

Research Article



Effect of Soybean Oil-Containing Diet on German Shepherd dogs' Lipid Profile Control

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Abstract | The present investigation was conducted inside a canine unit at the BGB headquarters in Peelkhana, Dhaka. The primary objective of this study was to assess the impact of food enriched with soybean oil at varying dosages on the control of lipid profiles in dogs. A total of nine German Shepherd dogs, chosen without regard to their breed or gender, were included in the study due to their overall good condition. The weights of the dogs varied from 25 to 30 kg, while their ages spanned from 2 to 3 years. The canines were assigned randomly to three distinct groups, each consisting of three individuals. Group T0 was designated as the control group and was not administered any soybean oil in their diet. T1 and T2 groups were assigned to a diet supplemented with soybean oil. Group T1 had a daily supplementation of 5 ml, while group T2 received a higher supplementation of 10 ml oil per day. The duration of the trial spanned 28 days. The weights of the dogs involved in the experiment were documented, the shininess of their body coats was evaluated, and blood samples were obtained on days 0, 14, and 28 to analyze their lipid profiles. The findings indicated that the animals subjected to treatment had a statistically negligible ($p > 0.05$) elevation in body weight while demonstrating a statistically significant enhancement in the shininess of their body coat when compared to the control group. The levels of serum cholesterol, triglycerides (TG), and low-density lipoprotein (LDL) exhibited a statistically significant reduction ($p < 0.01$) in both the T1 and T2 groups. Nevertheless, the treatment group exhibited a noteworthy ($p < 0.01$) elevation in the blood serum levels of high-density lipoprotein (HDL) in comparison to the control group. The study demonstrates that including food enriched with soybean oil yields a reduction in blood cholesterol, triglycerides, and LDL levels, while simultaneously improving HDL levels. Additionally, the study exposes the quality of the dogs' body coats.

Keywords: Soybean oil, Supplemented diet, Various dosages, Lipid profile, German shepherd dog

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INTRODUCTION

To stop border crimes, the trafficking of medicines (such as cocaine, heroin, fentanyl, and opioids), and illegal border crossings, the Border Guard Bangladesh (BGB) keeps a close eye on these activities (Kumar, 2016). The BGB uses the dog as a major deterrent for several bor-

der violations, including the trafficking of drugs, the illegal arms trade, and the sale of snares (Kumar, 2016). Animal fats contain fatty acids that are frequently straight-chain derivatives with a high carbon content whereas the fatty acids present in animal fats are often straight-chain derivatives consisting of a significant number of carbon atoms (Wakil & Abu-Elheiga, 2009). However, it is possible to

address coronary heart conditions in canines by providing them with polyunsaturated fatty acids derived from vegetable sources (Ander *et al.*, 2003). The presence of unsaturated fatty acids (PUFAs) within the phospholipid composition of the cellular membrane plays a crucial role in the preservation of membrane fluidity. Lipoproteins with low and high viscosity, known as low-density lipoproteins (LDL) and high-density lipoproteins (HDL), aid in the movement of cholesterol to and from the liver. High-density lipoprotein (HDL) is known as “good cholesterol” because of its capacity to form molecular connections with various lipid carriers, allowing them to be transported to the liver for elimination (Witztum, 1994). Plant seeds are regarded as nutrient-dense food sources that are vital to human nutrition because of their high nutrient content. They are rich in several vital elements, including fats, peptides, proteins, amino acids, carbohydrates, dietary fiber, vitamins, and minerals. Additionally, it fulfills a protective function against chronic ailments such as coronary artery disease, diabetes mellitus, and cancer. Retail establishments serve as a valuable reservoir of omega-3 fatty acids, which are known for their adipose composition. These establishments are also abundant in antioxidant vitamins such as nascent tocopherol, ascorbic acid, and beta-carotene. Additionally, they include glutathione and proteins. Furthermore, a notable advantage is that these establishments can be cultivated in many environments, including arid regions. The soybean, scientifically known as *Glycine max*, is a frost-sensitive legume crop that falls under the family Fabaceae. It possesses a diploid number of chromosomes, as indicated by Hymowitz and Newell in 1981 (Hymowitz & Newell, 1981). Commercial cultivation of this crop is widespread, spanning over 35 nations globally. Notably, the United States, Brazil, China, and Argentina contribute to around 90 percent of the present global production (Uhegbu *et al.*, 2013). About 54% of linoleic acid (18:2), 23% of oleic acid (18:1), 11% of palmitic acid (16:0), 8% of linolenic acid (18:3), and 4% of stearic acid (18:0) are found in soy oil. Although there are a lot of beneficial unsaturated fatty acids in this fatty acid composition, their oxidative stability is low. Partial hydrogenation is frequently employed to increase oxidative stability; however, this results in trans fats, which are harmful to health. High temperatures (140–225 °C) and pressures (414 kPa) are required for partial hydrogenation, which is facilitated by a nickel catalyst in the presence of pure hydrogen (Indiarto & Qonit, 2020). Soybean oil painting’s unique manufacturing procedure offers a lipid supply that exhibits resistance to rancidity (Hammond *et al.*, 2005). So, we hypothesized that soyabean oil in the diet can help lipid profile regulation in German Shepherd dogs. The study’s goal was to investigate the effects of a soybean oil-enriched diet on dogs

