Formulation of dog food using locally available ingredients

Dilrukshi H.N.N., Jayaweera B.P.A. & Gamika A.Prathapasinghe

Department of Livestock and Avian Sciences, Faculty of Livestock, Fisheries and Nuitrition, Wayamba University of Sri Lanka

Puppy stage is a critical period of dog's life cycle as it requires more nutrition. During this time period, puppy requires more than 28% of protein and energy density of less than 3.5 kcal ME/g DM. Dog food is material intended for consumption by the domestic dog. Dogs are able to healthily digest a variety of foods. The remarkable adaptability of the dog has led to the successful use of commercial diets that differ widely in their ingredient composition. The pet food industry has well established markets in developed countries like United States but it plays minor role in developing countries like in Sri Lanka. Therefore, this study was carried out with the objectives of formulating a palatable dog-food using locally available ingredients in Sri Lanka at lower price level, which confirm the main nutritional requirements and to determine its influence on growth rate of local breeds. Maize, Rice flour, Rice polish, Animal fat, Soya bean meal, Fish meal, Hypro meal, Chicken, Eggs, Baking soda and Vitamin premixes were the ingredients used in dog food formulation. A total of 08 puppies, between 06-08 weeks of age were selected for the study. Body weight was measured using weighing scale and serum electrolyte concentrations were measured to determine nutritional status. Sensory evaluation was performed for dog feces and skin/coat condition. The body weight and feed intake had a significant (P<0.05) and positively associated relationship (r = 0.84, P =0.000). The mean growth rate of puppies which were fed using formulated feed was 0.088 kg/day ± 0.038 whereas 0.025 kg/day ± 0.006 was the mean growth rate of puppies which were fed using homemade diets in first trial. The current study found that the mean growth rate was 0.0586 kg/day ± 0.022 in formulated feed group whereas 0.0628 kg/day ± 0.019 was the weight gain in imported feed group in second feed trial. Sensory evaluation results revealed better mean scores for sensory attributes in dog feces and skin/coat condition in formulated feed group. In conclusion, formulated puppy feed had positive association with growth rate, electrolyte concentration and sensory attributes of skin/coat condition and dog feces.

Key words: Puppy stage, Formulation, Dog feed, Locally available ingredients, Pellets

Dog food is material intended for consumption by the domestic dog (*Canis lupus familiaris*) which is one of the most widely kept working and companion animals in human history. Of the total production of pet food, dog food accounted 61% in 2007 (www.petfoodindustry.com, 2008). In the world pet food industry, the leading exporters of pet foods were France ($993 million), United States ($786 million) and Netherland ($511 million) while the leading importers were Japan ($718 million), Germany ($617 million) and the UK ($563 million). In 2007, global sales of cat and dog food totaled US$ 45.12 billion, a growth of 4.9% from the previous year (www.petfoodindustry.com, 2008). The Association of American Feed Control Officials (AAFCO) is a commercial enterprise which attempts to regulate the quality and safety of pet food. AAFCO regulations for pet food include requirements regarding product names, flavor designations, guaranteed analysis, nutritional adequacy statements, proper ingredient names, and other aspects of labeling. The remarkable adaptability of the dog has led to the successful use of commercial diets that differ widely in their ingredient composition. Commercial dog foods are of the three basic types. Dry type dog foods contains low in moisture content (usually about 10-12%), Semi moist dog foods are moderate in moisture content (usually 25-30%) whereas Canned Dog foods high in moisture content (usually 74-78%)(Mcellhiney R.R.,1994).

