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INVESTIGATING THE PALATABILITY OF MEDICINE ASSISTED TREATS (MAT) TOWARDS LPS SUPPLEMENT FOR CATS

NIK AMIR AZIB BIN ABD RAHMAN

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INVESTIGATING THE PALATABILITY OF MEDICINE ASSISTED TREATS (MAT) TOWARDS LPS SUPPLEMENT FOR CATS

NIK AMIR AZIB BIN ABD RAHMAN

A project paper submitted to the
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CERTIFICATION

It is hereby certified that we have read this project paper entitled “Investigating the palatability of medicine assisted treats (MAT) towards LPS supplement for cats”, by Nik Amir Azib bin Abd Rahman and in our 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.

DR. MOHD MOKRISH MD. AJAT
BSc (Hons), MSc. (UPM), PhD (UTRECHT),
Senior Lecturer,
Faculty of Veterinary Medicine Universiti Putra Malaysia
(Supervisor)

DR. GAYATHRI THEVI SELVARAJAH
DVM (UPM), PhD (UTRECHT),
Associate Professor,
Faculty of Veterinary Medicine Universiti Putra Malaysia
(Co-Supervisor)

DR. MICHELLE FONG WAI CHENG
DVM (UPM), PHD (UPM),
Senior Lecturer,
Faculty of Veterinary Medicine Universiti Putra Malaysia
(Co-Supervisor)

DEDICATION

Heartfelt gratitude overflows from the depths of my soul to each and every individual who played a pivotal role in crafting this thesis, with a special acknowledgment to my unwavering pillars of strength, Umi and Ayah. To my cherished supervisors and dear friends, your guidance and support have been the beacon that illuminated my academic journey. May the divine grace of Allah (SWT) embrace them, bestowing upon them His boundless mercy, and may their souls find eternal solace in the paradisiacal heaven of Jannatul Firdaus.

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ABSTRAK

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

PENYELIDIKAN KESERASIAN RASA RAWATAN BANTUAN UBAT TERHADAP MAKANAN TAMBAHAN LPS UNTUK KUCING

Oleh

Nik Amir Azib bin Abd Rahman

2023

Penyelia: Dr. Mohd Mokrish Md Ajat

Secara keseluruhan, selera makan bergantung kepada pelbagai faktor, seperti keserasian rasa, frekuensi pemakanan, tempoh masa bagi setiap sesi pemakanan, jumlah tenaga bagi setiap makanan yang telah dimakan dan kepelbagaian jenis makanan yang diambil bagi kucing tersebut. Selera makan akan berkurangan semasa haiwan peliharaan menjadi sakit atau sesuatu yang menghalang faktor-faktor yang disebutkan sebelum ini. Beberapa jenis makanan telah dihasilkan bagi meningkatkan selera makan bagi melawan situasi tersebut yang dinamakan makanan bantuan perubatan. Tujuan utama projek ini adalah untuk menyelidik keserasian rasa rawatan bantuan ubat terhadap makanan tambahan LPS untuk kucing. Teknik menggunakan dua mangkuk telah digunakan bagi menentukan keserasian rasa rawatan bantuan ubat terhadap 5 ekor kucing domestik untuk tempoh selama 7 hari. Selepas itu, terdapat dua jenis rawatan bantuan ubat yang telah digunakan dalam projek ini iaitu perisa Salmon dan juga Sardin. Keserasian rasa rawatan ini seterusnya dianalisa menggunakan parameter “Mendekati dahulu”, “Makan dahulu”, “Jumlah mendekati

dan makan” dan “Nisbah pengambilan makanan”. Ini menghasilkan keputusan dimana jumlah “Mendekati dahulu” dan “Makan dahulu” bagi Salmon lebih tinggi daripada Sardin. Selain itu, Salmon dengan suplemen menghasilkan jumlah nisbah yang lebih tinggi daripada Sardin. Ini menunjukkan kucing lebih gemar terhadap Salmon berbanding Sardin. Kucing tidak akan makan suplemen sahaja tanpa ada makanan bantuan perubatan. Makanan bantuan perubatan berperisa Salmon mengandungi jumlah protein yang lebih tinggi dan lemak yang rendah berbanding makanan berperisa Sardin dimana ini lebih digemari oleh kucing untuk dimakan. Bau makanan tersebut juga lebih digemari oleh kucing tersebut. Justeru, isi kandungan makanan bantuan perubatan adalah amat penting bagi menentukan kesesuapan makanan tersebut. Makanan bantuan perubatan yang mengandungi suplemen lebih disukai oleh kucing namun jika suplemen sahaja tanpa disertakan makanan bantuan perubatan tidak disukai oleh kucing. Sikap kucing itu sendiri amat penting bagi menentukan kesesuapan sesuatu makanan itu. Sehingga sekarang, tiada lagi artikel berkaitan dengan makanan bantuan perubatan untuk memudahkan pemberian ubat untuk kucing. Ubat oral kebiasaannya diberikan melalui teknik yang betul daripada menggunakan makanan.

Kata Kunci: kucing; keserasian rasa; rawatan bantuan ubat; makanan kucing; Teknik dua mangkuk; perubatan

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfillment of the course VPD 4999 – Final Year Project.