MATERIALS AND METHODS

From January 2 to January 29, 2022, this study was done in the dog squad at the BGB office in Peelkhana, Dhaka. The

goal was to see how different amounts of soybean oil added to a dog’s food affected the regulation of lipid profiles.

MANAGEMENT OF EXPERIMENTAL DOGS

Nine dogs of the same breed, age, and sex were randomly selected for the studies. All dogs followed the identical feeding, watering, squatting, and exercise routine. Dogs were fed twice daily. Breakfast includes 500 ml milk, 150 g atta, and one hard-boiled egg. The midday meal of rice (250 g), chicken (500 g), and vegetables (250 g) includes no spices or oils. It maintains room temperature and supplies ad libitum of water during dogs’ meals, during grooming, and after their walk in the morning and afternoon. Grooming takes about 30 minutes. The grooming process takes one minute for visual examination, five minutes for detachment, six minutes for fingertip massage, two minutes for combing, ten minutes for brushing, two minutes for slicking down, three minutes for cleaning the eyes, ears, nose, and anus, and one minute for inspection.

ETHICAL APPROVAL STATEMENT

This research project has been approved by the animal ethics committee of the Department of Physiology and Pharmacology at Hajee Mohammad Danesh Science and Technology University in Bangladesh at meeting resolution number 15, which was held on December 27, 2021, because the experimental design of the study was not objectionable or subversive to animal ethics.

EXPERIMENTAL DESIGN

The experiment was conducted with the support of nine dogs of 2 years old. These nine dogs were divided into three groups with three dogs each: T0, T1, and T2. Group T0 served as the control group, receiving no soybean oil. T1 and T2 were given 5 and 10 mL of soybean oil-enhanced diets, respectively. When the feed was lukewarm in the afternoon, soybean oil was syringe-added. The study lasted 28 consecutive days.

COLLECTION AND MEASUREMENT OF SOYABEAN OIL

Soybean oil from (Sena Fortified Soyabean Oil, Dhaka from Corporate Office, KB Petrochemicals Ltd.) was used in the experiment. The company provided a container for the oil, which was bought at the neighborhood store. Syringes with five and ten milliliters of oil were also purchased from a nearby medical supply store to quantify the oil that would be administered to the meals-taking dogs.

COLLECTION OF BLOOD FOR ANALYSIS

We purchased a serum tube, a 3 ml syringe, a clipper, vinyl gloves, cotton, a spirit pad, and hand sanitizer from a nearby medical supply store. Using a needle and syringe, blood samples were taken from the experimental dog’s radial vein.

DETERMINATION OF LIPID PROFILE

A blood sample was collected and transported to the Border Guard Hospital in Dhaka for analysis using an auto lipid analyzer.

BODY WEIGHT MEASUREMENT

We assessed 2-year-old dogs, utilizing weighing devices to record body weights on days 0, 14, and 28.

BODY COAT EXAMINATION

A visual examination of the dog's body coat shininess was performed.