Dog's unique nutritional requirement varies with age, breed, gender, activity, temperament, environment and metabolism. From a nutritional stand point, growth is the most critical time in a dog's life. By two months of age, pups can be fed using puppy food. They are in an important phase of life-growth; skeletal development is at its peak for the first six months of life (National academy of sciences, 1974). Puppies in their active growth phase should be fed a high-quality diet that meets their specific nutritional needs (National research counsil, 2006). Growing dogs exhibit omnivorous feeding behavior and therefore, their diet should be comprised of proteins, carbohydrates, fats, vitamins and minerals in correct proportions. A puppy food that meets these requirements is called a "Complete" or "Balanced" diet. The amount of food a puppy requires changes during growth and depends on the puppy's nutritional deficiencies and/or imbalances during this period are more devastating than at any other time (National academy of sciences, 1974). During this phase, dog develops a functioning immune system, dramatically adds bone and muscle mass, and developing proper socialization behaviors all the while. There is no more critical time to ensure proper nutrition. Growth diets have been formulated to meet the increased requirements of puppies. The more reputable brands are available at the market for growing puppy to ensure that they support healthy growth. But in developing countries like Sri Lanka, due to low income levels, dog foods are not very popular among the pet owners. Because, most of available imported brands are high in price. Therefore, this study was carried out to formulate the puppy feed using locally available ingredients at lower price level with which confirm the main nutritional requirements.

METHDOLOGY

Study Design and Study Period

This study was conducted as an experimental study, during the period of March to June, 2009 to formulate the dog feed using locally available ingredients.

Study Sample

Apparently 08 healthy puppies that were in the age range of 6 to 8 weeks were selected purposefully. Puppies were divided in to two groups which were having same total weight based on individual body weight.

Materials

All ingredients which required preparing dog feed (maize, rice flour, rice polish, animal fat, soya bean meal, chicken, fish meal, hypro meal, eggs, vitamin premixes and baking soda) were purchased from commercial stores. Maize and soya bean meal were ground in to powder form. Animal fat was turned into liquid form using heat treatment. Chicken flesh was grounded and minced.

Preparation of dog feed

The ingredients were weighed using a kitchen scale.

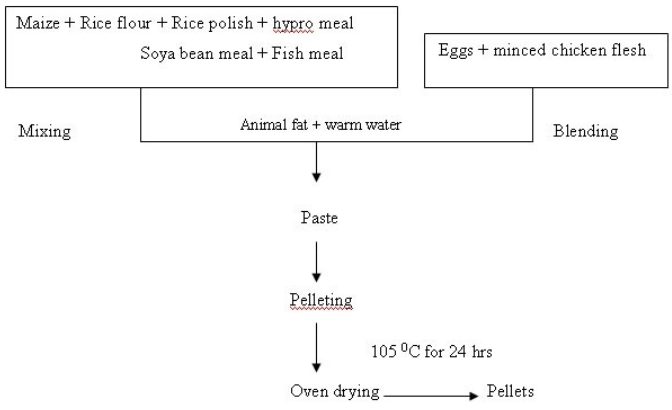


Figure 1: Dog feed preparation procedure

Data collection

Determination of weight

Weight was determined using the weighing scale. Subjects were hanged using thread and measurements were recorded to the nearest 100 g.

Determination of feed intake

Daily feed requirement was determined using standards according to body

weight.

kg puppy needs 1000 kcal/ME per day (Nutrient requirement of dogs and cats, National academic press)

Daily feed intake was recorded using remaining amount.

During month of April two groups of puppies were fed using homemade diets and formulated feeds. After one week of flush up, homemade diet group was replaced by imported feed.

Determination of electrolyte concentrations in blood serum

3-5 ml of blood was taken from every puppy and those were centrifuged 1000 r.p.m for 05 minutes. Serum was separated and sent to PetsVcare animal hospital for electrolyte analysis.

Sensory evaluation

Three types of sensory evaluation tests were carried out with thirty five untrained panelists.

First 5 points Hedonic scale tests were performed to evaluate the skin/ coat condition and texture, color and odor of dog feces of two treatment groups.

Palatability test was performed by using two- pan free choice test.

Proximate analysis

Proximate analysis was done for the crude protein and energy was calculated using bomb calorimeter.

Statistical analysis

Statistical analysis was done using Minitab15 software.

Non parametric Friedman test was used to analyze the sensory evaluation data using MINITAB software. (Test is significant at $P<0.05$)

RESULTS

A total of 8 puppies were recruited to the study of formulation of dog feed using locally available ingredients. Growth rate, feed intake, blood parameters, cost condition and sensory evaluation data were used in analysis in this report.