INVESTIGATING THE PALATABILITY OF MEDICINE ASSISTED TREATS (MAT) TOWARDS LPS SUPPLEMENT FOR CATS

By

Nik Amir Azib bin Abd Rahman

2023

Supervisor: Dr. Mohd Mokrish Md Ajat

By a broad definition, appetite encompasses a variety of factors, including palatability, frequency of feeding, the length of eating episodes, the energy density of the foods consumed, and the variety of food consumed by cats. These can be seen to decrease whenever pets become sick, or something interferes with those factors. Several foods developed that can increase appetite to combat those situations which is called medicine assisted food or treats. The overall goal of this study is to investigate the palatability of medicine assisted treats towards lipopolysaccharide supplement in cats. Two-bowls method was used to determine the palatability of the medicine assisted treats on five DSH cats for 7 days. Furthermore, there are two types of the medicine assisted treats that were used in this study which are Salmon and Sprat flavoured. The treats palatability was then analysed using “First to Approach”, “First to Consume”, “Total Approach and Consume” and “Intake Ratios”. These produced findings which shown “Total Approach” and “Total Consume” were significantly high in Salmon than Sprat. In addition, Salmon with supplement have the highest ratio per day than the

Sprat with supplement which showing the preferences of Salmon is higher than the Sprat. Supplements were not consumed by the cats themselves. The content of the medicine assisted treats which salmon have higher protein and less lipid that were preferred to the cats along with the smell of the treats themselves. Therefore, these ingredients may contribute to the palatability of the medicine assisted treats. Medicine assisted treats that contain lipopolysaccharide supplements do increase the palatability of the treats, but the supplement itself is not palatable to cats. Individual preference and behaviour can affect the palatability of medicine assisted treats towards lipopolysaccharide supplement. There are no reports on palatability of medicine assisted treats until today on any article to ease giving medication to cat to deliver oral medication drugs. Oral medication in cats usually requires proper technique instead of using foods.

Keywords: cat; palatability; medicine assisted treats; pet food; two-bowl; medication

1.0. Introduction

The pet food industry is rapidly expanding as a result of pet owners' increased awareness on the importance of feeding a balanced and healthy diet to their pets. Pet owners provides the best diet for their pets and are willing to spend more on their feed especially prescription types of diet. There are prescription diets that were curated just for pets that suffer from conditions such as chronic kidney disease, obesity, allergies, and many more. Medicine-assisted treats were created to aid those owners in giving medications to their pets. To compete with the various types of pet food brands in the market, pet owners will have to choose the one that is suitable for their pets, which can be measured mainly by their appetite. By a broad definition, appetite encompasses a variety of factors, including palatability, frequency of feeding, the length of eating episodes, the energy density of the foods consumed, and the variety of food consumed by cats (Arora and Anubhuti 2006). In cats, the term "palatability" describes the extent to which a food or diet is accepted and liked by cats based on their preferences for taste, texture, and other sensory aspects of the food. In order to encourage optimal food intake and maintain proper nutrition in cats, palatability is a crucial aspect (Nazhan et al. 2022). This is due to the fact that they have relatively smaller numbers of taste buds compared to other animals (Ahmet et al. 1979). Cats can identify which diet is suitable for them as they are obligate carnivores, so they will need more protein and amino acids to meet their daily requirement. Essential nutrients for cats like Taurine are supplemented into the diet (Knopf et al. 1978). On the other hand, Lipopolysaccharide (LPS) is a cell wall component of Gram-negative bacteria. However, LPS from Gram-negative bacteria is ubiquitous in the environment, including air, soil, and plant surfaces, and does not cause inflammation after oral ingestion or dermal contact (Smith et al. 2011). While, when ingested this LPS is reported to have

several advantages and can act as a supplement. Therefore, this study aimed to determine the palatability of medicine assisted treats towards LPS supplement for cats.

2.0. Literature Review

2.1. Nutrient Requirements for cats

Felis catus, or domestic cat, belongs to the Felidae family, which solely consumes meat products, just like the larger cat, also known as a tiger or lion. Cats are unique as their nutritional requirements differ from those of other animals. Dated around 10,000 years ago, cats were domesticated from wildcats and are considered one of the most recent domesticated mammal species. They consumed the scraps and leftovers from the human settlements which making them diverged from their wildcat ancestors by Driscoll et al. (2009). To relate from this matter, cats often hunt smaller prey multiple times a day to meet their energy requirements by Aldrich et al. (2015). Due to their habit of eating several tiny meals over the day, cats are also categorised as intermittent eaters. From Bradshaw et al. (1996), they are able to distinguish tiny differences in the ingredients of the food they found or offered. Labelled as obligate carnivore as they need food-based products in their daily consumption to meet their nutritional needs or severe nutritional deficiencies can occur.

Cats do have higher nutrient requirements than dogs in terms of dietary protein which essential amino acids must be present in adequate level. Some of the enzyme that catalyse amino acids being impaired making essential amino acids such as Taurine and Arginine are important in the diet. Calcium, phosphorus, magnesium, sodium, potassium, and chloride are macrominerals that cats need, whereas iron, copper, zinc, manganese, selenium, and iodine are microminerals that cats need as mentioned by National Research Council (2006). To add, phosphorus and calcium

levels in the diet can also have various negative impacts on feline health. Phosphorus deficiency in the diet is linked to an increased risk of hypercalcemia. In healthy cats, dietary phosphorus levels more than 3.0 or 3.6 g/1000 kcal may cause kidney damage or dysfunction, as well as chronic kidney disease (CKD) from Stockman et al. (2021). We can observe this matter which Feline Lower Urinary Tract Disease (FLUTD) is very common among the local DSH cats in Malaysia due to poor diet and feed intake. There are three types of diet available in the market which are complete diet, balance diet and also complementary diet. Treats are belonged in the complementary diet thus treats itself only comprise of 10% from the nutrient requirements of the cats so other diet must be given alongside treats so the nutrient requirements of the cats can be achieved.

2.2. Palatability Drivers

To understand more about palatability, we must first understand the components that drive the food intake in animals especially in cats. In terms of biological aspects of the cats, behaviour and exposure towards certain types of food play a major role that influence their preferences towards certain types of food. By exposing certain types of food during pregnancy by their mothers via amniotic fluid, kittens may follow certain trend and pattern of food intake similar to their mothers by Bradshaw et al. (2006). The primacy effect occurs when cats has limited exposure to other foods as a kitten and develops a predilection for specific flavour as mentioned by Stasiak (2002). Cats supposed to be neophilia (attracted or preferences towards new types of food over the same type of food) but if primary effect takes place, they will exhibit neophobia also by Bradshaw et al. (2006).

