*Original Article*

# Comparison of Nutrient Contents, Digestibility and Fecal Output of Concentrate Rations (Gel) for Dog

**Uttra Jamikorn***

***Abstract***

The purposes of this current study were to compare the amount of nutrient contents and digestibility between different concentrate ration brands and their effects on fecal output. These concentrate rations mean the diets formulated in order to improve the nutritive status of the animals. In this study, nine mature female mongrel dogs were randomly subjected into three groups of the triplicated 3x3 Latin square design. Three brands of concentrate ration in form of gel were used as dietary treatments. Nutrient contents (on DM basis), body weight, fecal output, and apparent digestibility of nutrients were determined. Percentages of dry matter, organic matter and fiber of all treatment gels were about the same. However, nutrient profiles of all three brands were not equal to the nutrient profiles indicated on the product leaflets. No significant difference was observed between different dietary treatments for initial body weight, final body weight, and body weight loss. Stool excreted from the dogs receiving T gel had the least amount of fecal DM ($p < 0.05$). On the contrary, the dogs receiving C gel had the greatest amount of fecal DM ($p < 0.05$), although it was not significantly different from the dogs receiving A gel. No significant differences were observed between the dogs fed A and C gels for DM, OM and fat digestibilities. Comparison of protein and fiber digestibilities between the three dietary treatments showed no significant difference. In conclusion, the dogs fed A gel defecated more consistency than the dogs fed C gel. The A and C gels seem to have the same standard resulting in similar efficacy in terms of fecal output and nutrient digestibility.

**Keywords:** concentrate rations (gel), digestibility, dog, feces

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# บทคัดย่อ

## การเปรียบเทียบองค์ประกอบของสารอาหาร การย่อยได้ และการขับถ่ายมูลของสุนัขที่ได้รับอาหารข้น (เจล)

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งานวิจัยนี้ทำการเปรียบเทียบผลิตภัณฑ์อาหารข้น (เจล) สามชนิดในเรื่อง ปริมาณและการย่อยได้ของสารอาหารที่เป็นองค์ประกอบ รวมทั้งผลกระทบต่อการขับถ่ายมูลของสุนัข ในที่นี้ อาหารข้น (เจล) หมายถึงอาหารที่ผลิตขึ้นโดยมีวัตถุประสงค์ เพื่อปรับปรุงสภาวะทางโภชนาการของสัตว์ สุ่มแบ่งสุนัขพันธุ์ผสม เพศเมีย โตเต็มวัย จำนวน 9 ตัว ออกเป็น 3 กลุ่มๆ ละ 3 ตัว แบบการทดลอง คือ 3x3 ลาตินสแควร์ จำนวน 3 ซ้ำ ใช้อาหารข้น (เจล) จำนวน 3 ผลิตภัณฑ์เป็นอาหารทดสอบ ทำการตรวจ สอบปริมาณ องค์ประกอบทางโภชนาการ (คิดเป็นร้อยละของวัตถุแห้ง) น้ำหนักตัว มูลที่ถูกขับถ่าย และการย่อยได้ที่ปรากฏของสารอาหารพบว่าปริมาณร้อยละของมวลวัตถุแห้ง สารประกอบอินทรีย์ และเยื่อใย ที่มีอยู่ในผลิตภัณฑ์ทั้งสามชนิดม่ค่าใกล้เคียงกัน แต่รูปแบบของสารอาหารที่ตรวจวิเคราะห์มีความแตกต่างจากปริมาณสารอาหารที่ระบุในเอกสารกำกับเช่นเดียวกันทั้งสามผลิตภัณฑ์ สังเกตไม่พบความแตกต่างของน้ำหนักตัวสัตว์เมื่อเริ่มต้นและสิ้นสุดการวิจัย รวมทั้งน้ำหนักตัวที่ลดลงเมื่อทำการเปรียบเทียบระหว่างกลุ่มทดสอบ สุนัขที่ได้รับอาหารข้น (เจล) T ขับถ่ายมูลที่มีร้อยละของมวลวัตถุแห้งน้อยที่สุด ($p < 0.05$) ส่วนสุนัขที่ได้รับอาหารข้น (เจล) C ขับถ่ายมูลที่มีร้อยละของมวลวัตถุแห้งมากที่สุด ($p < 0.05$) แต่ไม่แตกต่างอย่างมีนัยสำคัญทางสถิติเมื่อเปรียบเทียบกับสุนัขที่ได้รับอาหารข้น (เจล) A ไม่พบความแตกต่าง อย่างมีนัยสำคัญทางสถิติของการย่อยได้ของมวลวัตถุแห้ง สารประกอบอินทรีย์ และไขมันระหว่างสุนัขที่ได้รับอาหารข้น (เจล) A กับ C การเปรียบเทียบการย่อยได้ของโปรตีนและเยื่อใยระหว่างผลิตภัณฑ์ทั้งสาม พบว่า ไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติ โดยสรุปสุนัขที่ได้รับอาหารข้น (เจล) A ขับถ่ายมูลอย่างสม่ำเสมอมากกว่าสุนัขที่ได้รับอาหารข้น (เจล) C ผลิตภัณฑ์ A และ C จึงดูจะมีมาตรฐานการผลิตใกล้เคียงกัน ส่งผลให้การขับถ่ายมูลและค่าการย่อยได้ไม่แตกต่างกัน