Characteristics of the sample

The total sample obtained, consisted of 07 females and 01 male aged 06-08 weeks.

Growth performances

Puppies in group number 01 were fed using formulated feed and group number 02 was fed using homemade diets.

Table 1: Growth performances of puppies during first feed trial (03 weeks)

Group number	Code number of puppy	Initial weight (kg)	Final weight (kg)	Weight gain (kg) / week
	01a	3.0	5.9	0.967
	01b	5.2	7.0	0.600
01	01c	5.0	5.9	0.300
	01d	3.3	5.1	0.600
	02a	2.8	3.3	0.167
	02b	7.0	7.7	0.233
02	02c	3.8	4.3	0.167
	02d	2.9	3.3	0.133

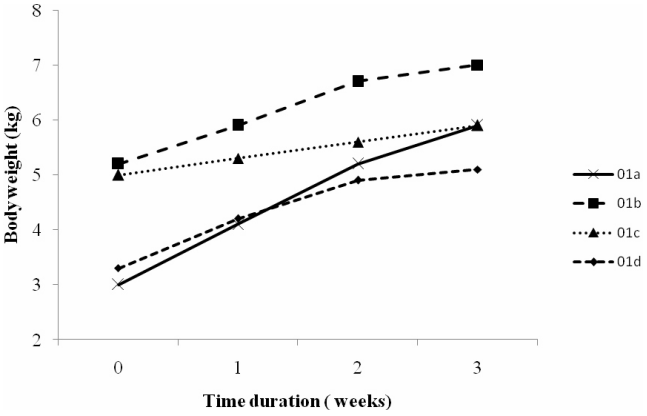


Figure 3: Increase of body weight (kg) with the time (weeks) in group number 0**1**

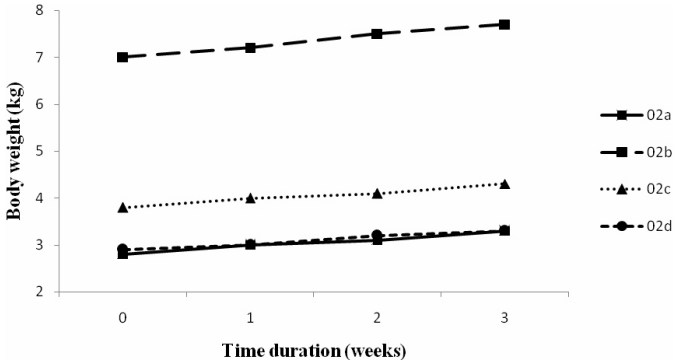


Figure 4: Increase of body weight (kg) with the time (weeks) in group number 02

Table 2: Mean growth rate (kg/day) values of two groups of puppies (n=8)

Treatment	Growth rate (kg/day) Mean ± SD		*P* value
Homemade diets	0.025	0.006	0.049[1]
Formulated feed	0.088	0.038	

t- test for the difference between growth rates of puppies were fed using homemade diets and formulated feed.

Body weight gain of the group 01 was greater than that of group 02. One week of flush up period was carried out for puppies fed with homemade diet group (group number 02) to be adapted to imported feed. Group number 01 was continuing with formulated feed as usual.

Table 3: Growth performances of puppies during adaptation period (01 week)

Group number	Code number of puppy	Initial weight (kg)	Final weight (kg)	Weight gain (kg) / week
	01a	5.9	6.3	0.4
	01b	7.0	7.1	0.1
01	01c	5.9	6.0	0.1
	01d	5.1	5.5	0.4
	02a	3.3	4.9	1.6
	02b	7.7	8.9	1.2
02	02c	4.3	5.9	1.6
	02d	3.3	4.0	0.7

[1] Table 4: Mean growth rate (kg/week) values of two groups of puppies (n=8) during adaptation period

Treatment	Growth rate (kg/week) Mean ± SD	*P* value
Imported Feed	1.27 0.427	0.021[1]
Formulated feed	0.25 0.173	

[1]

t- test for the difference between growth rates of puppies were fed using imported feed and formulated feed.

During the adaptation period puppies in group number 01 were achieved weight gain in a significantly higher rate than that of group number 02.