STATISTICAL INVESTIGATION

A minimum of three repetitions were run through each experiment. As a ratio to each control, the results are shown as mean $\pm$ SEM. The statistical differences were examined using a single-factor analysis of variance (ANOVA). Analysis of Variance, or ANOVA, is a statistical test that examines how the means of more than two groups differ from one another. One independent variable is used in a one-way ANOVA, with significance set at $p < 0.05$. The student-Newman-Keuls test was additionally utilized to compare the two groups, this test is a step-by-step multiple comparison technique to determine which sample means differ significantly from one another. When differences reached a p -value of 0.05, they were deemed significant. Differences were considered significant at the level of $p < 0.05$.

RESULT

THE EFFECT OF SOYBEAN OIL-SUPPLEMENTED DIET ON BODY WEIGHT IN DOGS

The effects of administering a soybean oil-enriched diet to dogs that underwent the designated intervention are displayed in Table 1. The research documented that incorporating soybean oil into the dogs' diet of the treated participants led to an insignificant increase in body weight compared to the control cohort of animals. The observed increase seems to be contingent upon the quantity of soybean oil used.

THE EFFECT OF SOYBEAN OIL SUPPLEMENTED DIET ON BODY COAT IN DOG

The results of supplementing the body coats of the treated dogs with soybean oil are presented in Table 2. In comparison to the control group, the treated canines' body coats responded significantly better to a diet supplemented with soybean oil in terms of sheen. The control group exhibited no discernible change. The T1 group exhibited no notable alterations on the fourteenth day, whereas the T2 group underwent a substantial transformation. T1 and T2

demonstrated similar changes on the 28th day, except for T1, which remained unchanged. Initially, the sheen level of the body coat was consistent between all experimental groups.

EFFECT OF SOYBEAN OIL SUPPLEMENTED DIET ON SERUM CHOLESTEROL LEVEL IN DOG

Table 3 presents the findings about the impact of a diet supplemented with soybean oil on the blood cholesterol levels of dogs. The findings indicated a statistically significant reduction in blood cholesterol levels among the dogs who received treatment, as compared to the control group. There is a substantial level of significance shown when comparing day 0 with days 14 and 28. Nevertheless, the observed reduction in blood cholesterol levels from T1 to T2 did not reach statistical significance. The observed reduction in blood cholesterol levels appears to be unrelated to the dosage administered. There is no apparent alteration in the control group.

EFFECT OF SOYBEAN OIL SUPPLEMENTED DIET ON TRIGLYCERIDES (TG) IN DOG

The effect of soy oil supplementation on triglyceride (TG) levels in dogs is shown in Table 4. The results showed that, in comparison to the dogs in the control group, the dogs that got therapy had triglyceride (TG) levels that were statistically significantly lower. Comparing days 0 to days 14 and 28, a significant degree of importance is seen. However, there was no statistically significant decrease in triglyceride (TG) levels between time points T1 and T2. There doesn't seem to be a direct relationship between the dose given and the reported drop in blood triglyceride levels. Not a single noticeable change was seen in the control group.

EFFECT OF SOYBEAN OIL SUPPLEMENTED DIET ON LOW-DENSITY LIPOPROTEIN (LDL) IN DOGS

The effects of a diet supplemented with soybean oil on dog LDL (low-density lipoprotein) levels are shown in Table 5. Comparing the LDL levels of the dogs that received therapy to the dogs that did not, the results showed a statistically significant decrease in LDL levels. A significant amount of relevance is shown when comparing day 0 to days 14 and 28. However, there was no statistically significant decrease in LDL levels from time point T1 to time point T2. The decrease in blood triglyceride levels that have been seen does not seem to be related to dosage. Not a single noticeable change was seen in the control group.

