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Research Article

IMPACT OF WEIGHT LOSS ON LAMENESS ASSOCIATED WITH HIP OSTEOARTHRITIS IN OBESE DOGS

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ABSTRACT: The present clinical study was conducted in ten Labrador retriever obese dogs with lameness associated with hip osteoarthritis to evaluate the effect of weight loss on its management. The weight loss protocol involved feeding of high protein and low-fat diet (for 90 days) along with conservative therapy (for 30 days) to assess the effect of these interventions on lameness, quality of life, haemato-biochemical parameters and subcutaneous fat thickness in obese dogs. After 90 days of feeding weight loss diet, dogs achieved on an average 6.5 % body weight loss at the rate of 0.5% weight loss per week. Body condition score, lameness scores (Numeric Rating Scale, NRS and Visual Analogue Scale, VAS) and quality of life showed significant improvement at the end of the study. Subcutaneous fat thickness significantly reduced from mid abdomen and chest on day 30, day 60 and day 90. The mean haemoglobin and packed cell volume increased significantly, whereas mean relative neutrophil counts decreased significantly on day 30, day 60, day 90 as compared to day 0. The mean serum cholesterol, calcium and C-reactive protein concentrations also decreased significantly.

Key words: Dogs, Hip osteoarthritis, Lameness, Obesity, Weight loss.

INTRODUCTION

Obesity is considered as a risk factor for lameness associated with osteoarthritis (OA) in dogs (Kealy *et al.* 2000, Marshall *et al.* 2010). The prevalence of lameness associated with dog obesity has been reported to be 15% (Marcelo 2019). Large breed dogs with higher body weight are vulnerable to osteoarthritis (O'Neil *et al*. 2014). Dogs with more than 20% of their average breed body weight are 2.3 times more likely to develop osteoarthritis than dogs that are underweight (Anderson *et al*. 2018). Increased body weight exerts more strain on weight-bearing joints, potentially increasing the risk of osteoarthritis and predisposed arthropathies. Obesity increases adiposity and adipocyte produces inflammatory cytokines which lead to cartilage degradation resulting into osteoarthritis (Belshaw 2017).

Obese dogs with osteoarthritis show clinical signs of lameness, limited range of motion, crepitus at affected joint, difficulty in climbing stairs, difficulty in standing, and occasional effusion without systemic signs (Budsberg and Bartges 2006). Diagnosis is made using combination of clinical examination like palpation of limb, pain on limb manipulation, range of motion assessment, visual gait scoring and radiography (Belshaw 2017). Medical management of OA included steroidal or nonsteroidal anti-inflammatory drugs (NSAIDs) and glycosaminoglycans (glucosamine and chondroitin sulphate) to reduce pain and inflammation (Bland 2015). Omega-3 fatty acid supplementation decreases cartilage degeneration, oxidative stress in chondrocytes and also reduces inflammatory markers expression (Loef *et al.* 2018). Weight loss is an important treatment modality for obese dogs with hip or elbow OA and noticeable improvement in lameness could be seen after modest weight loss of 6.10–8.85% body weight (Marshall *et al.* 2010). Weight loss decreases mechanical stress on joints and improves joint mobility. In view of paucity of available literature on obesity related lameness and its therapeutic management with weight loss in obese dogs from India, the present clinical study was designed with

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the aim to evaluate the effects of nutritional interventions in overweight and obese dogs with osteoarthritis.

MATERIALS AND METHODS

Animal selection

Ten obese Labrador Retriever dogs with lameness diagnosed for hip osteoarthritis by clinical signs and hip joint radiography in the Department of Veterinary Medicine at Multispecialty Veterinary Hospital of Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana were selected for weight loss programme after taking consent of the owners. Detailed anamnesis and thorough clinical examination of obese dogs was done using standard clinical protocols. In case of hind limb lameness, diagnosis of hip osteoarthritis was made based on radiographic examination of ventro-dorsal view of pelvis and lateral view of affected limb. The lame obese dogs (N=10) with BCS 4 and 5 diagnosed for hip osteoarthritis were fed with prescribed weight loss diet for 90 days along with conservative therapy for 30 days. The cases were followed up at 30, 60 and 90 days interval and all parameters such as BCS, body weight, muscle condition score, lameness score (NRS and VAS), quality of life, haemato-biochemical analysis and subcutaneous fat thickness were recorded as per following methods:

Body Condition Score (BCS): BCS was assigned to dogs by 5-point scale of Laflamme (1997) and graded as 1- thin, 2- underweight, 3 - ideal, 4 - overweight, 5- obese.