Cats' diet selection is remarkable in that they can detect and select meals using both scent and taste. Olfactory which functioned to perceive and process the various

chemicals existing in their environment was used by the cats to recognise both novel and untrusted aromas by Aldrich et al. (2015). To add, these senses can also detect the freshness and safety of food, which may explain why cats are more selective when it comes to eating than dogs. If the odour or aroma of the food is more attractive for the cats, they will prefer that over another.

Next, taste receptor of the cats is one of the palatability drivers. They have a very unique tongue which comprise of very small units of fungiform papillae. They comprised of three different groups that respond to different types of components. The groups responded to acids, amino acids and also nucleotides as mentioned by Boudreau et al. (1997). The major groups that are available are groups that responded towards amino acids making them sensitive and alert with specific food's amino acid content. Cats also appear to reject bitter food due to the amino acids in them such as L-isoleucine, L-phenylalanine and L-tryptophan while accepting L-lysine and L-histidine from Beauchamp et al. (1977). According to Li et al. (2006), cats do not have any functional sweet taste receptors, hence sweet is not sensed in cats. On the other hand, umami flavours which related to high concentrations of amino acids, L-glutamic acids are well perceived by the cats by Salaun et al. (2016). Due to the abundance of the amino acid group receptor in cats, they can differentiate meats with different types of quality. Fish, notably salmon, has been shown in study to be preferred by cats over commercial cat food (fish, liver, chicken, or beef-flavoured) and rats by Adamec (1976).

Another thing that can be looked at is the physical properties of the food itself. Since there are many types of food that are available in the market, their nutritional compositions are different with each other. Dry food which has the lowest amount of moisture, provide the lowest amount of protein content in comparison with wet diets but have the same amount of fat levels. As we know, wet diets and treats are more preferable for the cats may be due to the content inside them. Dry food or kibbles sometimes have variable of shapes and some with sharp edges that can damage the

oral cavity of the cats or even the stomach. Therefore, the texture and shape of the food itself play a major role in the palatability of food in cats. From Bradshaw et al. (1996), temperature of the food also affecting the palatability of the food as cats prefer food that have temperature similar to the body temperature, or at least room temperature. Warming the food instead giving chill food can drastically improves the food palatability.

Behavioural responses of the cats during the testing can be considered as one of the palatability drivers. Preferences and consumption towards different types of food in animal is always accompanied by their behavioural responses. Some responses can be seen such as facial expression, eye and face movements, sniffing or smelling, nose licking, grooming and many more as mentioned by Ahmet et al. (2020). He added that, these responses can be classified further into three parts, those related to taste of food, those related to consumption and those related to satiety. From this, we can see the palatability of the different types of food from the behaviour of the cats.

2.3. Medicine Assisted Treatments

There are many types of drugs that are available on the market, and they are being prescribed by veterinarians to pet owners daily. Different types of drugs and medication require different ways of administration in terms of the time the drugs are given, before or after meals, how many per consumption, and specific instructions for specific drugs, such as the administration of water after doxycycline and steroids after meals as stated by Nivy et al. (2020). This topic about the administration of drugs to pets is rarely discussed in the papers on feline and canine medicine. Proper instruction must be given to the pet owners by the veterinarian in order the administration of drugs

is given correctly. For examples, the vets must demonstrate first and teach pet owners on how to give drugs especially tablets and liquid form. Incorrect technique can cause injury to the pets and also to the pet owners. By Levy et al. (2019), aspiration pneumonia can occur when liquid enters the trachea of animals, which can be induced by the improper technique of liquid drug administration. On the other hand, vets must explain the significance of antibiotic drugs to be finish off completely to the pet owners and antimicrobial resistance value. In contrast for livestock drug administration, they usually used injections, feed additives, ruminal boluses and topical pour-on as explain by Imran and Kasra (2002).

Several strategies have been developed to assist pet owners in administering medication to their pets, such as administering medication through wet food. Medication can be hidden in wet food, especially in dogs, as they will eat their food along with the medication easily. Conversely, from by Aldrich et al. (2015), cats are really sensitive to the change in aroma in their food, as these strategies may or may not work. These "strategies", which use food as a medium to administer drugs or medication to pets, may be considered medicine-assisted treatments. These medicine-assisted treatments must have the correct content and formulation in order to be given to the pets and avoid any contraindications with the drugs or medication given to them.

3.0. Materials and Method

3.1. Ethical approval and informed consent

Animal used in this study was approved under permission and guidelines of Institutional Animal Care and Use Committee of Universiti Putra Malaysia (UPM) with the Animal Use Protocol (AUP) permission reference number UPM/IACUC/AUP-U031/2023. The IACUC approved five cats for this study. The owner of the cats signed a consent form before proceeding with the study.

3.2. Research location, study period and animals

The study was conducted in the Animal Research Facility, Faculty of Veterinary Medicine, UPM from 4th September 2023 to 14th September 2023. Five (2 males and 3 females) adults (median age of 2 years old) DSH cats were used. Routine physical examination was performed at the beginning of the study and throughout the experiment to observe any abnormalities. Most of them were presented with body weight 3 to 4 kg with median of 3.51 kg. All of them were placed into individual cages next to each other in the same room and remained healthy throughout the study.

3.3. Palatability test

In this study, the two-bowls technique was used to test the diet palatability as done by Tobie et al (2015). First, the cats were acclimatized for 3 days before the study in order to make them adapt to the new environment. They were given dry food from the same brand that they are given at home during the acclimatization and study period by Hall et al. (2018). Food was given twice daily at 8am and 4pm. Types of medicine assisted treats used in this study was salmon and sprat flavoured while supplement used was lipopolysaccharide supplement that aids in immune system booster and skin health. These foods were obtained from an undisclosed company to protect its commercial rights. Both flavours have different kind of content, but both

have low amount of sodium and phosphorus content to the commercially available treats.

Study was conducted for 7 days, with food A and B given on 1st day, food A and C on the 2nd day, food C and D on the 3rd day, food B and C on the 4th day, food B and D on the 5th day, food A and D on the 6th day and food A and on the last day (7th day). For references, food A is Sprat, food B is Salmon, food C is Sprat with LPS, food D is Salmon with LPS, and food E is LPS only. Dry food was weighed using digital scale and calculated sufficient for the cat's daily requirements.