Table 5: Growth performances of puppies during second feed trial (05 weeks)

Group number	Code number of puppy	Initial weight (kg)	Final weight (kg)	Weight gain (kg) / week
	01a	6.3	7.4	0.22
	01b	7.1	9.2	0.42
01	01c	6.0	8.0	0.40
	01d	5.5	8.5	0.60
	02a	4.9	6.2	0.26
	02b	8.9	11.2	0.46
02	02c	5.9	8.8	0.58
	02d	4.0	6.3	0.46

Figure 4 shows the pattern of growth of puppies was fed by formulated feed during 35 days.

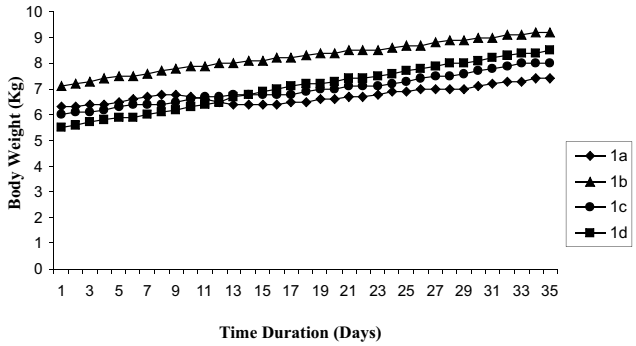


Figure 5: Increase of body weight (kg) with the time (days)

Puppies in group number 01 have similar pattern of growth. In the case of puppy numbered as 1a had gradually declining pattern of growth, nearly for 07 to 15 days. The reason for that was its suffering from bacterial disease.

Figure 5 shows the pattern of growth of puppies was fed by imported feed during 35 days.

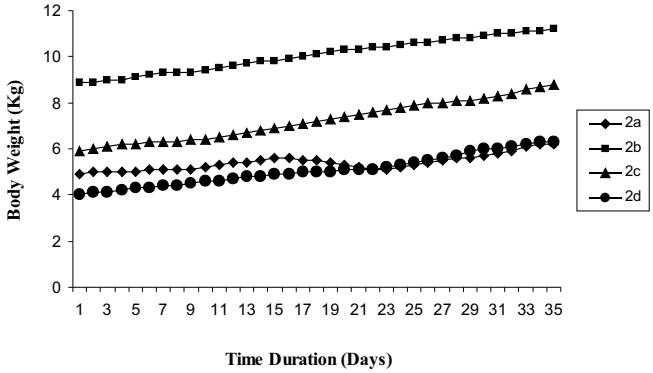


Figure 6: Increase of body weight (kg) with the time (days)

Table 6 Mean growth rate (kg) values of two groups of puppies (n=8)

Treatment	Growth rate (kg/day) Mean ± SD	P value
Imported feed	0.0628 0.0189	0.781[1]
Formulated feed	0.0586 0.022	

[1] t- test for the difference between growth rates of puppies were fed using imported diets and formulated feed.

Results indicated, there was no significant difference of growth rate of puppies were feusing imported diets and formulated feed.

Relationship between feed intake and body weight

As figure 4.2.5 shows, there was a positive relationship between feed intake and body weight of puppies in group number 01 which was significant.

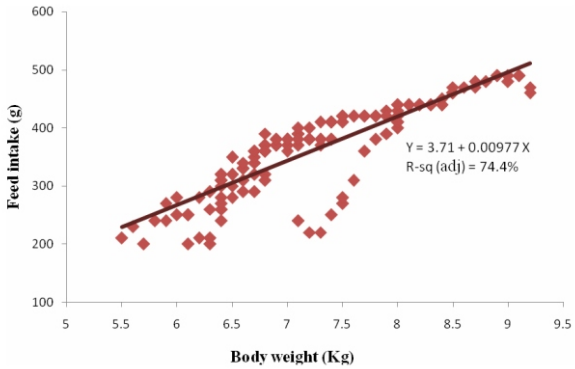


Figure 7: Regression analysis between feed intake and body weight(Group no. 01)

Pearson correlation = 0.864 (P-Value = 0.000)

As same in group number 01, there was a positive relationship between feed intake and body weight of puppies in group number 02 which was significant.