Body weight: The body weight was measured by using same electronic weighing System (Metis) throughout the study period.

Muscle Condition Score (MCS): MCS was scored subjectively using 4-point system of Michel *et al.* 2011 (0 - severe muscle wasting, 1 - moderate muscle wasting, 2 - mild muscle wasting, 3 - normal muscle mass).

Lameness score: Lameness was scored subjectively using NRS (0 - clinically sound, 1 - barely detectable, 2 - mild lameness, 3 - moderate lameness, 4 - severe lameness, 5 - could not be more lame). For Visual Analogue Scale,a 100 mm long horizontal bar was labeled with "clinically sound" (0) at one end and "could not be more lame" (100) at the other end (Marshall *et al.* 2010). The observer made a mark on the VAS that best represented the lameness in obese dogs.

Haemato-biochemical analysis: For complete haematological analysis, 2ml of blood was collected in sodium EDTA coated vials. A fully Automatic Laser Based Hematology Analyser (ADVIA ® 2120 Hematology system, Siemens Healthcare diagnostics Inc, USA) was used for estimation of haemoglobin (Hb, g/dl), total leucocyte count (TLC, mL^{-1}), total erythrocyte count (TEC, $x10^{6}mL^{-1}$), packed cell volume (PCV, %) and platelet count ($x10^{3}mL^{-1}$). Differential leukocyte count (DLC) was done manually using blood smear stained with Giemsa stain (Jain, 1986) and Erythrocyte Sedimentation Rate (ESR) was determined using Westergren method.

Biochemical analysis was performed in serum samples collected and stored at -20°C. Vitros DT 350 Chemistry system (Ortho Clinical Diagnostics, Johnson and Johnson Company) was used for estimation of biochemical parameters including Alanine Aminotransferase (ALT, U/L), Alkaline Phosphatase (ALKP, U/L), Blood Urea Nitrogen (BUN, mg/dl), Creatinine (Cr, mg/dl), Creatinine Kinase (CK, mg/dl), Calcium (Ca, mg/dl), Phosphorus (P, mg/dl), C- Reactive Protein (CRP) (U/L), Cholesterol (mg/dl), Triglycerides (mg/dl) and High Density Lipoprotein Cholesterol (HDL, mg/dl), Low

Table 1. Quality of life score in dogs with lameness.

Question	Score
Appetite	1 (Good)
	2 (Poor)
	3 (No)
Water intake	1 (Adequate)
	2 (Poor)
	3 (Dehydrated)
Elimination (Urination and Defecation)	1 (Normal)
	2 (Reduced)
	3 (None)
Pain	1 (No pain)
	2 (Feels pain while getting up &climbing stairs)
	3 (Feels pain while walking)
Mobility	1 (Good)
	2 (Gets tired easily & limps while walking/lameness)
	3 (Recumbent)
Interaction	1 (Interacts normally)
	2 (Some interaction)
	3 (Lies in one corner alone)
Favourite things	1 (Normal)
	2 (Decreased)
	3 (No interest)

Density Lipoprotein Cholesterol (LDL, mg/dl) and Very Low Density Lipoprotein Cholesterol (VLDL, mg/dl) were calculated using Friedewald formula (Friedewald 1972):

VLDL= Triglyceride / 5

LDL= Total Cholesterol- (HDL + VLDL)

Fibrinogen was determined by heat precipitation method (Schalm 1980).

a. Ultrasonographic subcutaneous fat thickness assessment

Subcutaneous fat thickness (SFT) was measured by ultrasound from six anatomical sites i.e. 9th ICS, abdomen, thigh, lumbar, chest and mid-abdomen using General Electric ultrasound scanner Logiq P5 equipped with a multifrequency linear transducer. Coupling medium used was ethanol and ultrasound gel.

b. Quality of life

Quality of life was assessed using prepared questionnaire on day 0 and after weight loss on day 90 for 10 obese dogs with lameness. The score up to 7 was graded as acceptable, 8-14 for moderate quality of life and 15-21 for poor quality of life.