Dry food was given 2 hours prior to the trials to reduce hunger factor that can influence the palatability test. Medicine assisted treats trials were done by randomly placed treats in respective bowls, and labelled A or B, presented individually to the animals and observed for 20 minutes or until the food finished. Treats were put first before the supplement to hide it from the cat. First to approach and first to consume samples was recorded. These methods were repeated during evening trial but switch bowl sides to avoid choice bias for the cat.

3.4. Human sensory assessment

This assessment was adapted from Pickering et al. (2009) which involved human assessment towards aroma or smell of the pet food. Human was given the treats randomly and the odour was smelled and score the odour by scale 1 to 4 from least pleasant up to most pleasant. Survey was done on both flavour and result was tabulated. After each sample, human volunteer was given coffee to smell to clear off or neutralized the previous smell. These produce another result for the medicine assisted treats from human point of view.

4.0. Results

First approached

The medicine assisted treats were compared by observing the cat first approach samples or sniffed treats that were presented each day. The First Approach result in shown in Figure-1. Based on the frequency data, the result shown slight superiority in MAT Salmon especially on day 5 between Salmon versus Salmon with LPS supplement (P=0.04).

To summarize, MAT salmon and Salmon with LPS supplement have the highest number of frequencies rather than Sprat and Sprat with LPS. LPS supplement itself have the lowest number of first approach. The results from these trials may be due to differences in smell of the samples itself which Salmon and Sprat produce different odour and taste for the cat which aroma of sprat was less appealing than the salmon for the DSH. Each cat also has individual behaviour such as approaching the bowl that is closer to them, liking dry food more than treats and eating only when no one around.

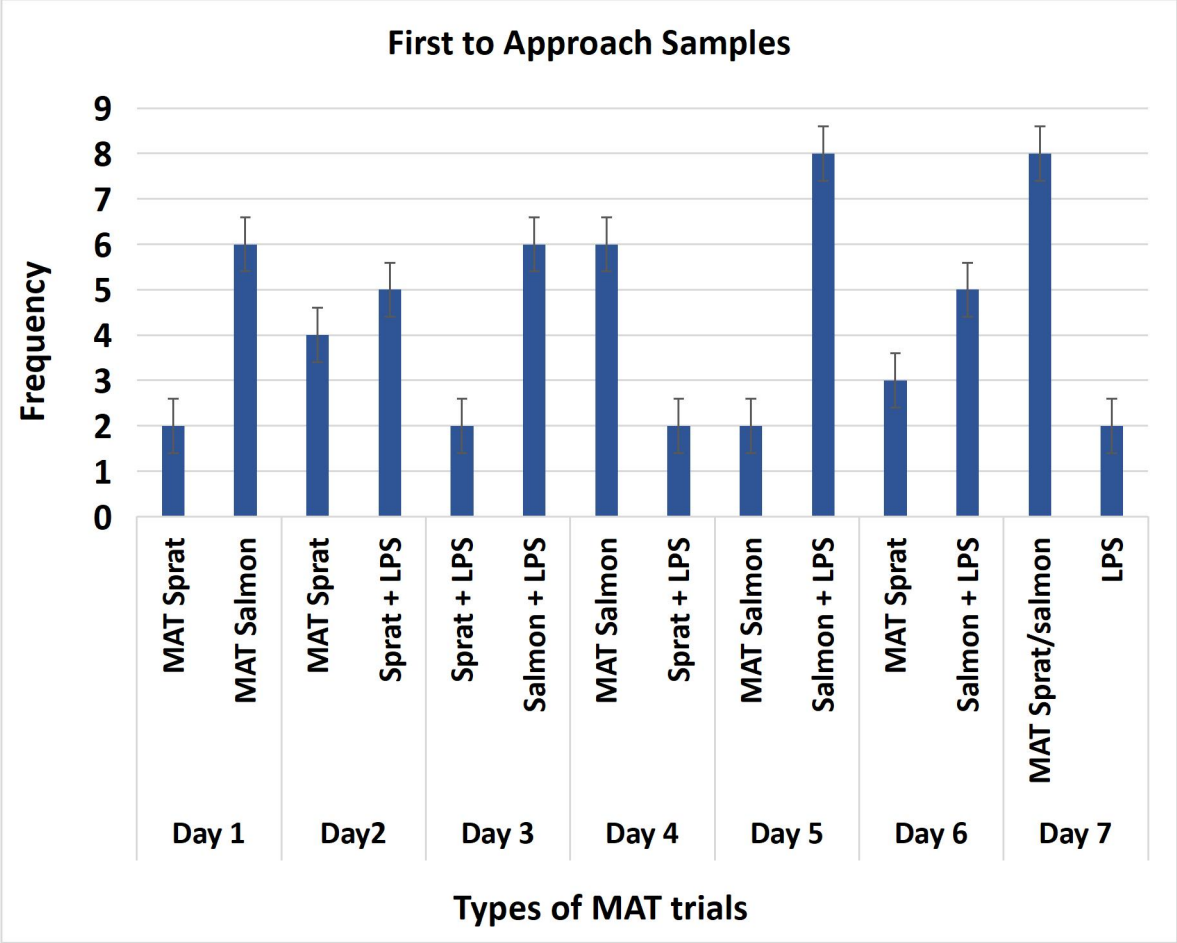

Fig. 1 Different MAT trials "First Approached" by cats according to different days.

First Consumed

From the same trials we also compared the MAT trials which presented to the cats daily. "First consumed" results were shown in the Figure-2. Behaviour of the cats was monitored for 20 minutes, and the data was recorded. We can also see here that variable results were produced which slight favourable towards the salmon and also salmon with LPS supplement. On day 3, trials between Sprat with LPS and Salmon with LPS was proven significant by using chi-square ($p<0.05$).

