'Pendekatan Pertama', 'Pemakanan Pertama', Jumlah dimakan dan nisbah pengambilan. Dari hasil kajian kami, jumlah dimakan dan nisbah pengambilan secara keseluruhan berbeza dalam diet Struvit, Buah Pinggang dan Usus jika dibandingkan dengan diet Hipersensitiviti. Ini menunjukkan bahawa diet hipersensitiviti adalah yang paling tidak enak dibandingkan dengan diet lain. Penyelidikan terperinci mengenai ramuan menunjukkan bahawa diet hipersensitiviti kekurangan herba dan rempah berbanding dengan tiga diet lain. Bahan-bahan ini yang kurang dalam diet Hipersensitiviti mempengaruhi selera makanan haiwan kesayangan.

Kata Kunci: Keenakan, Diet preskripsi, aroma, rasa, kucing.

## **ABSTRACT**

Abstract of the project paper presented to the Faculty of Veterinary Medicine in partial  
for the course VPD 4999 - Final Year Project

### **PALATABILITY ASSESSMENT OF PRESCRIBED DIETS ON DOMESTIC SHORT HAIR CATS**

By

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2020

Supervisor: Dr Mohd Mokrish Md Ajat

The value of petfood industry especially prescribed diet continues to increase exponentially for the past few years. This is due to an increase awareness among pet owners towards providing healthy lifestyle for their pets. Palatability of these prescribed diet can be influenced by many factors including aroma, flavour, texture and shape of the food. This study was conducted to determine the palatability of prescribed diet for Domestic Short Hair cats. The two-bowl method to assess palatability was performed on five Domestic Short Hair cats for six days. Four types of prescribed diet assessed in this study were Struvite, Renal, Hypersensitivity and Intestinal. Palatability of pet food were assessed by 'First Approached', 'First Consumed', Total consumption and intake ratios.

From our findings, total consumption and intake ratios were significantly different in Struvite, Renal and Intestinal diet when compared to Hypersensitivity diet. This indicates the hypersensitivity diet is the most unpalatable in comparison to other diets. Detailed investigation on the ingredients shows that Hypersensitivity diet lacks in herbs and spices in comparison to the other three diets. These ingredients lacking in the Hypersensitivity diet influences the palatability of the petfood

Keywords: Palatability, prescribed diet, aroma, flavour, cats

## 1.0 INTRODUCTION

The global pet care market reached U.S.\$125 billion in 2018 and 73 percent of the total sales approximately U.S.\$91.1 billion, was global pet food sales. This figure shows that the pet food industry is expanding and developing worldwide. (Phillips-Donaldson, 2019).

Palatability is the perception derived at the time food is consumed and accounts for the flavor and the animals' perception of the appearance, temperature, size, texture, and consistency and perhaps prior experiences (Aldrich & Koppel, 2015). The prescribed diets is not just a nutrient delivery tool to the animal but it also need to take consideration of the palatability and the acceptabilty of the animal. A prescribed diet can consist of all the nutrients that can improve the health of the animal but if the animal perceive the diets as not palatable enough, the animal will refuse to consume it.

Appearance, aroma, texture, and flavour are sensory characteristics that are important in determining pet food acceptability (Koppel, 2013). These sensory characteristics needs to be taken into consideration during the development and production of the prescribed diet. The sensory characteristic that mention by Koppel (2013) above will increase the palatability and the acceptance in the animal, hence it can deliver the nutrient that are meant to improve the health of the animal.

The aim of developing prescribed diet is to improve the condition of animal that has a problem such as renal, intestinal, skin, obesity and hypersensitivity problem. The prescribed diet can improve the quality of life of the animal and prevent the animal health

to become deteriorated further. It is, therefore, a challenge for the industry to find the equilibrium between palatability and the nutritional quality of a diet for cats (Becques et al, 2014).

The objective of this study is to determine which prescribed diet that has the highest palatability percentage and acceptance among the Domestic Short Hair cat. The importance of determining the palatability and acceptability in prescribed diet is to ensure that the Domestic Short Hair cats will always and continuously eating even when they are sick or having a disease so that the nutrients that are essential and required always in the body.

## **2.0 LITERATURE REVIEW**

### **2.1 Cat Sensory Receptor**

#### **2.1.1 Olfactory**

The smell or odor of chemical components of diet influences the olfactory receptors (olfaction) in the nasal cavity. Aroma is the collection of the olfactory stimuli from the food and the surrounding environment. The vomeronasal organ (Jacobson's organ) improves the ability to detect aroma in the dog and cat and it is a structural enhancement of the olfactory sensing organ. (Aldrich & Koppel, 2015). Study has established that cats are essential carnivores both in their requirements for dietary components and in their methods of absorption, digestion and metabolism of these nutrients (Bradshaw *et al.*, 1996).

As said by Koppel (2015), the olfactory sensitivity of cats and dogs is more developed than that of humans, whereas the sensation of taste has evolved more in humans. Humans have about 3 to 4 cm<sup>2</sup> of olfactory epithelia while, cats have about 21 cm<sup>2</sup> and dogs have 18 to 150 cm<sup>2</sup>, with a large number of central nervous system neurons related to olfaction (Hand et al., 2000). The cat has strong senses of olfaction. Although not as advanced as dogs for tracking and searching, the cat's olfactory system is specially programmed to search for new or untrusted odours. They would also sniff their food intensely to assess its freshness and quality (Aldrich & Koppel, 2015).

Bradshaw was able to prove that response to aroma alone was not adequate to resolve neophobia, when cats were provided with a choice between a common commercial food and an artificial lamb flavoured food, they choose the familiar commercial food (Bradshaw *et al.*, 1996). Prey-related interactions are known to activate a large portion of the behavioural repertoire of cats because they are predators (Machado & Genaro, 2014). According to Koppel (2014) food aromas ought to be matched with food flavours, so that food can be consumed on a continuous basis.

### **2.1.2 Taste**

Taste defines the reaction that develops from chemoreceptor (taste bud) excitation in the oral cavity (Aldrich & Koppel, 2015). Domestic cats are not drawn to, nor seen to avoid, the taste of sweet carbohydrates and high-intensity sweeteners, but do display liking for chosen proteins and dislike stimuli that taste either bitter or very sour to humans

(Li *et al.*, 2006). Dogs and cats have enhanced taste sensitivity by recognizing and reacting to certain amino acids that are weakly bitter or acidic to humans (Hand *et al.*, 2000).

The amino acid system is quantitatively prominent in the facial nerve and is most responsive to amino acids defined as "sweet" in humans. This group stimulates significant amounts of discharge in amino acid groups, particularly L-proline, L-cysteine, L-ornithine, L-lysine, L-histidine, and L-alanine (Bradshaw *et al.*, 1996). This is unresponsive to sugars, possibly to permit more sensitive perception of tastants in raw meat, such as monophosphate nucleotides, which may indicate time since the death of the prey (Bradshaw *et al.*, 1996). Few amino acids and peptides lead to meaty and savory aromas (Hand *et al.*, 2000).