Proximate analysis of diet and feeding of weight loss diet

Proximate analysis of pre-weight loss diets fed by owners and prescribed diet was done by standard methods given by Bureau of Indian Standards (1990) to determine crude protein, crude fibre, ether extract, total ash and nitrogen free extract on dry matter basis. The prescribed weight loss diet contains 14.027% crude protein, 5.428% crude fibre, 3.62% ether extract, 1.4405% total ash and 75.48% nitrogen free extract. The weight loss diet was fed to all ten obese dogs with only 60% of their maintenance energy requirement (NRC 1985). The calculated amount of feed was either given once a day or same amount divided into twice a day, based on the preference of food frequency of the animals. During weight loss period snacks, treats or extra food were not fed to dogs. Omega-3 fatty acids, vitamins and calcium were also supplemented with weight loss programme.

Conservative therapy

Conservative therapy included non-steroidal anti-inflammatory drugs (NSAIDS) Carprofen (Trade name- Carodyl) @ 4 mg/kg orally once a day along with Antacids-Ranitidine (Trade name - Aciloc) @ 2mg/kg orally once a day for 7 days, Glucosamine sulphate and Chondroitin sulphate (Trade name- Tiptose hip and joint) @ 25-50mg/kg and 15-40mg/kg, respectively orally once a day for 30 days.

Statistical analysis

The statistical analysis was performed using MedCalc version 20.009 computer software and one way ANOVA was done for body weight, BCS, MCS, NRS, VAS, haemato-biochemical and subcutaneous fat thickness to test significance of mean values of parameters between follow-ups. Paired t-test was applied to compare quality of life before and after weight loss treatment.

RESULTS AND DISCUSSION

Comparison of composition of prescribed and pre-weight loss diets

The prescribed weight loss diet contained higher crude protein (14.027%), crude fibre (5.43%) and lower ether extract (3.62%), total ash (1.44%), and nitrogen free extract (NFE) (75.48%) as compared to the pre-weight loss diets (Table 2). High protein and high fibre diet have few calories and increase satiety and thermogenesis which resulted in four times more fat mass loss (Weber *et al.* 2007, German *et al.* 2010). Yamka *et al.* (2007) observed that diet with increased levels of amino acid and crude protein helps in maintaining lean muscle mass during weight loss and low total dietary fibre but high soluble fibre resulted in losing body fat at faster rate. Brooks *et al.* (2014) also suggested that therapeutic diets having higher protein, vitamins, fibre, moisture and low fat reduces calorie density and hence, more effectively help

Table 2. Composition of pre-weight loss diets and prescribed weight loss diet on dry matter basis.

Parameter	Crude Protein (%)	CrudeFibre (%)	Ether Extract (%)	Total Ash (%)	N.F.E. (%)
Pre-weight loss diet (n=10) (Mean ± S.E.)	2.38±0.31^{a}	2.10±0.25^{a}	11.85±1.84^{b}	3.08±0.31^{b}	80.58±2.03^{b}
Prescribed Weight Loss diet	14.027	5.428	3.62	1.4405	75.4845

Values with superscript letter “a” is lower than prescribed weight loss diet and “b” is higher than prescribed weight loss diet.

in weight loss of dogs than simply restricting the amounts of over-the-counter diets. Marcelo (2019) also reported that high protein low fat diet helped in reducing weight in healthy overweight and obese dogs. The nutritional composition of diet given to dogs consisted of 21.45% crude protein, 6.35% crude fibre, 2.2% fat, 3.92% ash and 66.09% NFE.

Effect of weight loss on quality of life

Before weight loss treatment 6/10 (60%) obese lame dogs had poor quality of life and 4/10 (40%) had moderate quality of life. After weight loss treatment, 7/10 (70%) had moderate quality of life and 3/10 (30%) had acceptable quality of life score (Table 3). Quality of life score showed highly significant ($p \leq 0.0001$) improvement after weight loss treatment (Table 4). Wiseman-Orr *et al.* (2004) observed that chronic pain associated with chronic degenerative joint disease in dogs which limits physical activity had adverse impact on quality of life. Increased physical activity, mental alertness, and decreased pain score are associated with weight loss and helped in improving quality of life in obese dogs (German *et al.* 2012).

Effect of weight loss on body weight, BCS, MCS, NRS and VAS

In this study, an average of 6.5 % body weight loss was recorded, with weekly weight loss at the rate of 0.5%. When compared to day 0, there was a significant ($p \leq 0.05$) decrease in body weight on day 30, day 60, and day 90. There was significant reduction ($p \leq 0.01$) in BCS on day 30, day 60, and day 90 as compared to day 0. When comparing day 0 to day 30, day 60, and day 90, MCS showed significant ($p \leq 0.01$) decrease. NRS showed a significant ($p \leq 0.01$) improvement on day 30, day 60, and day 90 as compared to day 0. After comparing day30, day 60, and day 90 of weight loss to day 0 of weight loss, VAS showed a significant ($p \leq 0.001$) difference (Table 5).