**คำสำคัญ:** อาหารข้น (เจล) การย่อยได้ สุนัข มูล

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# *Introduction*

Concentrate rations the diets formulated to use in combination to improve the nutritive balance of the total feed and intended to be further diluted and mixed to produce a supplement or a complete feed (AAFCO, 2000). These are close to supplement, which AAFCO (2000) defined as a feed used with another to improve the nutritive balance or performance of the total and intended to be: (i) fed undiluted as a supplement to other feeds; or (ii) offered free choice with other parts of the ration separately available; or (iii) further diluted and mixed to produce a complete feed. However, in pet food market, they are products in form of gel containing high levels of nutrients and energy, including amino acids, minerals and vitamins. The most important property of these diets is high concentration of nutrients and energy so animals require only small amount to meet their requirements. These gels are recommended for various conditions such as rapid growing animals, working dogs, pregnant and lactating females, anorexia, under-eating (malnutrition) or recovery following illness and surgery.

Nutritive value of diet for dog is determined by number of factors such as raw material, nutrient content, texture, odor, and taste (Strombeck, 1999). Digestibility, the relative amounts of nutrients in the diet utilized by the animals, is one of the most significant factors for determination of nutritive values (Ajmal Khan and Sarwar, 2003). Little data are available on nutrient digestibility and effects on fecal output of concentrate rations for dogs. Therefore, the purposes of this current study were to compare the amount of nutrient contents and digestibility between different concentrate ration brands and their effects on fecal output.

# *Materials and Methods*

***Animals:*** Nine mature female mongrel dogs with body weight between 6 to 17 kg were used in this study. All dogs were housed individually in kennels (1.0 x 1.2-m) with a cement and slat floor at ambient temperature (28-35$^0$C). Each kennel was cleaned twice a day. The animals were randomly subjected into three groups of the triplicated 3x3 Latin square design. Periods were composed of 5 days for adaptation followed by 5 days for sample collection.

***Feed and feeding:*** All dogs received only treatment diet with no regular commercial feed during the study. Three brands of concentrate ration in form of gel, A (made in USA), C (made in Canada) and T (made in Thailand) were used as dietary treatments. The nutrient components of these rations are shown in Table 1. Regarding products recommendation, all gels were fed at 100 g/10 kg BW/day (2 to 4 teaspoons per 5 kg (or 10-20 cm of gel) BW/day). The

dogs were fed 2 times per day at 8:00 am and 16:00 pm. Fresh water was available *ad libitum* throughout the study.

***Sample collection and determination:*** The dogs were weighed and data were recorded on the first day of every period. These bodyweights were used to calculate amount of feed for each individual dogs. Amount of feed offered and odd were weighed and recorded every meal.

***Food*:** Samples of dietary treatments were collected at the beginning and the end of the study for analysis of nutrient contents. Diets were squeezed out of the containing tubes and were analyzed in duplicate for DM, OM, CP, EE, CF, ash, and moisture contents using AOAC (1990) procedures.

*Blood*: On D0 and D1 of each period, 5 ml of blood samples from cephalic vein were collected into EDTA polypropylene (PP) tubes for complete blood count (CBC) and heparinized PP tubes for blood chemistry (e.g. alkaline phosphatase (ALP), blood urea nitrogen (BUN), creatinine, serum glutamic pyruvic transaminase (SGPT) etc.) to evaluate animals' health status.