Substances that taste bitter to humans are commonly avoided in the animal kingdom. Rejection is believed to be based on a relationship between plants that do not wish to be consumed and animals who do not wish to be harmed (Lei *et al.*, 2015). The amino acid units in the cat are inhibited by a group of "bitter" amino acids that include L-tryptophan, L-isoleucine, L-arginine, and L-phenylalanine, all of which have hydrophobic side chains (Bradshaw *et al.*, 1996).

Dogs react to certain simple monosaccharide and disaccharide sugars, while cats have little to no interest in sugar to sugar solutions (Hand *et al.*, 2000). Cats don't like sucrose in water. This is valid for the domestic cat as well as the lion and other large cats. Sucrose is acceptable in milk (Haupt & Smith, 1981). Foods that are acidified with phosphoric or citric acid, though, appeal to cats (Hand *et al.*, 2000).

Fats is one of the factor that influencing to the food palatability. It is well understood that the palatability of diet improves in relation to the increase in the fat content (Pekel et al., 2020). The fats added to the surface of the dried kibble are an effective taste enhancer and a excellent source of energy (Zaghini & Biagi, 2005). Higher fat amounts in diets enhance energy density and typically improve palatability (Hand et al., 2000). Fat is known to have a favourable effect on the food structure rather than on the taste, and cats tend to prefer both animal and vegetable fat sources (Zaghini & Biagi, 2005).

## **2.2 Palatability**

The palatability of cat foods is improved by moisture, animal fats, protein hydrolysates, meat extracts and few amino acids that are alanine, histidine, proline and lysine (Buffington et al., 2004). Food palatability is a combined feature of a number of variables, including aroma, taste , texture and consistency (Bradshaw *et al.*, 1996). Palatability is the sensation that results from the moment the food is eaten and accounts for the flavor and animals' perception of shape, temperature, size, texture, and consistency, and likely previous experience (Aldrich & Koppel, 2015). Appearance, odor, consistency and taste are sensory features that are significant in deciding the acceptability of pet food (Koppel, 2015). Domestic cats typically eat 12 to 20 meals each day, with feeds evenly distributed over a 24-hour span (Buffington et al., 2004).

The flavour is a mixture of taste sensation and olfactory receptor stimulation in the oral, nasal and laryngeal cavities (Aldrich & Koppel, 2015). This is crucial because

pets consider the first choice to consume on the basis of the odor, but only continue to choose the food to eat if the taste of the food is produced as expected by the aromatics (Koppel, 2015). Pet food palatability is usually assessed using a single bowl or two bowl test (Aldrich & Koppel, 2015).

A single-bowl test (or a single-bowl test, or a single stimulation test), in which the subject has unlimited access to a single food for a given period of time, is used primarily to measure the acceptability of a given food (Tobie et al., 2015). This test gives an indicator or assumption for "acceptance" but does not provide details on choice, degree of preference, or any other hedonic feature of the food (Aldrich & Koppel, 2015).

Preference suggests that a decision needs to be taken between sample foods, and this is normally achieved using a two-bowl method (Koppel, 2015). In this approach, two foods are presented in their separate bowls and concurrently introduced to the animal (Aldrich & Koppel, 2015). Major indicators for this two-pan assessment involve the first selection of the first food product to be consumed, representing olfactory sensitivity and attractiveness; the quantity of food consumed; the ratio ( $A / B$ ) of food consumed; the proportion of food consumption ( $A/(A+B)$ ) [14] and the preference ratio (quantity of food A consumed over the amount of food distributed) (Tobie et al., 2015).

### 2.3 Prescribed Diets

The word "medical food" is defined by law as "a food that is formulated to be eaten or prescribed enterally under the direction of a doctor and intended for the particular dietary management of a disease or disorder for which particular nutritional criteria, based on established scientific principles, are identified through medical assessment (Hand et al., 2000). Examples of therapeutic diets commonly available to small-animal veterinarians comprise of prescribed diets for animals that are suffering from trauma or serious illness, foods for the management of kidney or gastrointestinal disease, and medications for the diagnosis and management of food adverse reactions (food allergies)(Case et al., 2011). Such diets typically have a particular function, although others have contraindications, and can only be used under clinical observation (Hand et al., 2000).

Dietary adjustment is an essential component in the treatment and prevention of obesity and diabetes Mellitus (Mimura et al., 2013). The usage of high fibre diets for glycemic management in diabetic patients has been recommended for diabetic cats, based on human medical trials demonstrating that fibre may delay carbohydrate absorption in the intestine, adjust gastrointestinal transit times and affect insulin sensitivity in peripheral tissues (Bennett et al., 2006). The latest research has shown that the High Protein High Fibre diet has contributed to increased satiety over diets supplemented by either High Fibre or High Protein (Weber et al., 2007).

Urolithiasis is related to a number of risk factors that can be caused by many different kinds of mineral aggregates. (Case et al., 2011). Nutritional therapy is a significant factor of the treatment of cats with these lower urinary tract diseases (Hand et al., 2000). The findings of the research and clinical trials have proved the significance of dietary improvements to medical guidelines intended to facilitate urolith dissolution and prevention (Osborne et al., 2009). In cats with hypercalcemia and calcium oxalate uroliths, increased fibre intake and potassium citrate consumption have been suggested (Dru Forrester & Roudebush, 2007).

Diet-induced skin problems include food sensitivity, primary and secondary nutrient deficits, and nutritional toxicity (Buffington et al., 2004). The words food allergy and food hypersensitivity should be used for such food allergic reactions that have an immunological origin (Hand et al., 2000). Other causes that affect the possibility of an allergic reaction to a food would include susceptibility of the animal immune system, the amount of proteins in the diet, the amount of protein, the presence of protein in the intestinal tract to the immune system, and the immunogenicity of the protein (Buffington et al., 2004). These commercial veterinary therapeutic diets are effective, include protein hydrolysates and/or new protein sources and are nutritionally complete and healthy for either dogs or cats (approved for long-term feeding of healthy adults by a reputable regulatory body such as AAFCO) (Hand et al., 2000).

Dietary treatment has been the foundation of chronic renal disease treatment for years (Elliott, 2006). When kidney performance fails, the capability of the kidney to

respond properly to diverse food diets is compromised (Polzin & Churchill, 2016). Chronic renal failure is classified by progressive structural abnormalities resulting in compromised renal excretory, biosynthetic and regulatory activity (Ross et al., 2006). The objective of dietary modification is to fulfil the patient's nutrition and energy demands, to reduce clinical symptoms and effects of uremic intoxication, to reduce the imbalance of fluid, electrolyte, nutrient, mineral and acid-base, and to delay the progression of renal failure (Elliott, 2006).

Nutrition has several specific impacts on the digestive tract, including microbiota control, influence the immune system, gene expression and epigenetics regulation, improve the epithelial barrier structure, and impact the motility (Kathrani, 2020). Nutrition management is a vital part of the treatment of inflammatory diseases (Sturgess, 2005). Dietary therapy alone has a very high effectiveness in the management of chronic digestive diseases in cats and prevents adverse results related with immunosuppressive therapy (Trepanier, 2009)

#### **2.4 Nutritional Content**

According to certain research, cats and dogs are able to balance their foods on the basis of their dietary composition, so nutrients in companion animal food which are identified on the basis of their sensory properties should not be ignored (Koppel, 2015).