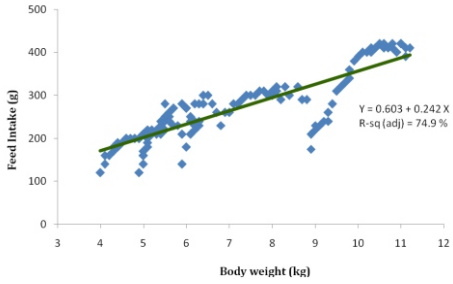


Figure 8: Regression analysis between feed intake and body weight(Group no. 02)

Pearson correlation = 0.867 (P-Value = 0.000)

Measurements of serum electrolyte concentration

Table 4.3.1 shows the concentration of potassium, calcium, sodium, chloride and phosphorus in blood serum. Results indicated that there was no difference among both groups.

Table 7: Serum Electrolyte concentrations in blood serums of two groups

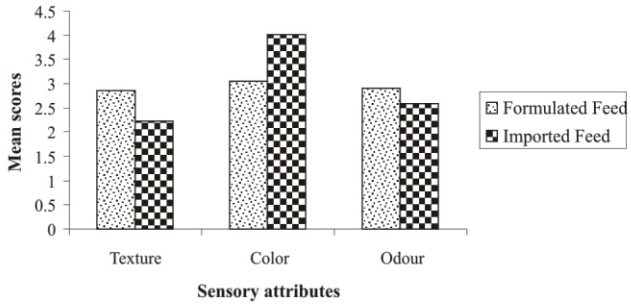
Electrolyte	Formulated feed group		Imported feed Group			Reference
	Mean	±SD	Mean	±SD	P value (<0.05)	Value
Potassium (mmol/L)	3.02	0.409	2.76	0.252	0.338 - No	4.5 - 6.3
Calcium (mg/L)	9.967	0.657	9.052	0.592	0.094 - No	10.5 - 13.6
Sodium (mmol/L)	81.25	8.90	81.42	20.554	0.989 - No	140 - 153
Chloride (mmol/L)	143.5	25.776	105.73	20.606	0.070 - No	106 - 118
Phosphorus (mg/L)	6.431	1.072	6.174	0.827	0.720 – No	2.6 – 6.8

Sensory evaluation

Table 8: Dog feces evaluation

Sensory Attribute	Formulated Feed			Imported Feed			Probability value
	Rank sum	Mean	±SD	Rank Sum	Mean	±SD	
Texture	100	2.86	0.607	78	2.23	0.614	0.000
Color	107	3.06	0.867	141	4.03	0.865	0.000
Odor	102	2.91	0.802	91	2.6	0.816	0.091

Probability values and rank sums of sensory attributes for Dog feces Statistical analysis of rank sum for sensory evaluation of dog feces showed that there is a significant difference among in terms of color and texture (P > 0.05). Feces of formulated feed group have mean values near to 3(Appendix 1), with compared with feces of imported group.



Fig

Texture: 01- hard pellets, 02- Hard, formed, dry stool that remains firm and soft, 03- Soft, formed, moist stool that remains its shape, 04- Soft, unformed stool that assumes shape of container and is pudding like and 05- Watery liquid that can be poured

Color: 01- Pale color, 02- Light Yellow, 03- Yellow to brown color, 04- Dark Brown, 05- Black color

Odor: 01- Odorless, 02- Slightly odor, 03- Moderate odor, 04- Bad odor, 05- Strong bad odor

Skin and coat condition

Friedman test indicates a significant difference in skin and coat condition parameters in two groups. Group number 01 has mean scores within the range of 0-2(Appendix 1).This indicates better skin and coat condition.