According to American Animal Hospital Association (AAHA) weight management guidelines, 1-2 % weight loss /week is considered appropriate to achieve significant body weight loss (Brooks *et al.* 2014). In the present study, desired body weight loss rate per week could not be achieved, which might be either due to non-compliance of owner, small sample size or uncontrolled clinical study type and the dogs included in this study were Labradors which need greater energy restriction to achieve weight loss (Bissot *et al.* 2006).Christmann *et al.* (2015) also discovered that dogs fed with weight loss diet for 6 months, had a considerable reduction in body weight (14.5%), BCS, and body fat index. They lost 0.7 percent of their body weight each week. There was a substantial reduction in muscle condition score in dogs, as compared to MCS at the beginning of this study. This could be due to the fact that obese dogs had expanded muscle mass, which reduced with weight loss. Similarly, MCS was also decreased during weight loss period in the current study.

The possible reason for improvement in lameness score with weight loss could be reduction in weight that causes less joint loading (Aaboe *et al.* 2011) and which improved mobility (Pettitt and German 2015). Another reason could be that obesity leads to accumulation of adipocytes which are responsible for increased production of inflammatory cytokines and contributes to cartilage damage (Belshaw 2017) and with weight loss, adipocytes decreases and result in decreased levels of inflammatory cytokines and leads to improvement in lameness.

Table 3. Comparison of quality of life before and after weight loss treatment in overweight and obese dogs with lameness (N=10).

Sl. No.	Quality of life	Before	After
1.	Poor (Score 21)	6(60%)	0(00%)
2.	Moderate (Score 14)	4(40%)	7(70%)
3.	Acceptable (Score 7)	0(00%)	3(30%)

Table 4. Effect of conservative therapy along with weight loss diet on quality of life of obese dogs with lameness (Mean ± SE, N=10).

	Before treatment	After treatment	p-value
Quality of life	18.20 ± 1.14^{b}	11.90 ± 1.07^{a}	<0.0001

Values with superscript letter "a" is lower than values with superscript letter "b".

Effect of weight loss on subcutaneous fat thickness

On day 30, day 60, and day 90, there was a significant decrease in SFT in the mid-abdomen ($p \leq 0.05$) and chest ($p \leq 0.01$). SFT of abdomen, 9th intercostal space, lumbar and thigh decreased insignificantly from day 0 (Table 6).

Payan-Carreira *et al.* (2016) and Preet (2018) used ultrasound to measure subcutaneous fat thickness in dogs at different anatomical sites and found that lumbar, abdomen, chest, thigh, flank and thigh had significant correlation with subcutaneous fat thickness. Marcelo (2019) observed reduction in SFT from six anatomical

Table 5. Effect of weight loss diet on body weight, BCS, MCS, NRS and VAS of obese dogs with hip osteoarthritis.

	Day 0 (Mean±SD)	Day 30 (Mean±SD)	Day 60 (Mean±SD)	Day 90 (Mean±SD)	p value (∝=0.05)
Weight (kg)	47.4±2.39	46.25±2.40*	45.00±2.41*	44.13±2.43*	0.024
BCS	4.40±0.46	4.35±0.53**	3.90±0.46**	3.70±0.42**	0.004
MCS	2.10±0.57	2.10±0.57**	1.45±0.79**	1.25±0.63**	0.008
NRS	3.30±0.82	2.80±1.03**	2.20±0.92**	1.80±1.03**	0.007
VAS	68.00±10.32	56.00±9.67***	49.00±8.75***	42.00±12.29***	<0.001

Values with superscript "asterisk (*)" differ (p≤0.05) from day 0 of treatment.
Values with superscript "asterisk (**)" differ (p≤0.01) from day 0 of treatment.
Values with superscript "asterisk (***)" differ (p≤0.001) from day 0 of treatment.

Table 6. Effect of weight loss on subcutaneous fat thickness in obese dogs diagnosed with hip osteoarthritis.