The first consumed was then summarized in one data producing total first consumed. These results may be due to the different content of the food itself while the LPS was not consumed at all may be due to lack of odour coming from it. Medicine

assisted treats with LPS have higher values than Medicine assisted treats without LPS which LPS itself may influence the overall palatability or due to the individual behaviour itself. Overall observations revealed that salmon with LPS were more palatable compared to others.

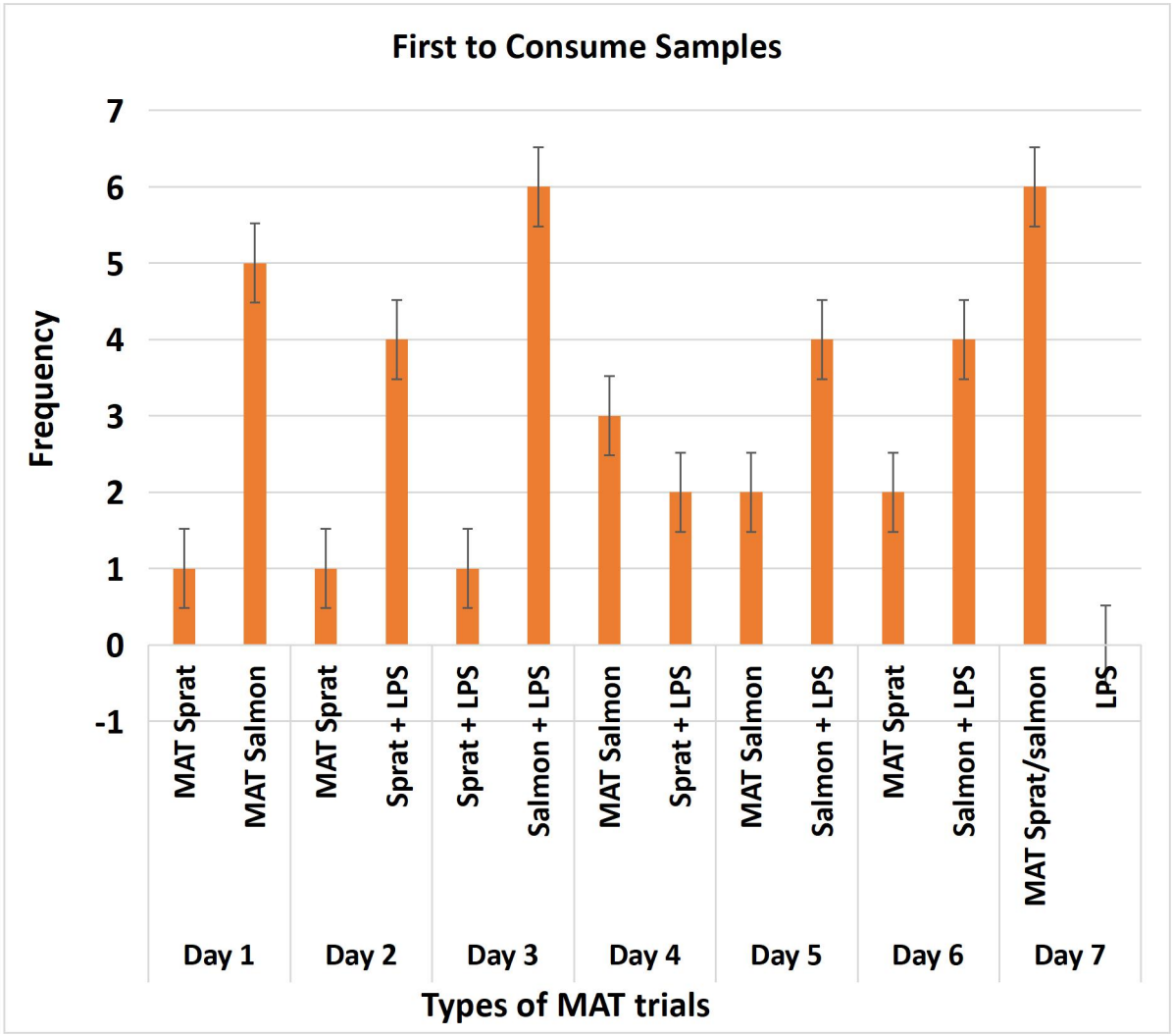

Fig. 2 Different MAT trials "First Consumed" by cats according to different days.

Intake Ratio

In this study, the Intake Ratio described the ratio between Total Consumed of the MAT trials presented each day as shown on Figure-3. According to Intake ratio results, Salmon with LPS on day 3 have the highest ratio (0.86) compared to the lowest value, Sprat with LPS (0.14). On day 7, salmon and sprat have the maximum ratio value (1) due to LPS was not consumed at all by the cats. We can see here the ratio of the MAT with LPS have higher ratio than those MAT without LPS. Therefore, LPS supplement itself was more unpalatable than other MAT trials.