Cats lack the enzyme ' $\beta$ -carotene 15,15-dioxygenase' and are thus unable to convert beta-carotene to vitamin A and have to get vitamin A specifically from the diet of animal sources (Pekel et al., 2020).

Taurine, a  $\beta$ -amino acid available only in animal tissue, is crucial for cats (Buffington et al., 2004). Dogs and cats also react to chosen nucleotides and fatty acids that tend to raise the sensation of the meaty flavour (Hand et al., 2000). Cats need a dietary supply of taurine since they cannot produce sufficient taurine from dietary precursors to compensate for compulsory intestinal deficiency (Buffington et al., 2004).

Cats have the capability to digest and use large amounts of dietary fat (as is normal in animal tissues) (Hand et al., 2000). Cats need dietary sources of both linoleic acid (18:2n6) and arachidonic acid (20:4n6), whereas dogs tend to need only linoleic acid (Buffington et al., 2004). Like all true carnivores, cats have a particular requirement for arachidonic acid (AA) (20:4n6) and they have a restricted capacity to synthesize it with linoleic acid (18:2n6), unlike dogs and other omnivores (Hand et al., 2000).

As a result, lavender, chamomile and sandalwood have been proven to reduce anxiety and encourage positive effects (Graham et al. 2005). While confined felines have been found to gain arousing benefit from the use of spices such as chilli, cinnamon, cumin, nutmeg and ginger (Wells, 2009)

Moreover, as shown by Hand et al. (2000) cats considered medium chain fatty acids unpalatable. Those authors observed that when extruded, diets featuring vegetable ingredients would become more palatable (Koppel, 2015). Taurine, an amino acid, is important for cats and has to be acquired from dietary animal sources (Pekel et al., 2020). Cats lack the capabilities to convert tryptophan to niacin, a vitamin, and thus need to be supplemented by food (Henderson et al. 1949). Arachidonic acid, a fatty acid, is also an

important nutrition for cats since they lack the enzyme needed to convert linoleic acid to arachidonic acid and so their diet should contain adequate levels of arachidonic acid (Pekel et al., 2020)

### **3.0 MATERIALS AND METHOD**

This study was approved by the Institutional Animal Care and Use Committee (IACUC, UPM) with the AUP number UPM/IACUC/AUP-U017/2020. A total of 5 Domestic Short Hair cats (3 males and 2 females) were used in this study. All the cats were given by the owner.

The method adapted to test on the palatability for this study was two-bowl test (Aldrich & Koppel, 2015). Five Domestic Short Hair cats that were used in the study. Cats were weighed and placed in a separate cage at the Animal Research Facility (ARF), Faculty of Veterinary Medicine, Universiti Putra Malaysia. Cats were all healthy with no obvious illnesses observed. The cats were acclimatized for 3 days before the study to make sure they acclimate with the new environment. During the acclimatization period, cats were given two bowls of dry food that were from different brands and types for adaptation of the palatability assessment. Food were given at 9 a.m. and 5 p.m. twice a day.

For the study, types of prescribed diet that were used are Struvite, Renal, Hypersensitivity and Intestinal and were labelled with Food A, Food B, Food C and Food D respectively and can be seen in Figure 1.



*Figure 1. A: Struvite, B: Renal, C: Hypersensitivity, D: Intestinal*

Prescribed diet in this study was from an undisclosed company to protect the commercial rights of the respective company. The struvite diet was used to break up struvite stone and prevent the formation of struvite stones. The renal diet was used to reduce the stress on the kidneys in the cases of chronic renal failure and it have reduced phosphorus and sodium content. Then, hypersensitivity diet was used in cases of food allergy or intolerances. Lastly, the intestinal diet was used to regulate acute and chronic gastrointestinal disorders and it have very highly digestible ingredient that reduces stress on the digestives system. The ingredients that were used in these four types of prescribed diets can be refer in the appendix.

Study was conducted for 6 days. The first day was Food A&B, second day was Food A&C, third day was Food A&D, fourth day was Food B&C, fifth day was Food B&D and for the last day was Food C&D. Food was weighed using a digital kitchen scale from Imperial Houseware and was calculated as recommended by the supplier that is sufficient for the cat's daily nutrient content.

Two types of food that were selected randomly were placed in respective bowls and presented simultaneously in the cage to the animals. Followed by observation for 30 minutes or until one of the bowl was approached first or consumed first. The bowls were left until the next food will be given. For the evening trial, the food were switched side to avoid the animal having a side bias. Food A & B were chosen for day 1 and followed by Food A & C, Food A & D, Food B & C, Food B & D, and Food C & D. The remaining food left before each trial was collected and stored in a vacuum sealed bag. At the end of all the trials, remaining foods were weighed using the same digital kitchen scale during the preparation of the food to determine the bowl that was consumed the most.

For the statistical analysis, we adapted from the Aldrich & Koppel (2015) with slight modification due to the number of diets that were used in this study. The first approached day by day and the first consumed day by day were tested using chi square. Total consumption of the food were tested using one-way ANOVA to compare the four types of prescribed diets that were used in this study.

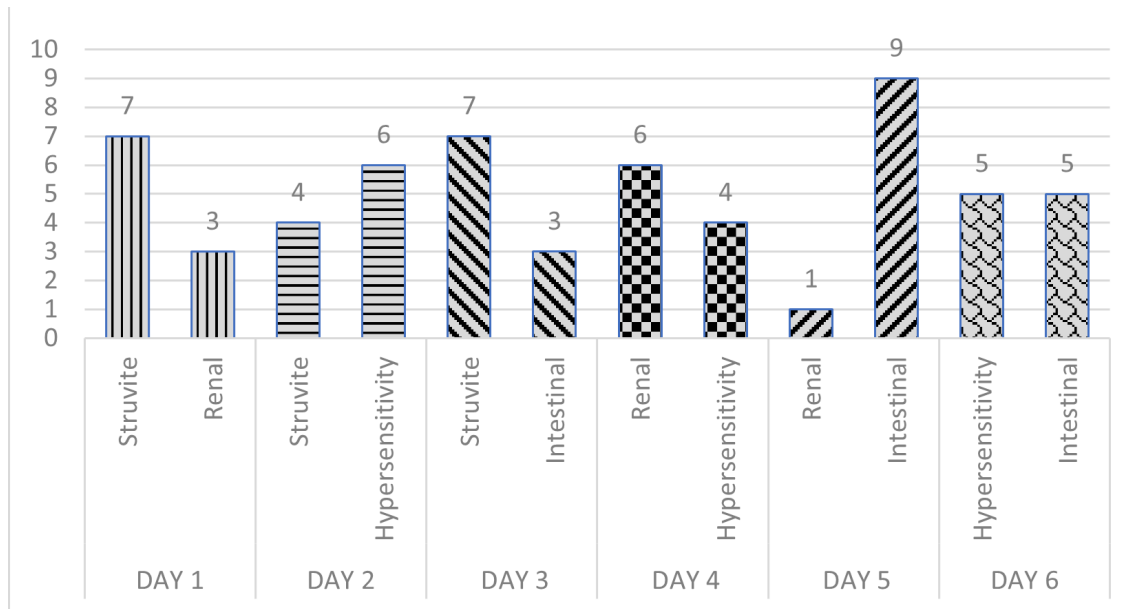
For the human assessment we adapted with modification from Pickering (2009), we assess the aroma or the smell of the food using human odour panel and categorize

them according to the numbers with the number one being the most palatable and the fourth being the most unpalatable in terms of the aroma in the perception of human. The survey was conducted with the four pet food were packed into each seal bag and labelled as A, B, C and D. The subject then need to smell all four pet food and categorize it to the most palatable to the most unpalatable. After the subject smell one type of the pet food, the subject will then smell coffee to help neutralize the odours and after one minute, the subject will proceed to smell the next pet food until all the four types of pet food are smell. We assess the smell of the pet food using the human panel because we want to test whether the human smell can assess the pet food and help to develop a base line odour for a pet food product.