***Stool*:** During five days (D6 to D10) of sampling collection, fecal appearance was observed and photographed. Total collection of stools from each dog was performed for three consecutive days (D8 to D10) for determination of nutrient digestibilities. On the first day of fecal collection (D8), all stool before 0700 h were removed and discarded. Fecal output was collected from this point until D10 from individual dog and placed into labeled plastic bags. Fecal samples of each dog were stored frozen throughout the study and dried at $55^0$C in a forced-air oven. These samples were weighed before and after drying. The dried fecal samples were ground by blender and stored in labeled plastic bags at room temperature until further analysis. Fecal samples were determined for dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE), crude fiber (CF), ash, and moisture contents (AOAC, 2006).

***Statistical analysis:*** All data were expressed as mean±SE. Statistical analysis of these data was carried out as the 3x3 Latin square design. Effects of treatments were analyzed using General Linear Model (GLM). Significant differences between the treatment means were tested by Duncan method at $\alpha = 0.05$.

**Table 1** Nutrient contents (as feed) of dietary treatments A and C as available for commercial on website

| Nutrient Contents*, % | A | C |
|---|---|---|
| Crude protein (min) | 1.5 | 0.7 |
| Crude fat (min) | 35 | 28 |
| Crude fiber (max) | 2.2 | 3.8 |
| Ash (max) | 1.3 | 0.5 |
| Carbohydrate | 49 | - |
| Moisture (max) | 15 | 14 |

* No information was available for the gel made in Thailand.

# *Results*

The dogs in all treatment groups had normal values of CBC, ALP, BUN, creatinine, SGPT, total protein, and albumin. Nutrient contents (on DM basis) are shown in Table 2. These nutrient profiles are not equal to the nutrient profiles indicated on the product leaflets. Percentage of DM, OM and fiber of all treatment gels were about the same.

All concentrate rations resulted in body weight loss ranging from 0.81, 0.79 and 0.71 kg for A, C, and T, respectively (Table 3). However, no significant difference was observed for initial body weight, final body weight, and body weight loss.

The dogs receiving A gel appeared to have the most normal daily stool and ordinary excretion (Fig 1a). Fig 1b shows stool sample of the dogs receiving C gel that looks alike the stool of dog fed A gel, but most dogs did not have daily defecate. Stools of dogs fed T gel were either watery or very sticky with no texture (Fig 1c) and required more than 48 hours to dry in the hot air oven at $55^0$C. The dogs receiving T gel did have severe diarrhea with yellow color.

**Table 2** Laboratory analysis of nutrient contents (on DM basis) of all three dietary treatments

| Nutrient Contents, % | A | C | T |
|---|---|---|---|
| DM | 88 | 88 | 88 |
| OM | 95 | 96 | 95 |
| Crude protein (min) | 25 | 27 | 24 |
| Crude fat (min) | 22 | 28 | 19 |
| Crude fiber (max) | 4.3 | 4.1 | 4.6 |
| Ash (max) | 4.6 | 4.4 | 5.3 |
| Moisture (max) | 12 | 12 | 12 |

**Table 3** Body weight of the dogs at the beginning and the end of the study

| Body Weight | A | C | T | SEM |
|---|---|---|---|---|
| Initial BW, kg | 14.7 | 12.1 | 14.7 | 1.18 |
| Final BW, kg | 13.9 | 11.4 | 14.0 | 1.15 |
| Loss BW, % | 5.5 | 6.5 | 4.8 | 0.11 |

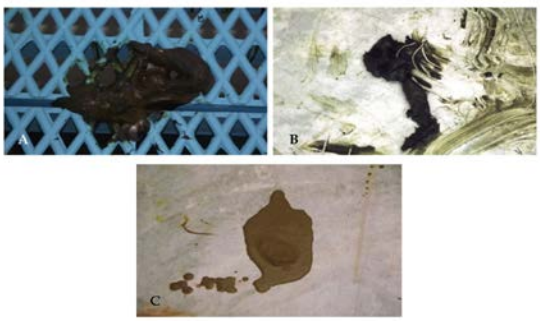


**Figure 1** Comparison of fecal appearances excreted from dogs receiving A (Stool of dogs fed A gel), C (Stool of dogs fed C gel) and T (Stool of dogs fed T gel) gel, respectively.

The dogs receiving T gel had the greatest ($p < 0.05$) amount of wet fecal excretion (Table 4). Fecal DM percentage of the dogs receiving T gel was lower ($p < 0.05$) than the dogs receiving C gel, but was not different from the dogs receiving A gel. The dogs

receiving A gel excreted significantly lesser ($p < 0.05$) amount of dry stool than the dogs receiving Local Brand gel, but did not significantly differ from the dogs receiving C gel.