Anatomical sites (in cm)	Day 0 (Mean±SD)	Day 30 (Mean±SD)	Day 60 (Mean±SD)	Day 90 (Mean±SD)	p value
Abdomen	0.96±0.31	0.87±0.28	0.78±0.24	0.67±0.18	0.094
Mid abdomen	0.77±0.22	0.69±0.18*	0.62±0.16*	0.54±0.15*	0.046
9ICS (flank)	1.40±0.67	1.11±0.49	0.91±0.47	0.81±0.43	0.071
Lumbar	2.82±1.42	2.54±1.41	2.26±1.39	1.93±1.25	0.511
Thigh	0.57±0.26	0.50±0.23	0.40±0.23	0.35±0.23	0.163
Chest	1.90±0.67	1.54±0.55**	1.30±0.48**	1.07±0.46**	0.011

Values with superscript "asterisk (*)" differ (p≤0.05) from day 0 of treatment.
Values with superscript "asterisk (**)" differ (p≤0.01) from day 0 of treatment.

sites i.e., abdomen, mid abdomen, 9th inter-costal space, lumbar, thigh and chest in obese dogs during the weight loss study.

Haemato-biochemical changes during weight loss protocols

There was significant increase in mean haemoglobin values (p≤0.05) and PCV (p≤0.01) and significantly decrease in relative neutrophil count ((p≤0.01) on day 30, day 60, and day 90 as compared to day 0. The mean TLC value revealed a non-significant decline on day 30, day 60 and day 90 (Table 7). In the current study, significant increase in haemoglobin, PCV and significant decrease in neutrophil count were seen during the weight loss period, which could be attributable to the reduction in fat deposition and low-grade chronic inflammation linked to obesity and osteoarthritis (Rafaj *et al.* 2016). Marcelo (2019) did not find any significant changes in haematological parameters of healthy overweight dogs during the weight loss study.

The serum cholesterol, calcium and CRP concentrations showed significant (p=0.01) decrease on day 30, day 60, and day 90 compared to day 0, whereas mean serum ALT, alkaline phosphatase, creatinine kinase, and LDL concentrations were non-significantly lower on day 30, day 60, and day 90 compared to day 0 (Table 8).Canine obesity is characterized by increased plasma cholesterol, triglyceride, HDL, VLDL and LDL concentrations and these levels could be decreased by feeding high protein and low energy dry diet (Jeusette *et al*. 2005). With weight loss, there is a considerable decrease in blood cholesterol, triglyceride, leptin, ALKP, and phosphorus concentrations in overweight dogs, which helps to improve obesity and obesity-related diseases such arthritis by reducing joint loading (Yamka *et al.* 2006, Yamka *et al.* 2007). Pena *et al.* (2014) and Xenoulis *et al.* (2020) also found that obese dogs fed with a low-fat high fibre diet had lower levels of ALT, ALKP, total cholesterol, triglyceride, glucose and blood pressure at the end of the weight loss programme.

Table 7. Effect of weight loss diet on haematological parameters (Mean ± SD) in obese dogs diagnosed with lameness.

Parameter		Day 0	Day 30	Day 60	Day 90	p value (á=0.05)
Hb (g%)		12.15±1.17	13.38±1.40*	12.22±0.37*	12.73±0.35*	0.022
TLC (μL^{-1})		17869.20±6822.24	16079.20±5417.62	14920.00±2618.48	14968.30±2502.39	0.472
N	Relative (%)	82.70±6.73	76.90±7.82**	74.80±4.89**	74.10±1.19**	0.008
	Absolute (μL^{-1})	15017.38±6456.51	12664.47±5781.20	11111.94±2547.74	11109.00±1966.35	0.208
L	Relative (%)	14.50±5.62	16.20±5.53	14.50±5.25	13.10±4.58	0.632
	Absolute (μL^{-1})	2318.70±577.18	2361.39±342.00	2060.59±501.13	1889.88±500.83	0.120
M	Relative (%)	0.40±1.26	0.40±1.26	0.00±0.00	0.00±0.00	0.576
	Absolute (μL^{-1})	100.36±317.37	45.60±144.20	0.00±0.00	0.00±0.00	0.530
E	Relative (%)	2.10±3.07	0.20±0.63*	0.60±1.35*	0.00±0.00	0.039
	Absolute (μL^{-1})	377.85±542.64	28.80±91.07*	73.80±157.43*	0.00±0.00	0.020
TEC ($x10^6 \mu L^{-1}$)		6.27±0.45	6.49±0.22	6.42±0.42	6.53±0.18	0.374
PCV (%)		36.27±2.59	39.42±7.82**	36.19±1.03**	37.80±0.76**	0.010
Platelets ($x10^3 \mu L^{-1}$)		286.40±57.22	301.40±78.31	253.00±54.39	520.60±770.02	0.412
ESR (mm/Hr)		4.60±2.17	7.40±5.4	7.80±10.82	3.90±0.88	0.398

[N= Neutrophil, L = Lymphocyte, M = Monocyte, E = Eosinophil]
Values with superscript "asterisk (*)" differ (P≤0.05) from day 0 of treatment.
Values with superscript "asterisk (**)" differ (P≤0.01) from day 0 of treatment.