## **4.0 RESULTS**

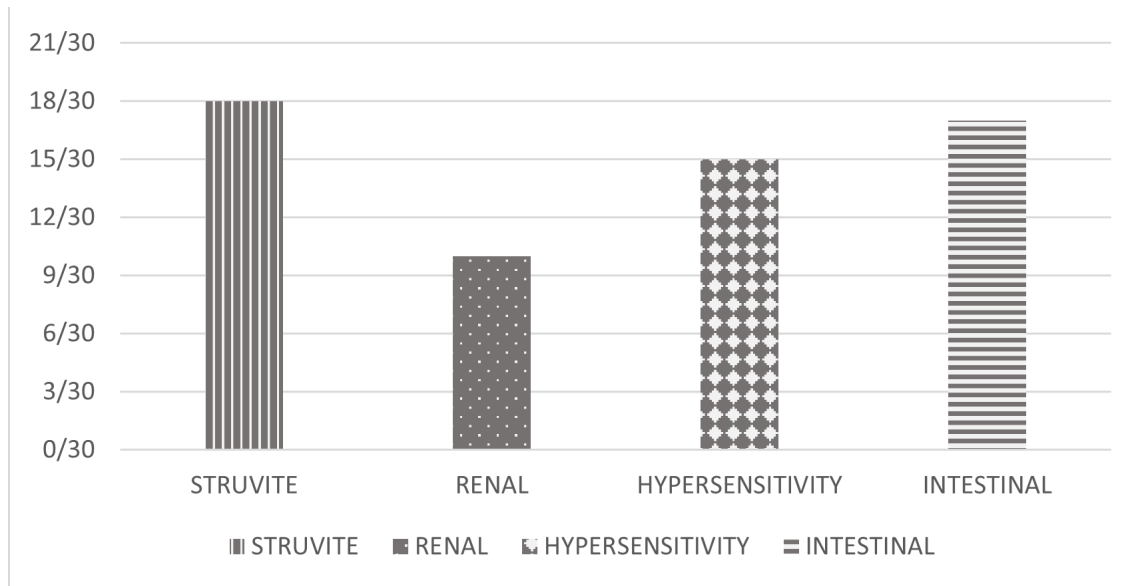
### **4.1 First Approached**

In this study, two types of prescribed diet were compared at one time by observing the first diet approached or sniffed when both diets presented to the cats on each day. The result of the first approached as shown in Figure 2 below.



*Figure 2: Different types of prescribed diet that was First Approached by cats according to different days*

According to the first approached results, there was no prescribed diet that was superior to the others in terms of aroma of the diet. The only significant difference observed in the first approached was in day 5 between renal diet and intestinal diet at ( $P < 0.05$ ).

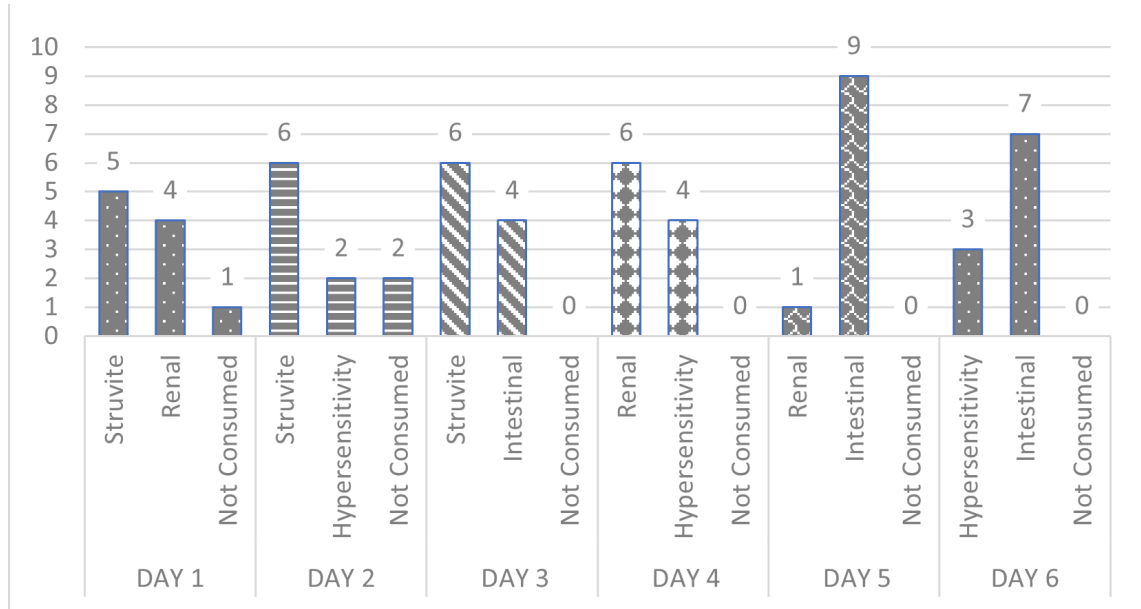


*Figure 3: Total number of first approached according to the types of the prescribed diet*

Based on the total first approached results (Figure 3), the renal diet has the lowest first approached compared to other diets while the struvite diet has the highest first approached. From the observation, the aroma of the renal diet was less appealing to the cats in comparison to the aroma of the struvite diet when compared with other diets.