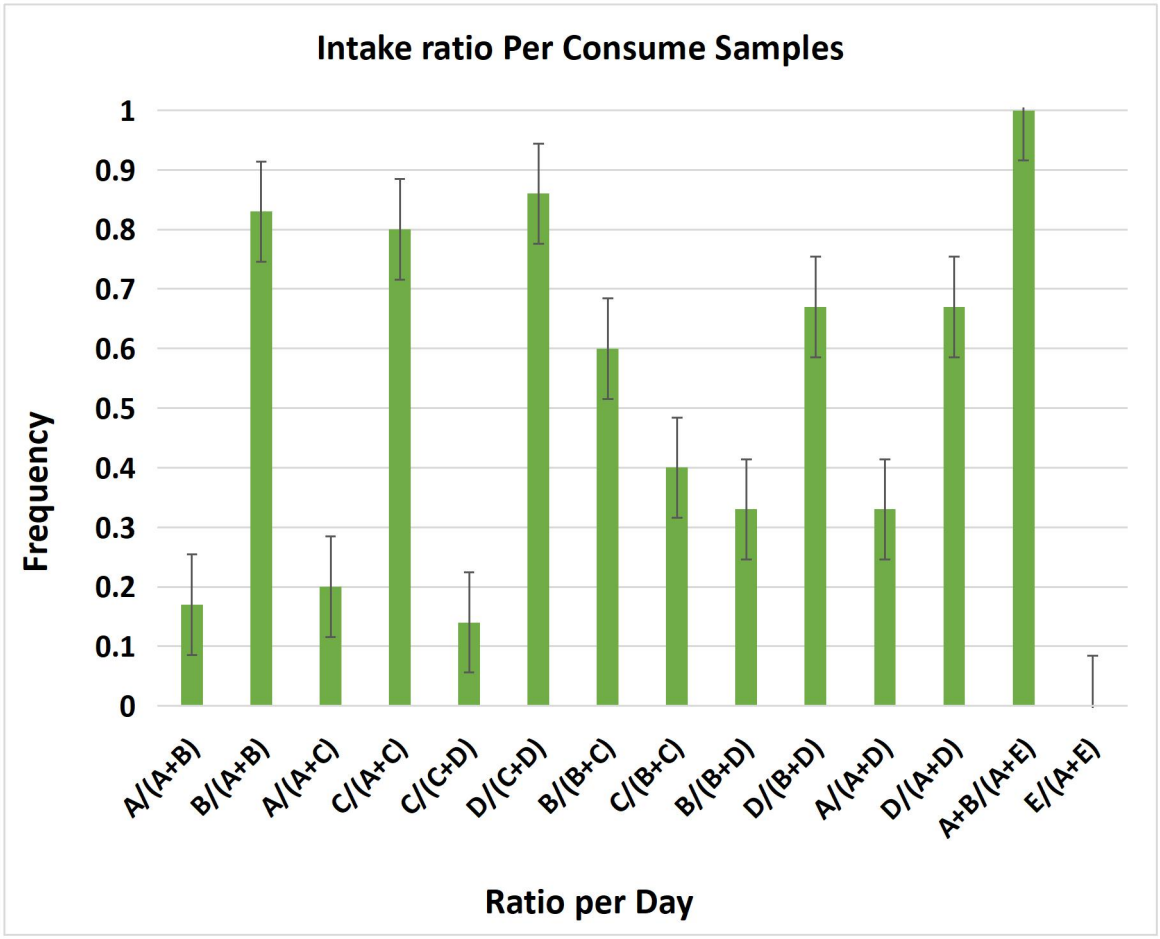

Fig. 3 Intake ratio of MAT trials. A=Sprat, B=Salmon, C=Sprat with LPS, D=Salmon with LPS, E=LPS

Survey on humans

Total of 18 respondents were selected in this survey. Human volunteers were asked to smell both of the medicine assisted treats and score them according to scale from 1-4 which represents least pleasant (1), less pleasant (2), more pleasant (3), and most pleasant (4). Results from the observations are shown in Table-1.

	Score			
Types of MAT Flavours	**Least pleasant (1)**	**Less pleasant (2)**	**More pleasant (3)**	**Most pleasant (4)**
Sprat	13	10	8	5
Salmon	8	5	10	13

Table 1 Descriptive analysis of medicine assisted treats' aroma by human sensory assessment.

5.0. Discussion

In this study, palatability was assessed based on First Approached, First Consumed, Total Approach, Total Consume and Intake ratio. From the First Approached, the results that we get which Salmon with LPS supplement was more approachable than Salmon only may indicate the LPS do have effect in increasing the palatability of the medicine assisted treats itself. This may be due to several factors such as individual preferences, behaviour, or LPS itself. Aroma plays a major role in determining the palatability of food towards cat. This LPS supplement may alter some of the aroma component inside the medicine assisted treats itself despite being displayed in the different bowl simultaneously to the cats. Preferences towards specific sides of bowl, distances from the bowl, appearances or presentation of the food itself are some of the variables that we tried to minimize during the study. We give different types of medicine assisted treats (MAT) trials on different side of bowl during the morning trial and evening trial to reduce the selection bias by Watson et al. (2023). Next, the distances from the bowl were standardized because each cage had the same size, and the bowl was made sure to put across from the cat. Appearances of the food presented may affect the approachability by having different colour, shape or even texture.

For the First Consumed, the results were tally and consistent with the First Approach results which both values correspond to each other. Due to different content of the medicine assisted treats for both the flavours, these produced different results for the palatability test. Salmon has higher protein but lower carbohydrate content than the Sprat. In terms of macronutrient selection, cats are driven to foods with a high protein and fat content and avoid carbohydrate-rich foods as mentioned by Hewson-Hughes et al. (2011). To add, cats do tend to prefer a higher protein content diet due to their higher essential amino acid requirements than dogs, such as taurine and arginine (Peron et al, 2018). LPS supplements alone that were given were not

consumed at all by the cats. These can be related to the aroma that was mentioned before, in which LPS does not display any aroma and thus will not stimulate the olfactory system of the cats. From Ahmet et al, (2020) cats do have higher sensitivity towards aroma or smell 14 times better than human.

To discuss more about our study, the palatability testing or consumption testing was done by using the two-bowl technique rather than one-bowl technique. The one-bowl technique was rather an acceptance testing which using single feed at given period while two-bowl technique was a preference testing which simultaneously present different types of feed/food at given period taken from Tobie et al, (2015). Even though this method was chosen, there are still some concerns which palatability testing may involve with the individual cat behaviour such as food preferences, biases, or rejections that can happen during the testing. It is really important to do pre-trials on the candidate in order to find a suitable candidate for the study as it will make the results more accurate. Furthermore, hunger levels may be included in the bias which can impact the amount of food eaten. Dry food was given 2 hours prior to the study to eliminate this bias. Some of the cat behaviours that we managed to encounter were individuals' cats being too scared to eat, as we did the study in a foreign environment for the cats. Some of them also prefer dry food to treats, as they may be conditioned to eat dry food as it has been given to them for a long time by their owner. They also eat in the absence of humans, especially if someone stranger to them is present.