EFFECT OF SOYBEAN OIL SUPPLEMENTED DIET ON HIGH-DENSITY LIPOPROTEIN (HDL) IN DOGS

The results on the effect of a meal enriched with soybean oil on HDL levels in dogs are displayed in Table 6. The

Table 1: Effect of soybean oil supplemented diet on body weight in dog

Group	Day 0 (Mean $\pm$ SE)	Day 14 (Mean $\pm$ SE)	Day 28 (Mean $\pm$ SE)
T ₀	25.33 $\pm$ 0.33 ^a	25.66 $\pm$ 0.33 ^a	25.66 $\pm$ 0.33 ^a
T1	26.66 $\pm$ 0.33 ^a	27.16 $\pm$ 0.49 ^a	27.50 $\pm$ 0.57 ^a
T2	26.33 $\pm$ 0.88 ^a	27.60 $\pm$ 1.06 ^a	28.33 $\pm$ 1.20 ^a
P-Value	0.308	0.208	0.128
Level of significance	NS	NS	NS

All values indicate mean $\pm$ standard error of the mean. Values followed by the same superscripts in the same column are not statistically significant ($p > 0.05$). NS means not significant. Here, T₀ = Control group (No soybean oil in the diet), T1= 5 ml soybean oil supplemented diet, T2= 10 ml soybean oil supplemented diet.

Table 2: Effect of soybean oil supplemented diet on body coat in dog

Group	Day 0	Day 14	Day 28
T ₀	+	+	+
T1	+	+	++
T2	+	++	++

Here, T₀ = Control group (No soybean oil in the diet), T1= 5 ml soybean oil supplemented diet, T2= 10 ml soybean oil supplemented diet.

Table 3: Effect of soybean oil supplemented diet on serum cholesterol level in dog

Treatment	Day 0	Day 14	Day 28
T ₀	312.00 $\pm$ 1.15 ^a	313.00 $\pm$ 0.57 ^c	312.00 $\pm$ 1.15 ^b
T1	311.00 $\pm$ 0.57 ^a	262.33 $\pm$ 1.45 ^b	244.33 $\pm$ 2.60 ^a
T2	311.33 $\pm$ 0.88 ^a	257.66 $\pm$ 0.88 ^a	240.33 $\pm$ 7.31 ^a
P-Value	.739	.000***	.000***

All values indicate mean $\pm$ standard error of the mean. The mean values with different superscripts in the same column are statistically significant ($p < 0.05$). Here *** denotes significance at 0.01 level. Here, T₀ = Control group (No soybean oil in the diet), T1= 5 ml soybean oil supplemented diet, T2= 10 ml soybean oil supplemented diet.

Table 4: Effect of soybean oil-supplemented diet on triglycerides (TG) in dog

Group	Day 0	Day 14	Day 28
T ₀	55.00 $\pm$ 0.57 ^b	53.66 $\pm$ 0.66 ^b	54.00 $\pm$ 1.15 ^b
T1	50.66 $\pm$ 0.88 ^a	44.33 $\pm$ 0.33 ^a	41.00 $\pm$ 0.57 ^a
T2	49.33 $\pm$ 1.20 ^a	44.00 $\pm$ 0.57 ^a	40.33 $\pm$ 0.88 ^a
P-Value	0.011**	0.000***	0.000***

All values indicate mean $\pm$ standard error of the mean. The mean values with different superscripts in the same column are statistically significant ($p < 0.05$). Here *** denotes significance at 0.01 level. Here, T₀ = Control group (No soybean oil in the diet), T1= 5 ml soybean oil supplemented diet, T2= 10 ml soybean oil supplemented diet.

Table 5: Effect of soybean oil-supplemented diet on low-density lipoprotein (LDL) in dog

Treatment	Day 0	Day 14	Day 28
T ₀	92.33 $\pm$ 1.45 ^b	92.66 $\pm$ 0.88 ^c	92.66 $\pm$ 1.45 ^b
T1	86.00 $\pm$ 0.57 ^a	79.00 $\pm$ 0.57 ^b	62.33 $\pm$ 1.45 ^a
T2	91.00 $\pm$ 0.57 ^b	73.00 $\pm$ 0.57 ^a	66.33 $\pm$ 0.88 ^a
P-Value	0.008***	.000***	.000***

All values indicate mean $\pm$ standard error of the mean. The mean values with different superscripts in the same column are statistically significant ($p < 0.05$). Here *** denotes significance at 0.01 level. Here, T₀ = Control group (No soybean oil in the diet), T1= 5 ml soybean oil supplemented diet, T2= 10 ml soybean oil supplemented diet.