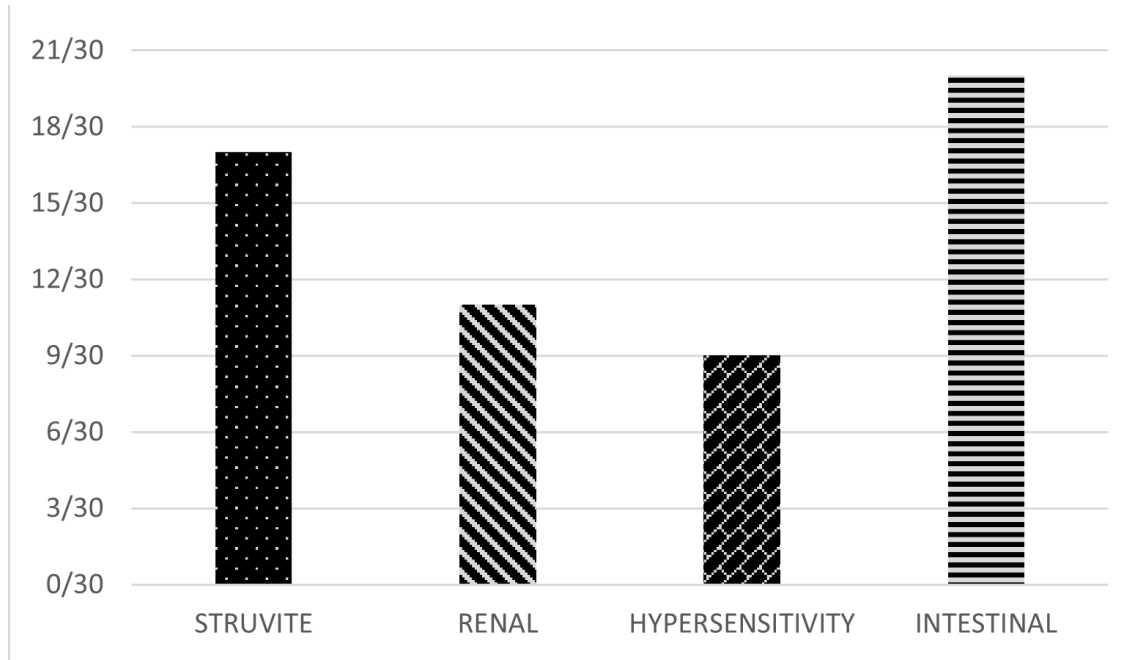
#### **4.2 First Consumed**

In this study, we compared two types of prescribed diet that were consumed or eaten first when both diets presented to the cats on each day. The result of the first consumed as shown in Figure 4 below.



*Figure 4: Different types of prescribed diet that was First Consumed by cats according to different days*

According to the first consumed results, there was no prescribed diet that was superior to the others in terms of flavour of the diet. As for 'not consumed' diet was when the cats does not consume either one of the diets after 30 minutes upon presentation. The significant differences in the first consumed can be observed in day 5 between renal diet and Intestinal diet ( $P < 0.05$ ).

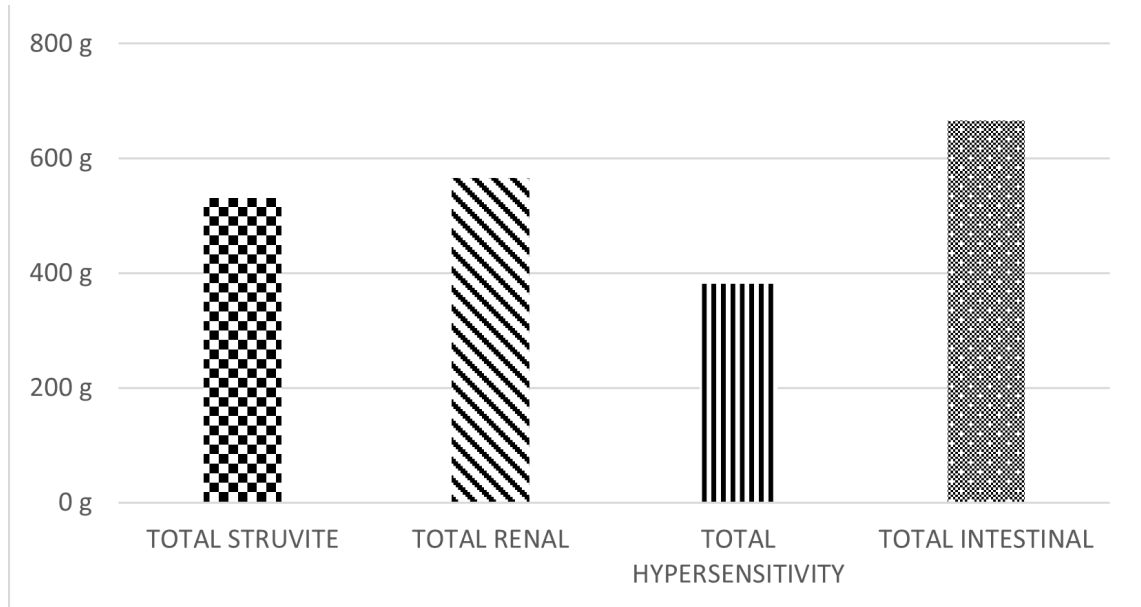


*Figure 5: Total number of first consumed according to the types of the prescribed diet*

Based on the total first consumed results (Figure 5), the hypersensitivity diet has the lowest first consumed compared to other diets while the intestinal diet has the highest first approached. From these observations, hypersensitivity diet was unpalatable to the cats while intestinal diet was more palatable for the cats when compared to other diets

### **4.3 Total Consumption**

In this observation, we compared the total consumption (g) of each prescribed diet that were used in this study. The result of the total consumption as shown in Figure 6 in below.



*Figure 6: Total Consumption (g) of each prescribed diet*

According to the total consumption results, the intestinal diet has the highest total consumption compared to the other diets while the hypersensitivity diet has the lowest total consumption. From this observation, the intestinal diet was the most palatable diet in comparison to the other three diets, while the hypersensitivity diet was the most unpalatable diet compared to the other diets. The difference between the intestinal diet and hypersensitivity diet was significant statistically ( $P < 0.05$ ) using One-Way ANOVA.

#### **4.4 Intake Ratio**

Intake ratio (g) in this study describes the ratio between the total consumption of the two types of prescribed diet that were presented in each day for this study. The result of the intake ratio as shown in Figure 7 below.

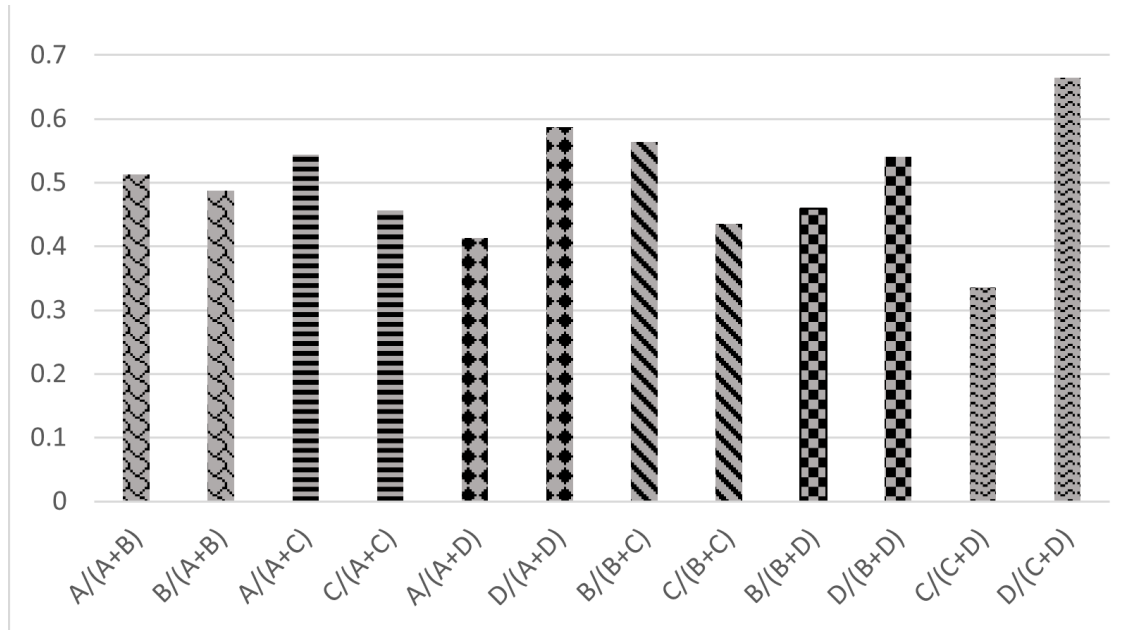


Figure 7: Intake Ratio in each day.