Next, the Intake ratio that was done were to determine the preferences ratio towards different types of medicine assisted treats trials in each day. In this, we can conclude that Salmon with LPS ranked first following with Sprat with LPS, Salmon, Sprat and lastly LPS. These referred back to the previous assessment on the first approach and consume which these results may be due to those factors. The results of Sprat were slowly accepted to the cats as its aroma was manageable and trained to

the smell receptor of the cats. Cats can eat same diet repeatedly for a long time without having flavour fatigue unlike humans also mentioned by Tobie et al, (2015).

Another test was done on human to test their sense of smell to determine whether if the pet food is acceptable and palatable from the human perspective. Logically, these results will be different as cats have superior sense of smell than humans. The survey indicates that from 18 respondents, salmon was more favourable in terms of smell than sprat. Sprat do have a stronger smell, anchovies-like which may influence its aroma. On the other hand, salmon have a lighter smell, a common wet-food smell, which may be better for humans and cats. While humans and pets may see things differently, descriptive sensory data from humans may be useful in determining whether pets accept or reject pet food as mentioned by Koppel (2014).

The Salmon medicine assisted treats flavours content does have a higher protein (10.5%) and moisture (84%) but lower lipid (1.9%) and fiber (0.2%) than Sprat which have protein (7.9%), moisture (83.2%), lipid (5%) and fiber (0.3%) respectively (Table 2 of the Appendix). The higher protein content of the salmon has influenced the overall palatability of the treats due to the cat's being less able to regulate the enzymes that catalyse the metabolism of amino acids, thus requiring more protein reported by Watson et al. (2023). According to the National Research Council (2006), cats prefer foods with a higher fat content since they require a minimum of 9% crude fat on dry matter for maintenance, although only 0.2% of arachidonic acid should be satisfied on a daily basis. Cats prefer lower intake of carbohydrates probably linked to a variety of sensory and metabolic changes, including the absence of sweet taste receptors, which prevents them from sensing sweetness as shown by Hewson-Hughes et al. (2011). From this perspective, salmon have both protein and carbohydrate in the proper level making them prefer salmon than sprat. The medication-assisted treats were advertised

as having low levels of phosphorus and sodium. According to FEDIAF (2018), the maximum phosphorus intake for dogs and cats is 4 g/1000 kcal, while the safe upper limit for sodium intake is 3.75 g/1,000 kcal.

6.0. Conclusion

Medicine assisted that were introduced to the group of cats resulted in Salmon was more preferred than Sprat. The supplements that were given alongside medicine assisted treats do increase its overall palatability. Pet food palatability assessment especially in cats are important for both pharmaceutical company and owners. There is still lack of studies on medicine assisted treats made of meat and meat by-products for their palatability in feline nutrition studies. With development of treats specialized in giving medication in cats, this can open to many more possibilities in the future to improve feline healthcare. Additional research is needed to bridge the gap between identifying more appetising complete foods and understanding the nutritional components within medicine assisted treats that drive food or medication intake in pets.

REFERENCES

Bradshaw, J. W., Goodwin, D., Legrand-Defrétin, V., & Nott, H. M. (1996). Food selection by the domestic cat, an obligate carnivore. *Comparative biochemistry and physiology. Part A, Physiology*, *114*(3), 205–209. https://doi.org/10.1016/0300-9629(95)02133-7

Koppel, K. (2014). Sensory analysis of pet foods. J. Sci. Food Agric., 94: 2148-2153. https://doi.org/10.1002/jsfa.6597

Driscoll, C. A., Macdonald, D. W., & O'Brien, S. J. (2009). From wild animals to domestic pets, an evolutionary view of domestication. *Proceedings of the National Academy of Sciences of the United States of America*, *106 Suppl 1*(Suppl 1), 9971–9978. https://doi.org/10.1073/pnas.0901586106

Aldrich, G. C., & Koppel, K. (2015). Pet Food Palatability Evaluation: A Review of Standard Assay Techniques and Interpretation of Results with a Primary Focus on Limitations. *Animals: an open access journal from MDPI*, *5*(1), 43–55. https://doi.org/10.3390/ani5010043

National Research Council. (2006). *Nutrient Requirements of Dogs and Cats*. Washington, DC: The National Academies Press. https://doi.org/10.17226/10668.

Stockman, J., Villaverde, C., & Corbee, R. J. (2021). Calcium, Phosphorus, and Vitamin D in Dogs and Cats. https://doi.org/10.1016/j.cvsm.2021.01.003

Bradshaw, J. W. S. (2006). The Evolutionary Basis for the Feeding Behavior of Domestic Dogs (Canis familiaris) and Cats (Felis catus), *The Journal of Nutrition*, *136*(7), 1927S-1931S. https://doi.org/10.1093/jn/136.7.1927S

Stasiak, M. (2002). The Development of Food Preferences in Cats: The New Direction, NutritionalNeuroscience, 5:4, 221(228), https://doi.org/10.1080/1028415021000001799

Boudreau, J. C. (1977). Chemical stimulus determinants of cat neural taste responses to meats. *Journal of the American Oil Chemists' Society*, *54*(10), 464-466. https://doi.org/10.1007/BF02671037

Beauchamp, G. K., Maller, O., & Rogers, J. G. (1977). Flavor preferences in cats (*Felis catus* and *Panthera* sp.). *Journal of Comparative and Physiological Psychology, 91*(5), 1118–1127. https://doi.org/10.1037/h0077380

Salaun, F., Blanchard, G., Paih, L. L., Roberti, F., & Niceron, C. (2017). Impact of macronutrient composition and palatability in wet diets on food selection in cats. *Journal of Animal Physiology and Animal Nutrition*, *101*(2), 320-328. https://doi.org/10.1111/jpn.12542

Hewson-Hughes, A. K., Victoria L., Hewson-Hughes, Andrew T., Miller, Simon R., Hall, Stephen J. Simpson, David Raubenheimer; Geometric analysis of macronutrient selection in the adult domestic cat, *Felis catus*. *Journal Experimental Biology*; 214 (6): 1039–1051. https://doi.org/10.1242/jeb.049429