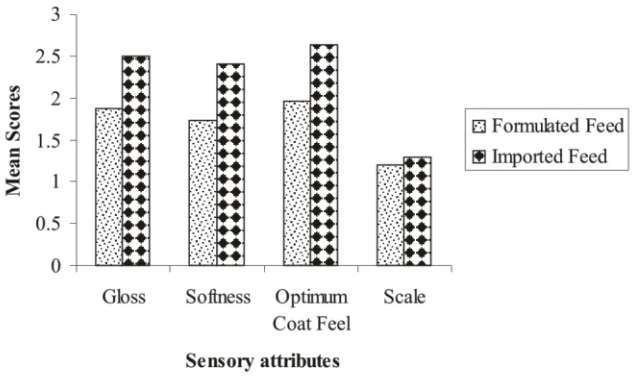


Figure 10: Mean values of sensory attributes in skin and coat condition (1-Best, 2-Better, 3-Moderate, 4- less than moderate, 5- Worst)

Palatability test

Two- pan, free choice test was used for palatability test (Plate 4.3.3.1). "First choice" indicates the diet first consumed and "first approach" indicates the diet first examined and smelled. In the study population, 67.85% of subjects had first choice for formulated feed. Imported feed has 69.64% as first approach (Figure 4.4.3.1).

Plate 4.3.3.1: Two-pan, free choice test

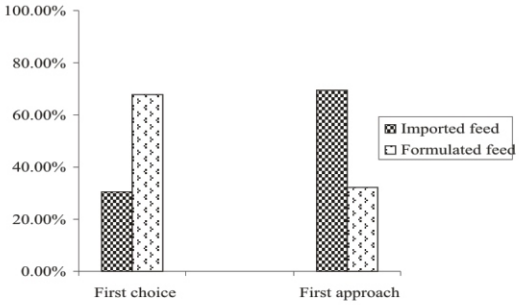


Figure 11. First choices and first approaches in two groups of puppies

Cost analysis

The new product should be produced most cost effectively. Table 4.5.1 represents the amount of money actually spent to purchase 01 kilogram of feed ingredients at present.

Table 9: Prices of feed ingredients at present market

Ingredient	Price (Rs/Kg)
Maize	31
Rice flour	55
Rice polish	23
Animal fat	70
Soya bean meal	92
Chicken	340
Fish meal	153
Hypro meal	160
Egg	800
Vitamin premix	400
Baking soda	1400

Table 10: Prices of dog food brands available at today's market and price of formulated feed

Dog food brand	Price (Rs/Kg)
Nutripet	1040
Pedegree	640
Eukanuba	500
Formulated Feed	**160**

Protein and Energy measurements

Table 4.6.1 represents the AAFCO standards, which implementing uniform and equitable regulation and standards for the manufacture and measurements of energy and protein

Table 11: AAFCO standards, protein and energy measurements in imported and formulated feed

	AAFCO standards	Imported Feed	Formulated Feed
Protein	28%	32%	30%
Energy	<3.5 - 4.0 Kcal/g	4.3 Kcal/g	3.3 Kcal/g

DISCUSSION

The pet food industry has global business system which comprises with developed and developing countries. Dog and cat foods play a major role among the other pet foods. The developed countries have rapidly expanding markets for pet foods than developing countries. The main reason for this scenario is pet owners in developing countries do not prefer for imported dog foods because of its high price. Pet owners often prefer dry food for reasons of convenience and price. Therefore, this study was an experimental study designed to formulate a palatable, dry dog-food using locally available ingredients for lower price levels which confirm the main nutritional requirements and to determine its influence on growth rate and blood parameters of local breeds.

The mean growth rate of puppies in group number 01 which were fed using formulated feed, showed a significantly higher value (0.088 kg/day ± 0.038) than puppies in group number 02 (0.025 kg/day ± 0.006) which were fed using homemade diets. This could be due to inadequate nutritional composition of home made diets. During the adaptation period there was significantly higher growth rate (1.27 kg/week ± 0.427) in group number 02 which were fed using imported feed than group number 01 (0.25 kg/week ± 0.173). The present study found that, there was no any significant difference in terms of growth rate of puppies during second feed trial. The mean growth rate was 0.0586 kg/day ± 0.022 in formulated feed group where 0.0628 kg/day ± 0.019 was the weight gain in imported feed group. This may be the consequence of similar nutritional, mainly energy and protein balance in formulated and imported feeds. The positive and significant relationship observed between body weight and feed intake. Potassium, Calcium, Sodium, Chloride and Phosphorus are the common electrolytes available in blood serum. Results revealed that, there is no any difference in terms of concentration of electrolytes in both formulated and imported feed groups.