Every dog ate all offered gels most of the time. No significant differences of feed intake and DM of feed intake between various concentrate rations were observed (Table 5). The dogs fed T gel (60.0, 56.04, 84.6%) had the less ($p < 0.05$) apparent fecal DM, OM, and fat digestibility coefficients when compared to the dogs fed C (77.24, 75.49, 92.6%) and A gels (81.11, 79.56, 91.0%) (Fig 2). Apparent fecal digestibility of protein, fiber and ash were not significantly different when compared between various treatments.

## Discussion

Only international products that are distributed worldwide have the information of nutrient contents available online for consumers. Levels of protein on the leaflets for A and C gels were the minimum level, but the levels of protein from the lab analysis were the actual amounts. These could mean both gels were not specifically designed for protein supplement. However, these actual amounts of protein in A, C and T gels were greater than the minimum requirement for regular diets (growth and maintenance) as recommended by either AAFCO (2000) or NRC (2006). For fat, this study found that the actual amounts of fats both A and C gels were lower than the guaranteed analysis of the product. In addition, the T gel appeared to have the least amount of fat when compared to A and C gels. Similar to the protein levels, the actual amount of fat in all treatment gels were greater than minimum requirement as recommended by AAFCO about four times, indicating that they are possibly meant for energy supplement. On the other hand, the actual amounts of fiber and ash were found to be greater than the maximum levels that the products guarantee. These various amounts might be due to the laboratory techniques or methods.

All treatment gels resulted in the reduction in body weight probably because they are intended to be used as dietary supplement. Feeding only gels that have incomplete or imbalance nutrient profiles could have negative effects on animal health. However, the results of blood analysis showed no parameters falling out of normal range (data not shown). Change in these parameters in healthy dogs may require longer period of study, more than 10 days.

Only the dogs fed T gel had watery, no texture and flat stools. Stools excreted from the dogs receiving either A or C gels still had texture and distinct shape, but were presented in piles. This might be caused by the amounts, sources, and ratio of soluble and non-soluble fibers. There was no difference in the amount of fecal excretion between the dogs fed A and C gels. The dogs fed T gel excreted the greatest amount of wet and dry stool. Inclusion of some kinds of dietary fiber can be useful for providing good stool quality (firm and not too moist) (Middelbos et al., 2007; Twomay et al., 2003). However, including excessive amounts, especially soluble fiber, can increase stool weight, decrease fecal DM and decrease nutrient digestibility (Bednar et al., 2000; Clapper et al., 2001). The viscous nature of soluble fiber tends to make the fiber molecules hold more water as they pass through the intestine (Burkhalter et al., 2001; Topping and Clifton, 2001).

Stool excreted from the dogs receiving T gel had the least amount of fecal DM, while the dogs receiving C gel had the greatest amount of fecal DM. However, the amounts of these fecal DM were not significantly different from the dogs receiving A gel. Increased level of soluble fiber could cause decreased level of fecal DM content, resulting in high moisture stool (Bednar et al., 2000; Topping and Clifton, 2001).

No significant differences were observed between the dogs fed A and C gels for DM, OM and fat digestibilities. Comparison of protein and fiber digestibilities between the three dietary treatments showed no significant difference. However, A and C gels tends to have about the same values while T gel tend to have lower values than those two gels.

In conclusion, the A and C gels seem to have the same standard resulting in similar efficacy in terms of fecal output and nutrient digestibility. However, the dogs fed A gel defecated more consistency than the dogs fed C gel.

**Table 4** Fecal properties of the dogs

| Fecal Property | A | C | T | SEM |
|---|---|---|---|---|
| Wet stool, g/d | 34[a] | 33[a] | 84[b] | 9.7 |
| Fecal DM, % | 38[ab] | 45[a] | 34[b] | 1.5 |
| Dry stool, g/d | 13[a] | 14[ab] | 26[b] | 3.3 |

[a, b] Means in the same row with different superscripts are significantly different ($p < 0.05$).

**Table 5** Feed intake and nutrient digestibilities of dogs after receiving various concentrate rations

| Digestibility, % | A | C | T | SEM |
|---|---|---|---|---|
| DM | 81[a] | 77[a] | 60[b] | 3.9 |
| OM | 80[a] | 75[a] | 56[b] | 4.3 |
| Protein | 84 | 83 | 73 | 2.7 |
| Fat | 92[a] | 93[a] | 85[b] | 1.5 |
| Fiber | 68 | 61 | 52 | 4.6 |
| Ash | 57 | 42 | 51 | 6.0 |

[a, b] Means in the same row with different superscripts are significantly different ($p < 0.05$).

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