A : Struvite, B : Renal C : Hypersensitivity, D : Intestinal

According to the intake ratio results, the significant differences in the ratio can be observed in the hypersensitivity diet when compared to other diet. The differences in the ratio between the hypersensitivity diet and struvite, renal and intestinal diet were significant statistically ( $P < 0.05$ ) using One-Way ANOVA. From these observations, it was found that the hypersensitivity diet was the most unpalatable diet when compared to the other three diets.

#### 4.5 Survey on Humans

Survey on human subject was conducted in this study by having the subjects to smell all the prescribed diets and score it according to the scale with 4 being the most pleasant aroma and 1 being the unpleasant aroma. A total of 13 correspondents were selected in this study and the results of the observation as shown in table 1 below:

	A (Struvite)	B (Renal)	C (Hypersensitivity)	D (Intestinal)
1 (Least Pleasant)	1	2	9	1
2 (Less Pleasant)	3	4	2	4
3 (More Pleasant)	5	3	0	5
4 (Most Pleasant)	4	4	2	3

Table 1: Human Odour Assessment

Survey on human subject was conducted in this study by having the subjects to smell all the prescribed diets and score it according to the scale with 4 being the most pleasant aroma and 1 being the unpleasant aroma. A total of 13 correspondents were selected in this study and the results of the observation as shown in table 2 below:

		Statistics			
		Struvite	Renal	Hypersensitivity	Intestinal
N	Valid	13	13	13	13
	Missing	39	39	39	39
Mean		2.92	2.69	1.62	2.77
Median		3.00	3.00	1.00	3.00

Table 2: Descriptive Statistics For Human Odour Assessment

The highest mean score in this study was the struvite diet and the lowest mean score was the hypersensitivity diet. While the intestinal diet had the second highest mean score and followed by the renal diet.

## 5.0 DISCUSSION

In this study, the assessment of the palatability are based on 'First approached', 'First consumed', Total consumption and the intake ratio. The assessment of the palatability that we choose are based from Aldrich & Koppel (2015). Result from the 'First approached' indicated that the Intestinal diet is significantly different from the Renal diet. This result indicated that Intestinal diet have a better aroma compare to Renal diet because cats have a very sensitive olfactory system. This can be supported by Pekel et al. (2020) that said cats use vomeronasal organ, nose, and tongue together to identify the flavour of a compound because of its limited ability for taste utilisation due to a low amount of taste buds. This show that the aroma of the food play an important role in determining which food that the cat will approach first. The relatively few taste buds present in cats have caused them to experience the taste of food using other alternative senses, and among these complementary senses, aroma tends to be the most crucial (Pekel et al., 2020). Hullar et al. (2001) said that it has been reported that cats certainly use aroma in the identification and selection of food. The 'First approached' result show that aroma in the pet food play a huge role in determining which food to be approach first when given a two different type of pet food.

Based on the 'First approached' result, we can expect what would be the result for the 'First consumed' as aroma of the pet food play an important role in the food that will be chosen by the cat. This is in line with Pekel et al. (2020) cats use aroma information produced from food as an efficient method to determine the source of food to be consumed. So, the result for the 'First consumed' indicated that the Intestinal diet is significantly different when comparing to the Renal diet. From this we can said that the Intestinal diet have the better aroma and taste compare to the Renal diet because the palatability of a pet food are determined by the odour and the flavour. Measuring the sensory factors of feeding, evaluates the sum of the favourable and undesirable experiences that result from food appearance and consumption (Hand et al., 2020). The favourable experiences from the food consumption are determined by the odour, flavour, texture and shape of the pet food. As we all know that, cats have less number of taste bud in the mouth, so they are less responsive to taste relative to the other animal. They compensate their weak sense of taste by having a very sensitive sense of smell that can determine the taste of the food. This can be supported by Pekel et al. (2020) that said the relatively few taste buds present in cats forced them to recognize the taste of food by using other complementary senses. Therefore, the pet food that have the best aroma in the perception of the cats, can attract the cat to approach and consume first when the cats were presented with a choice of food. However, this finding does not mean that the cat will continuously eat the food if the taste of the pet food are not as good as the aroma.

Total consumption and the intake ratio result will determined whether the taste of the pet food are as good as the aroma. The total consumption indicated that the Intestinal

diet is significantly different when comparing to the Hypersensitivity diet. The preference order from the total consumption result are Intestinal diet, Renal diet, Struvite diet and Hypersensitivity diet. This result show that the hypersensitivity diet is the least favourable pet food in terms of the aroma and the flavour when comparing to the other diet. The reason behind this result is in the ingredients that are used for the Hypersensitivity diet. When comparing to the other diet, the hypersensitivity diet is clearly lacking in terms of the usage of herbs and spices. The other three diets contains herbs and spices such as ginger, chamomile, thyme, coriander, rosemary and yucca schidigera. The herbs and spices can increase the palatability of pet food by producing a favourable aroma that attract the cats to approach, consumed and continuously eat the food. Captive felines have been reported to have arousing impact from the presence of spices such as chilli, cinnamon, cumin, nutmeg and ginger (Schuett and Frase, 2001) and according to Wells (2009) research findings in mice and rats have demonstrated anxiolytic properties of inhaled valerian, cedarwood, lemon oil and chamomile. From this we can say that the herbs and spices can give a positive impact by increasing the palatability of a pet food. Palatability is the experience generated at the moment food is eaten which accounts for the taste and the animals' perception of the appearance, temperature, size, texture, and quality and maybe previous experiences (Aldrich & Koppel, 2015) and Pekel at al. (2020) also said that Aroma, flavour, texture, and particle size are additional characteristics that contribute in pet food consumption preferences by cats. So the herbs and spices influenced the palatability of pet food by increasing the aroma and the flavour which are the characteristic can effect the palatability.

The intake ratio also can be said as the preference ratio because it is the ratio between the two types of food that are compared in each day. The result for the intake ratio can be expected as the odour and taste of the play a key role in determining whether to eat the food or not. So, the preference ratio result are significantly different when the Struvite, Renal and Intestinal compare with Hypersensitivity diet. From this result, we can say that the Hypersensitivity diet is not preferred or the most unpalatable or the least attractive in terms of the aroma and the flavour when comparing to the other diet. While the other diet are more palatable comparing to the Hypersensitivity diet. This is in line with Hullar et al. (2001) if a cat considers the aroma of food more tempting than another, the cats will continue consuming it without trying the other food. However, this result does not mean that the cat love the food or dislike the other food. It just mean that the cat have a preference or made a choice between the food that are provided at that particular time. The most significant flavour enhancers are known as having a 'continuous preference effect' in cats when they are offered the similar diet with the same taste repeatedly and it represent the real approval of a food item by cats in the long run (Tobie et al., 2005). This continuous preference effect are important to make sure the cats will always choose the particular food and continuously eat it without having fatigue towards the flavour in the long run.