Pet owner's preference for dog foods varies according to some factors. Those factors are age of pet, activity level, breed, and health at the same time some owners are considering some characteristics of the dog feces. To analyze the dog feces, used some of common characteristics of feces such as texture, color and odor in sensory evaluation. That study revealed a significant difference in texture and color but in the case of odor, there was no any difference (Table 4.4.1). There is a strong perception that skin and coat condition is an indicator of an animal's general well-being and the nutritional adequacy or superiority of its diet. The current study used evaluation table to measure the skin and coat condition established by WALTHAM centre for pet nutrition in UK (Appendix 01). According to the study results formulated group scored mean values in between 0 and 2 for gloss, softness and optimum coat feel which indicates those attributes better than imported group. This could be due to superiority of formulated feed over the imported feed in terms of micronutrients such as essential fatty acids. Two- pan, free choice test was used as palatability test (Plate 4.3.3.1). “First choice” indicates the diet first consumed and “first approach” indicates the diet first examined and smelled. In the study population, 67.85% of subjects had first choice for formulated feed. Imported feed showed 69.64% as first approach (Figure 4.4.3.1). This revealed there should be enhancement of palatability in formulated feeds.

Cost analysis is an important event in new product development. To produce 01 kilogram of formulated feed, it costed around 160 rupees. Most of the commonly available dog food brands cost more than 500 rupees/kilogram at present market (Table 4.5.2).

Association of American Feed Control Officials (AAFCO) is the responsible body to provide a mechanism for developing and implementing uniform and equitable laws, regulations, standards and enforcement policies for regulating the manufacture, distribution and sale of animal feeds. According to the AAFCO Dog Food Nutrient Profiles Published in 2008, puppy food should contain energy density of less than 3.5 kcal ME/g DM (metabolizable energy/gram dry matter) and minimum protein 28%. Formulated feed contains 3.3 kcal ME/g DM and 30% of protein whereas imported feed contains 4.3 kcal ME/g DM and 32 % of protein.

CONCLUSION

In this study the positive and significant relationship observed between body weight and feed intake. The mean growth rate of puppies that were fed using formulated feed was 0.088 kg/day ± 0.038 whereas 0.025 kg/day ± 0.006 was the mean growth rate of puppies that were fed using homemade diets in first trial. The current study found that, the mean growth rate was 0.0586 kg/day ± 0.022 in formulated feed group whereas 0.0628 kg/day ± 0.019 was the weight gain in imported feed group in second feed trial. There is no any significance in terms of electrolyte concentration in blood serum in formulated and imported feed trials. Sensory evaluation results revealed better mean scores for sensory attributes in dog feces and skin/coat condition in formulated feed group. Two-pan free choice test results shows, there should be an enhancement of palatability in formulated feed. Protein and energy measurements of formulated feed

RIFERENCES

1) Ad hoc committee on dog and cat nutrition, Committee on Animal Nutrition, Board on agriculture and natural resources, Division of earth and life studies and national research counsil. (2006). *Nutrient requirements of dogs and cats.* http://books.nap.edu (accessed 24 th April 2009)

2) Association of American Feed Control officials, (2009) Electronic references. Retrieved March 20, 2009 from http://www.aafco.org

3) MCellhiney R.R.(1994). *Feed manufacturing technology*. (4th ed).Ammerican feed industry association

4) National academy of sciences. (1974). *Nutrient Requirement of Dogs.* Wasington,D.C.

5) National research council of the national academies. (2006). *Your dog's nutritional needs.* National academies press

6) Pet food industry, (2009) Electronic reference. Retrieved April 23, 2009 from http://www.petfoodindustry.com

7) Pond,W.G., Church, D.C. and Pond K.R.(1995). *Basic Animal Nutrition and Feeding.* (4 th ed). John wiley and sons, New york:p.531-53

8) The internet animal hospital, (2009). Electronic reference. Retrieved July 28, 2009 from http://www.thepetcenter.com