Adamec, R. E. (1976). The interaction of hunger and preying in the domestic cat (Felis catus): An adaptive hierarchy? *Behavioral Biology*, *18*(2), 263-272. https://doi.org/10.1016/S0091-6773(76)92166-0

Watson, P. E., Thomas, D. G., Bermingham, E. N., Schreurs, N. M., & Parker, M. E. (2023). Drivers of Palatability for Cats and Dogs—What It Means for Pet Food Development. *Animals*, *13*(7), 1134. MDPI AG. Retrieved from http://dx.doi.org/10.3390/ani13071134

Ilias, N., Zaki, A.H.H., Junaidi, A.H.A., Fong, L.S., Saufi, I., Ajat, M. (2022) Palatability assessment of prescribed diets on domestic shorthair cats, Veterinary World, 15(3): 640-646. https://doi.org/10.14202/vetworld.2022.640-646

Watson, P., Thomas, D., Hoggard, A., Parker, M., & Schreurs, N. (2020). Investigating the Palatability of Lamb and Beef Components Used in the Production of Pet Food for Cats. *Animals*, *10*(4), 558. https://doi.org/10.3390/ani10040558

Hewson-Hughes, A. K., Colyer, A., Simpson, S. J., & Raubenheimer, D. (2016). Balancing macronutrient intake in a mammalian carnivore: Disentangling the influences of flavour and nutrition. *Royal Society Open Science*, *3*(6). https://doi.org/10.1098/rsos.160081

Imran, A., Kasra, K. (2002). Pharmaceutical challenges in veterinary product development, *Advanced Drug Delivery Reviews*, 54(6), 871-882, https://doi.org/10.1016/S0169-409X(02)00074-1

Nivy, R., Brenner, O., Shub, V., & Bruchim, Y. (2020). Obstructive fibrinous tracheal pseudomembrane in a cat. https://doi.org/10.1111/jvim.15944

Levy, N., Ballegeer, E., & Koenigshof, A. (2019). Clinical and radiographic findings in cats with aspiration pneumonia: retrospective evaluation of 28 cases. *The Journal of small animal practice*, *60*(6), 356–360. https://doi.org/10.1111/jsap.12990

Tobie, C., Péron, F., & Larose, C. (2015). Assessing Food Preferences in Dogs and Cats: A Review of the Current Methods. *Animals*, *5*(1), 126–137. MDPI AG. http://dx.doi.org/10.3390/ani5010126

Ahmet, Y. P., Serkan, B. M. & Nüket, A. (2020). Taste preferences and diet palatability in cats, *Journal of Applied Animal Research*, 48(1), 281-292, https://doi.org/10.1080/09712119.2020.1786391

Hall, J. A., Vondran, J. C., Vanchina, M. A., & Jewell, D. E. (2018). When fed foods with similar palatability, healthy adult dogs and cats choose different macronutrient compositions. *Journal of Experimental Biology*, 221(14). https://doi.org/10.1242/jeb.173450

Pickering G. J. (2009). Optimizing the sensory characteristics and acceptance of canned cat food: use of a human taste panel. *Journal of animal physiology and animal nutrition*, *93*(1), 52–60. https://doi.org/10.1111/j.1439-0396.2007.00778.x

APPENDIX

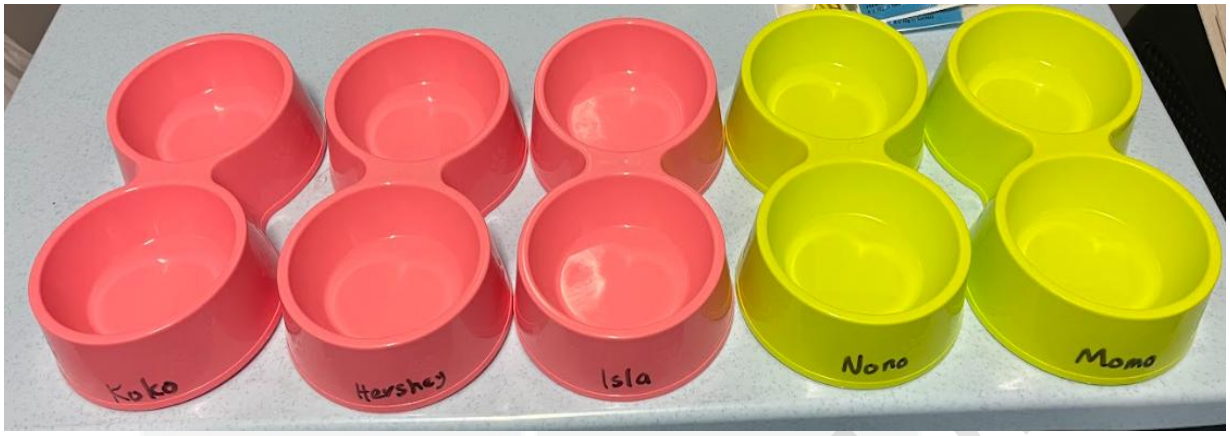

Fig. 1 Each of the cat has their own bowl and labelled.

Fig. 2 Bowl filled with medicine assisted treats.

Fig. 3 Both flavours of the medicine assisted treats.

Fig. 4 Each sachet of the medicine assisted treats were allocated in the specific bowl according to the flow.

Fig. 5 Palatability testing setting of the study.

Fig. 6 All cats have their own individual cages with name labelled.

Table-2 Salmon versus Sprat content of the MAT.

	Protein	Lipid	Fiber	Carbohydrate	Moisture	Sodium	Phosphorus	Calorie
Sprat	7.9%	5.0%	0.3%	1.6%	83.2%	29mg/stick	12mg/stick	10kcal/stick
Salmon	10.5%	1.9%	0.2%	1.4%	84.0%	26mg/stick	11mg/stick	13kcal/stick