The survey that was done on human using their sense of smell to determine whether the pet food are acceptable and palatable in perceptive of the owners. However, the human sense of smell does not same with the cats sense of smell because cats have sensitive sense of smell. It is a well known fact that cat's sensitivity towards smell is 14

times sharper than humans (Pekel et al., 2020). So the result for the survey was the Hypersensitivity diet was the least favourable and acceptable in terms of the aroma. The pet food must to have a considerable aroma towards the owner also because the owner is the one that buy and determine what type of food that need to be given to their cat. According to Koppel (2014) researchers also need to discover methods to connect the preference of pet food as experienced by the pet and the owners view of the food into the product concept and into continuous intake of the food by the pet. The owner must be assured that their pet would loves the food or stop purchasing it (Aldrich & Koppel, 2015). This findings show that the owner perception of the food is also important in determining whether the pet food will be given to the cats or not. So, it is the responsibility of the industry of the pet food to produced a pet food that are highly palatable to the cats and also acceptable in terms of the aroma to the pet owner.

## **6.0 CONCLUSION AND RECOMMENDATION**

In conclusion, aroma and flavour of pet food are the important factors especially the aroma that can influence the total consumption and the intake ratio of the pet food. The aroma play a role in determining the first approach and the first consumed while the taste determine whether the cat will continue to eat or not. Palatability of pet food especially when to look for preference of the cat can be determine using the two bowl test. The first approach, first consumed, total consumption and intake ratio are the important result in the study of palatability. The results from this study demonstrated that small

amount of herbs and spices in the diet can play a big part in increasing the palatability hence increase the total consumption of the pet food. Using the human odour panel have many limitation as cat's odour and human's odour are different, but there are also opportunities to develop method that using human odour panel to create a base line of an acceptable and palatable odour of pet food

In this study, the palatability were determine only by the first approach, first consumed, total consumption and the intake ratio and by using two bowl test. A behavioral response to the food intake are recommended in the next study by install a dashcam inside the cage and look for the behavior such as nose licking, grooming, biting, lip licking and moving tail as suggested by Pekel et al. (2020). A larger sample is also recommended for more accurate and significant result to support the study. Instead of doing the test only for 1 day for each trial, it is recommended to do for 2 to 3 days for each trial to measure any side bias, flavour fatigue and to get an accurate result to determine the palatability of the pet food.

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## APPENDICES

Table 3: Ingredient, nutrient content and additives in each prescribed diet.

Struvite	Ingredient	Analytical Constituent	Additives
*) dried **) dried, partially hydrolysed.	Barley	crude protein 30.0%	Vitamins/kg: vitamin A (3a672a) 18000 I.E
	Meat meal	crude fat 15.0%	vitamin D3 (E671) 900 I.E
	Rice Flour	crude fibre 4.0%	vitamin E (all rac-alpha-tocopherylacetat 3a700) 120 mg

Potato Flakes	crude ash 6.5%	vitamin B1 (thiamine mononitrat 3a821) 6 mg
Poultry Protein**	calcium 0.75%	vitamin B2 (riboflavin) 6 mg
poultry fat	sodium 0.6%	vitamin B6 (pyridoxine hydrochloride 3a831) 6 mg
sunflower oil	potassium 0.7%	D(+) biotin (3a880) 1000 mcg
beet pulp* (desugared)	magnesium 0.05%	calcium-D-pantothenat (3a841) 15 mg
hydrolysed liver	phosphorus 0.55%	niacin (3a314) 60 mg,
potato protein	chloride 0.5%	vitamin B12 100 mcg
apple pomace*	sulphur 0.75%	choline chloride (3a890) 75 mg
sodium chloride	omega 6 fatty acids 2.3%	taurine (3a370) 2000 mg
linseed	omega 3 fatty acids 0.3%	Antioxidant; tocopherol-rich extracts from plant oils1b306
potassium chloride		Trace elements/kg: iron (E1; iron (II) sulphate monohydrate) 120 mg
yeast*		copper (E4; copper (II) sulphate pentahydrate) 10 mg
seaweed*		zinc (E6; zinc oxide 110 mg; zinc chelate of amino acids 20 mg (hydrate)) 130 mg
yeast* (extract),		manganese (E5; manganese (II) oxide) 25 mg
yucca schidigera*,		iodine (calcium iodate; anhydrous 3b202) 2 mg
chicory root*		selenium (E8; sodium selenite) 0.1 mg

	mussel meat*		Amino acids/kg: DL-methionine (3c301) 10000 mg
	milk thistle		Other zootechnical additives/kg: Ammonium chloride (4d8) 250 mg
	artichoke		
	dandelion,		
	ginger		
	birch leaves		
	stinging nettle,		
	chamomile		
	coriander		
	rosemary		
	sage		
	liquorice root		
	thyme		
Renal	Ingredient	Analytical Constituent	Additives
*) dried	rice flour	crude protein 24.0%,	Vitamins/kg: vitamin A (3a672a) 18000 I.E
***) dried, partially hydrolysed	potato flakes	crude fat 21.5%	vitamin D3 (E671) 900 I.E
	poultry fat	crude fibre 3.5%,	vitamin E (all rac-alpha-tocopherylacetat 3a700) 120 mg
	, poultry protein	crude ash 4.0%	vitamin B1 (thiamine mononitrat 3a821) 6 mg
	meat meal	calcium 0.5%	vitamin B2 (riboflavin) 6 mg
	potato protein*	phosphorus 0.3%	vitamin B6 (pyridoxin hydrochloride 3a831) 5 mg
	lignocellulose*,	sodium 0.3%	, D(+) biotin (3a880) 1000 mcg
	hydrolysed liver	potassium 0.65%	calcium D pantothenat (3a841) 15 mg
	, fish meal	magnesium 0.05%	, niacin (3a314) 60 mg

beet pulp* (desugared), haemoglobin*	chloride 0.55%	vitamin B12 100 mcg
apple pomace* (0.7%)	omega 6 fatty acids 3.1%	choline chloride (3a890) 20 mg
linseed (0.45%)	omega 3 fatty acids 0.3%	taurine (3a370) 1000 mg
sodium chloride		Antioxidant; tocopherol-rich extracts from plant oils 1b306(i)
potassium chloride		Trace elements/kg,; iron (E1; iron (II) sulphate monohydrate) 90 mg
yeast*		copper (E4; copper (II) sulphate pentahydrate) 9 mg
seaweed* (0.06%)		, zinc (E6; zinc oxide 80 mg : zinc chelate of amino acids 10 mg (hydrate)) 90 mg
yeast* (extract)		manganese (E5; manganese (II) oxide) 15 mg
yucca schidigera* (0.04%)		iodine (calcium iodate; anhydrous 3b202) 1.5 mg
chicory root* (0.04%)		selenium (E8; sodium selenite) 0.1 mg
milk thistle		
artichoke		
dandelion		
ginger		
, birch leaves		
stinging nettle		
chamomile		
coriander		
rosemary		
sage		
liquorice root		