Table 6: Effect of soybean oil-supplemented diet on high-density lipoprotein (HDL) in dog

Treatment	Day 0	Day 14	Day 28
T ₀	25.50±0.28 ^a	25.66±0.66 ^a	25.66±0.33 ^a
T1	27.00±0.28 ^a	142.33±1.45 ^b	162.66±1.45 ^b
T2	27.66±0.88 ^a	151.33±1.85 ^c	179.66±2.60 ^c
P-Value	.082	.000***	.000***

All values indicate mean ± standard error of the mean. The mean values with different superscripts in the same column are statistically significant ($p < 0.05$). Here *** denotes significance at 0.01 level. Here, T₀ = Control group (No soybean oil in the diet), T1= 5 ml soybean oil supplemented diet, T2= 10 ml soybean oil supplemented diet.

results showed a statistically significant increase in HDL levels in the dogs that were treated, in comparison to the dogs in the control group. There is a significant difference observed when comparing day 0 with days 14 and 28. There was a substantial increase observed in the levels of HDL cholesterol between time point 1 (T1) and time point 2 (T2). There seems to be a correlation between the amount of medication given and the increase in high-density lipoprotein (HDL) levels in the blood. No noticeable change was seen in the control group.

DISCUSSION

A soybean-rich diet causes negligible weight gain in dogs. The little increase in organism mass may be due to soybean oil coating. The two necessary fatty acids, linoleic and linolenic, which the body cannot generate, are abundant in soybean oil. Linoleic and linolenic acids improve nutrient absorption and are needed for good health. These two essential acids are precursors of hormones that regulate smooth muscle contraction, blood pressure, and cell proliferation. Soybean oil painting has more digestible fats than animal-based oil paintings. Osteoarthritis treatment often uses reprocessed soybean oil. Dogs experience minimal weight gain after consuming a regular diet supplemented with soybeans. The marginal augmentation in the mass of the organisms might potentially be attributed to the use of soybean oil as a coating. Soybean oil painting refers to a type of vegetable oil painting that possesses a higher degree of digestibility in its fats compared to those derived from animal sources. Therefore, the canine's body weight exhibited a rise, aligning with the findings of previous research (Uhegbu *et al.*, 2013).

One of the previous studies claimed that the soyabean oil treatment makes the coat shinier, improves volume, and eliminates tangles (Momota *et al.*, 2017). However, there has been no scientific evaluation of such treatments. This supports the present study that no scientific evaluation to prove but improvements seen.

Soybean oil has a decreased quantity of saturated fat and a notable abundance of polyunsaturated fatty acids. Soybean oil is primarily composed of around 50% linoleic acids and

8% linolenic acids. Research has demonstrated that the use of soybean oil can successfully lower cholesterol levels by inhibiting the absorption of cholesterol in the gastrointestinal system. The presence of a larger proportion of polyunsaturated fatty acids compared to saturated fatty acids in one's diet is a crucial factor in decreasing cholesterol levels and preventing coronary heart disease. The references cited suggest that incorporating a certain recycling route of soybean oil, called unsaponifiable, has the potential to enhance joint health (Anderson *et al.*, 1995; Brown & Goldstein, 1984; Murray *et al.*, 1990). Various studies, such as clinical trials and demographic research, have shown a substantial decrease in blood cholesterol levels when polyunsaturated fats are consumed (Austin & Hokanson, 1994; Bloedon *et al.*, 2008; RH, 1986). The presence of impregnated adipose acids in the body has been found to elevate blood cholesterol levels, leading to the accumulation of plaque on artery walls and thus increasing the risk of developing heart disease (Kwiterovich Jr, 2000). The levels of triglycerides (TG) and low-viscosity lipoprotein (LDL) were seen to have a substantial decrease in the subjects, with values of 4.4 and 4.5, mmol/L respectively. The inclusion of soybean oil in the diet of the subjects may potentially result in a reduction in low-density lipoprotein (LDL) levels, leading to a notable decrease in triglyceride and LDL concentrations. Factory sterols, which are derived from soybean oil, are employed to reduce overall cholesterol levels as well as the levels of Low- viscosity Lipoprotein (Holzbeierlein *et al.*, 2005; Ostlund Jr, 2002; Potter, 1995). There was a notable rise in the levels of High-Viscosity Lipoprotein (HDL). The observed rise in levels might perhaps be attributed to the existence of omega-3 fatty acids in adipose tissue. Soybean oil is characterized by its significant content of omega-3 fatty acids, which have been found to effectively reduce the risk and susceptibility to cardiovascular diseases. There is a consensus among nutritionists that edible oils such as coconut and peanut oils should be limited in consumption due to their high levels of saturated fatty acids (Enig, 1996). The excessive consumption of any type of fat is considered bad. Various studies conducted worldwide have consistently demonstrated that communities adhering to diets reduced in saturated fats have lower mortality rates. Consequently, it is advisable to replace saturated fats with moderate amounts of polyunsaturated fats, such as