Table 8. Effect of weight loss diet on biochemical parameters (Mean±SD) in obese dogs diagnosed with lameness.

Parameter	Day 0	Day 30	Day 60	Day 90	p value
ALT (IU/L)	51.60±29.27	41.40±8.54	40.10±7.25	35.25±3.24	0.147
ALKP (IU/L)	123.55±58.69	102.05±30.71	96.75±27.41	86.45±25.42	0.186
Creatinine kinase (mg/dl)	198.20±145.88	189.00±124.68	184.70±93.55	146.10±74.38	0.745
BUN (mg/dl)	7.50±1.72	8.70±2.11	8.50±1.72	8.10±1.10	0.418
Creatinine (mg/dl)	0.68±0.17	0.72±0.21	0.87±0.26	0.70±0.16	0.163
Calcium (mg/dl)	10.63±0.33	10.37±0.29**	10.25±0.17**	10.16±0.41**	0.011
Phosphorous (mg/dl)	3.53±0.46	5.18±2.8	4.26±0.40	4.02±0.33	0.094
Cholesterol (mg/dl)	191.00±25.36	178.60±21.41**	167.20±20.62**	159.40±17.81**	0.013
Triglycerides (mg/dl)	73.90±11.05	74.70±9.74	71.20±10.57	70.70±10.20	0.783
LDL (mg/dl)	86.12±25.12	66.36±27.51	62.24±23.28	57.57±22.87	0.069
VLDL (mg/dl)	14.78±2.21	14.94±1.95	14.16±2.20	13.86±2.32	0.652
HDL (mg/dl)	90.10±21.59	97.30±16.54	90.80±19.31	88.00±20.29	0.738
CRP (U/L)	4.80±1.03	4.40±0.84*	3.90±0.32*	4.00±0.00*	0.022
Fibrinogen (mg/dl)	240.00±84.33	240.00±84.33	240.00±126.49	200.00±0.00	0.665

Values with superscript "asterisk (*)" differ (p≤0.05) from day 0 of treatment.
Values with superscript "asterisk (**)" differ (p≤0.01) from day 0 of treatment.

Increased calcium increases lipogenesis while inhibiting lipolysis, resulting in triglyceride build-up in adipocytes and obesity in humans (Shi *et al.* 2000). Sergeev and Song (2014) found that increasing calcium ion mediated apoptosis of white adipose tissue by activating the calcium/caspase/calpain-dependent pathway reduces diet-induced obesity in mice. These studies suggested that increase in intracellular calcium levels promotes obesity but by feeding high calcium weight loss diet intracellular calcium levels are decreased hence promotes weight loss. The present findings also supported these studies that decrease in intracellular calcium concentration results into weight loss in overweight and obese dogs fed with weight loss diet along with calcium supplementation.

The present study findings were in agreement with German *et al.* (2009), who reported significant decrease in plasma concentration of tumour necrosis factor-∝ (TNF-∝), haptoglobin and C-reactive protein (CRP) in overweight and obese dogs fed with high protein medium fibre or high protein high fibre diet on dry matter basis. They suggested that obesity in dogs is a subclinical inflammatory state which improves with weight loss. Wakshlag *et al.* (2011) also reported that serum CRP and Monocyte Chemoattractant protein-1 (MCP-1) are used as indicator of chronic inflammation associated with obesity in dogs. After weight loss, there was significant decrease in serum CRP and MCP-1 concentrations which suggested improvement in chronic inflammation state in obese dogs with osteoarthritis.

CONCLUSION

In obese dogs with osteoarthritis, a high-protein, low-fat weight-loss diet combined with conservative therapy is proved successful in managing lameness and hence improving the quality of life of the animal as well as their owners. Weight loss helps in improving NRS and VAS lameness score by reducing joint load. It also helps in reducing serum cholesterol, triglyceride levels and reducing subclinical inflammatory state of obesity.

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