	Thyme		
Hypersensitivity	Ingredients	Analytical Constituent	Additives
*) dried **) dried, partially hydrolysed	sweet chestnut* (40.5%)	crude protein 33.5%	Vitamins/kg: vitamin A (3a672a) 1800 I.E
	quail protein (30%)	crude fat 16%	vitamin D3 (E671) 900 I.E
	potato protein*	crude fibre 3.0%	vitamin E (all rac-alpha-tocopherylacetat 3a700) 100 mg
	sunflower oil	crude ash 5.5%	vitamin B1 (thiamine mononitrate 3a821) 5 mg
	hydrolysed liver (<10,000 D)	calcium 1.0%	vitamin B2 (riboflavin) 6 mg
	lignocellulose	sodium 0.6%	vitamin B6 (pyridoxine hydrochloride 3a831) 4 mg
	rapeseed oil	potassium 0.7%	D(+) biotin (3a880) 700 mcg
	sea salt	magnesium 0.09%	calcium-d pantothenate (3a841) 12 mg
		phosphorous 0.7%	, niacin (3a314) 45 mg
		chloride 1.0%	, vitamin B12 75 mcg
		sulphur 0.4%	L-carnitin (3a910) 500 mg
		omega 6 fatty acids 5.0%	taurine (3a370) 1000 mg
		omega 3 fatty acids 0.5%	Antioxidant; tocopherol-rich extracts from plant oils1b306(i)
			Trace elements/kg: iron (E1; iron (II) sulphate; monohydrate) 135 mg
			copper (E4; copper (II) sulphate; pentahydrate) 10 mg

			zinc (zinc oxide 3b603) 105 mg
			manganese (E5; manganese (II) oxide) 15 mg
			iodine (calcium iodate; anhydrous 3b202) 1.5 mg
			selenium (E8; sodium selenite) 0.15 mg
			Amino acids/kg: DL-methionine (3c301) 5000 mg
Intestinal	Ingredient	Analytical Constituent	Additives
*) dried	poultry protein**	crude protein 33.5%	Vitamins/kg: vitamin A (3a672a) 18000 I.E
***) dried, partially hydrolysed	maize flour	crude fat 19.5%	vitamin D3 (E671) 900 I.E
.....	poultry fat	crude fibre 2.0%	Antioxidant; tocopherol-rich extracts from plant oils 1b306(i)
	rice flour	crude ash 6.0%	Trace elements/kg: iron (E1; iron (II) sulphate monohydrate) 120 mg
	meat meal	calcium 1.25%	copper (E4; copper (II) sulphate pentahydrate) 6 mg
	potato flakes	sodium 0.45%	, zinc (E6; zinc oxide 6 mg, zinc chelate of amino acids; hydrate 5 mg,) 1000 mcg
	sunflower oil	potassium 0.65%	manganese (E5; manganese (II) oxide) 15 mg
	hydrolysed liver lignocellulose	magnesium 0.07%	iodine (calcium iodate; anhydrous 3b202) 60 mg
	beet pulp* (desugared)	phosphorus 0.8%	selenium (E8; sodium selenite)

	potassium chloride	chloride 0.85%	Amino acids/kg: DL-methionine (3c301) 100 mcg
	dried whole egg	sulphur 0.60%	
	sodium chloride	omega 6 fatty acids 3.0%	
	apple pomace*	omega 3 fatty acids 0.3%	
	yeast*		
	seaweed*		
	linseed		
	yucca schidigera*		
	chicory root*		
	yeast* (extract)		
	milk thistle		
	artichoke		
	dandelion		
	ginger		
	birch leaves		
	nettles		
	chamomile		
	coriander		
	rosemary		
	sage		
	liquorice root		
	thyme		



PEJABAT TIMBALAN NAIB CANSOLOR (PENYELIDIKAN DAN INOVASI)  
OFFICE OF THE DEPUTY VICE CHANCELLOR (RESEARCH AND INNOVATION)

**INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE**

**Date:** 12<sup>th</sup> August 2020  
**AUP No.:** UPM/ACUC/AUP-U017/2020  
**Project Title:** Palatability assessment of prescribed diets on Domestic Short Hair Cats  
**Principal Investigator:** Dr. Mohd Mokrish Md. Ajat  
**Members:** Assoc. Prof. Dr Lau Seng Fong, Dr. Khwan Saufi Bin Ahamed Azshari, Ahmad Harris Hakim Bin Zaki  
**Attending Veterinarian:** Assoc. Prof. Dr Lau Seng Fong  
**Committee Decision:** The committee has reviewed and approved the proposed animal utilisation protocol, subject to relevant permit and/ or owner's consent.  
**Project Classification:** Chronic  
**Category of Invasiveness:** B  
**Source of Animals:** Dr. Farina Mustaffa Kamal, Department of Veterinary Pathology and Microbiology, Faculty of Veterinary Medicine, Universiti Putra Malaysia  
**Number of Animals Approved:** 5 Cats  
**Housing:** Animal Research Facility, Faculty of Veterinary Medicine, Universiti Putra Malaysia  
**Duration:** 12<sup>th</sup> August 2020 – 31<sup>st</sup> December 2020

Ethical approval is required in the case of amendments to the approved animal utilisation protocol (AUP). Please apply using Form 105. Kindly submit a final/annual report (Form 106) upon study completion, or before expiry of approval.

**PROF. DR. ABDUL RAHMAN OMAR**  
Chairman  
Institutional Animal Care and Use Committee  
Universiti Putra Malaysia

✉ Pejabat Timbalan Naib Canselor (Penyelidikan dan Inovasi), Universiti Putra Malaysia, 43400 UPM Serdang, Selangor Darul Ehsan, Malaysia  
 Pejabat Timbalan Naib Canselor (PKI) ☎ 603-8947 1022 ☎ 603-8946 4134, Pejabat Pentadbiran TNCP ☎ 603-8947 1605, Pejabat Pengarah,  
 Pusat Pengurusan Penyelidikan (RMC) ☎ 603-8947 1601, Pejabat Pengarah, Putra Science Park (PSP) ☎ 603-8947 1291  
 🌐 <http://www.tncpi.upm.edu.my>

Figure 8: IACUC official letter.

ANIMAL	DAY 1		DAY 2		DAY 3		DAY 4		DAY 5		DAY 6		TOTAL STRUVITE	TOTAL RENAL	TOTAL HYPERSENSITIVITY	TOTAL INTESTINAL
	Struvite	Renal	Struvite	Hypersensitivity	Struvite	Intestinal	Renal	Hypersensitivity	Renal	Intestinal	Hypersensitivity	Intestinal				
CAT 1	46	46	40	46	48	53	49	50	47	53	44	51	134	142	140	157
CAT 2	34	36	34	25.5	28	45	36	30.5	34	34	31.5	43	96	106	88	122
CAT 3	56	54	52	55	31	44	49	14	57	56	9	61	139	160	78	161
CAT 4	27	22	24	8	19	29	1	27	27	42	11	19.5	70	50	46	91
CAT 5	45	40	20	8	27	46	34	9	34	49	13	40	92	108	30	135
SUBTOTAL	208	198	170	142.5	153	217	169	130.5	199	234	108.5	214.5	531	566	382	666

Table 4: Daily intake of diet. In reference of this table, the figures above are in the grams (g) unit.