those found in soybean oil. Cholesterol, triacylglycerol, and adipose acids have been identified as notable and distinct risk factors associated with unfavorable cardiovascular events (Cromwell & Otvos, 2004; Wierzbicki & Mikhalidis, 2002). The study findings indicate that the blood cholesterol, triglyceride (TG), and low-density lipoprotein (LDL) reduction effects of soybean oil administration in canines are not contingent upon the specific treatment regimen. Both the 5 ml and 10 ml boluses showed equivalent efficacy in reducing the observed impact. This phenomenon might be attributed to the fact that the required quantity of polyunsaturated fatty acids for canines daily is adequately provided by a 5 ml portion of a food enriched with soybean oil. However, the findings indicated that the elevation in high-density lipoprotein (HDL) levels in children was contingent upon the specific treatment administered. This might perhaps be attributed to the inadequate presence of the required quantity of omega-3 fatty acids in 5 ml of soybean oil for canines. This is the reason why the administration of 10 ml of soybean oil resulted in a more pronounced elevation in high-density lipoprotein (HDL) levels. The findings of the current investigation demonstrated that the ingestion of soybean oil may contribute to the mitigation of hyperlipidemia and atherosclerosis. Given the documented decrease in cardiovascular issues associated with reduced levels of tube lipids, it is very advisable to strongly endorse the utilization of this oil painting, particularly in canine populations. There may also be a necessity to promote conscientiousness in the preparation of ready-to-eat canine food, to include this significant seed oil in their goods.

CONCLUSION

The current study found that soybean oil in the diet reduced serum cholesterol, triglyceride (TG), and LDL cholesterol while increasing HDL cholesterol compared to the control group. The results showed that soybean-supplemented meal affects canine lipid profiles only if it raises HDL levels. However, the therapy did not need to lower cholesterol, TG, or LDL. The 5-ml meal supplemented with soybean oil has been shown to lower blood cholesterol, LDL, and TG while raising HDL.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

COMPLIANCE WITH ETHICAL STANDARDS

This article does not contain any studies with human participants performed by any of the authors.

NOVELTY STATEMENT

Effect of Soybean Oil-Containing Diet on German Shepherd Dogs' Lipid Profile Control" can be summarized as soybean oil in the diet reduced serum cholesterol, triglyceride (TG), and LDL cholesterol while increasing HDL cholesterol compared to the control group. The results showed that soybean-supplemented meals affect canine lipid profiles only if they raise HDL levels. This work is the first time in the canine unit at the BGB headquarters in Peelkhana, Dhaka. It will help access and control lipid profiles in dogs involved in stopping border crimes and the trafficking of illegal drugs on the Bangladesh border.

AUTHORS CONTRIBUTION

Conceptualization and design of the research, ANMA.A.M., M.B.R. and R.I.; methodology, ANMA.A.M., M.M.M.P., M.M.H.; experimental investigation ANMA.A.M., S.S., and R.I.; sample resources, ANMA.A.M. writing—original draft preparation, ANMA.A.M. and R.I.; writing—review and editing, M.B.R., S.S., and R.I.; supervision, R.I.; project administration, R.I. All authors have read and agreed to the published version of the manuscript.

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