Raw Hempseed oil as a Novel Ingredient for Dog's Diet

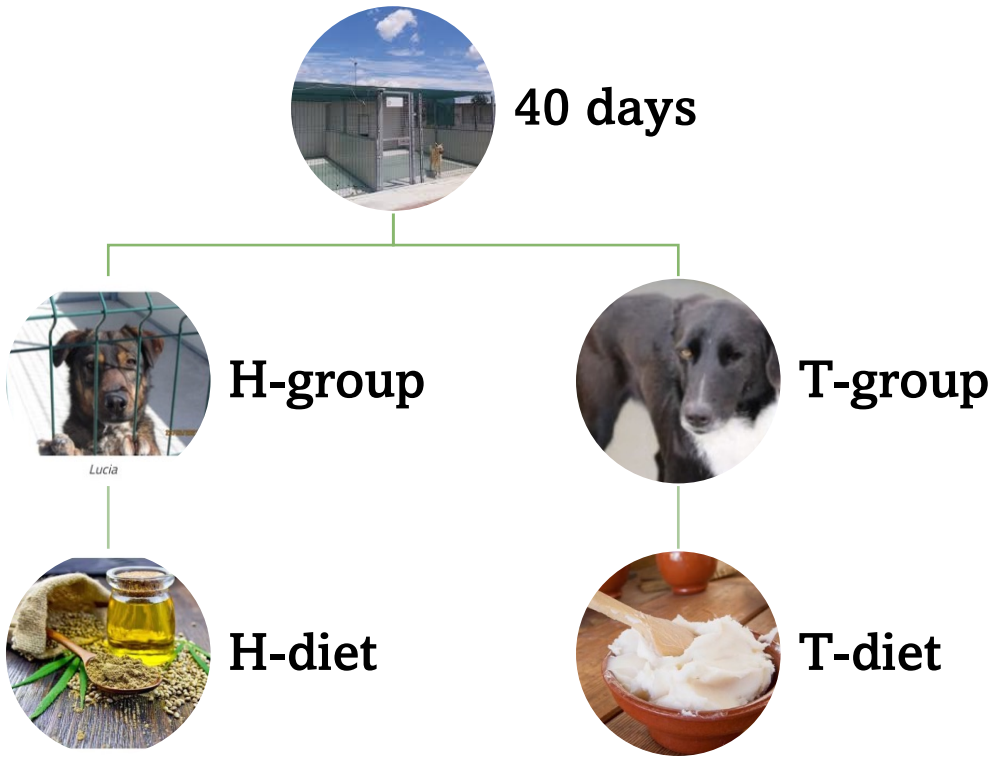


Table 1. Chemical composition (mean and standard deviation) of administered diets

Nutrients (% as feed)	Diet*(n=4)	T-diet (n=4)	H-diet (n=4)
Moisture	75.02±0.25	67.35±0.26	66.09±0.31
CP	11.81±0.18	10.54±0.73	11.53±0.02
CF	4.14±0.20	2.99±0.15	3.52±0.35
EE	5.55±0.56	8.91±0.60	7.09±0.02
Ash	3.25±0.21	3.15±0.07	3.70±0.14
NFE	13.29±0.36	6.95±1.11	8.00±0.22
ME (kcal/kg) *	1350.3	1286.4	1369.4

*Commercial diet has reported as term of comparison and it was not statistically analyzed. T-diet: tallow diet; H-diets: hemp diet; CP: crude protein; CF: crude fiber; EE: ether extract; NFE: nitrogen free extract; * calculated according to modified Atwater's factors

Dipartimento Medicina Veterinaria Produzioni Animali

Fatty acids profile

UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

Table 2. Fatty acid profiles (% of total fatty acids) of tested diets

Fatty Acids	Diet*	T-Diet	H-Diet	p-value
C4:0	3.23±0.03	2.11±0.07	2.68±0.02	0.0082
C6:0	0.69±0.05	1.61±0.03	2.37±0.07	0.0246
C14:0	1.97 ± 0.09	1.77 ± 0.01	0.79 ± 0.09	<0.0001
C15:0	0.17 ± 0.009	0.18 ± 0.008	0.06 ± 0.001	0.0066
C16:0	21.3 ± 0.53	23.6 ± 0.15	17.7 ± 0.04	0.0003
C17:0	3.46 ± 0.18	2.31 ± 0.08	1.71 ± 0.07	0.0069
C18:0	8.6±0.57	15.7±0.09	15.4±0.10	0.0816
C18:1 trans 11 (TVA)	0.95±0.06	1.23±0.01	1.90±0.04	0.0019
C18:1 cis 9	35.5±0.033	35.7±0.17	28.4±0.56	0.0032
C18:1 cis 10	0.16±0.03	0.29±0.02	0.38±0.05	0.0277
C18:2 cis n-6 (LA)	18.4 ± 0.34	9.96 ± 0.06	20.9 ± 0.09	<0.0001
C20:0	0.15 ± 0.01	0.19 ± 0.05	0.37 ± 0.03	0.0141
C18:3 n-6 (GLA)	0.04 ± 0.001	0.49 ± 0.03	0.23 ± 0.01	0.0093
C18:3 n-3 (ALA)	1.79 ± 0.01	1.30 ± 0.02	3.53 ± 0.02	<0.0001
C20:3 n-6	0.07±0.05	0.04±0.01	0.04±0.02	0.9357
C20:3 n-3	0.20±0.02	0.22±0.01	0.61±0.03	0.0026
C20:4 n-6 (AA)	0.28±0.004	0.18±0.02	0.12±0.02	0.0691
C22:2 n-6	0.36±0.01	0.29±0.01	0.08±0.03	0.0107
C24:0	0.06±0.003	0.09±0.03	0.06±0.01	0.0695
C20:5 n-3 (EPA)	0.12±0.002	0.15±0.006	0.18±0.004	0.1214
C24:1	0.02±0.003	0.02±0.005	0.15±0.005	0.0006

*Commercial diet has reported as term of comparison and it was not statistically analyzed. T-Diet: tallow diet; H-diet: hemp diet; C4:0: butyric acid; C6:0: caproic acid; C8:0: caprylic acid; C14:0: myristic acid; C15:0: pentadecylic acid; C16:0: palmitic acid; C17:0: margaric acid; C17:1:heptadecenoic acid; C18:1 cis6: petroselinic acid; C18:0: stearic acid; C18:1 trans 11: trans vaccenic acid (TVA); C18:1 cis 9: oleic acid; C18:2 cis n-6: linoleic acid (LA); C20:0: arachidic acid; C18:3 n-6: γ-linolenic acid (GLA); C18:3 n-3: α-linoleic acid (ALA); C20:2 n-6; C22:0: behenic acid; C20:3 n-6; C20:3 n-3: dihomo γ-linolenic; C20:4 n-6: arachidonic acid(AA); C22:2 n-6: docosadienoic acid; C24:0: lignoceric acid; C20:5 n-3 eicosapentenoic (EPA).

Table 3. Categories of fatty acids (% of total fatty acids) of the administered diets

Categories	Diet*	T-Diet	H-Diet	p-value
SFA	40.5±0.53	48.9±0.19	41.5±0.10	0.0004
MUFA	37.8±0.42	38.3±0.18	31.9±0.60	0.0048
PUFA	21.2±0.38	12.8±0.09	25.9±0.01	< .0001
n-6	19.2±0.36	11.3±0.09	21.6±0.002	< .0001
n-3	2.01±0.01	1.57±0.001	4.32±0.01	< .0001
PUFA/SFA	0.52±0.002	0.26±0.0008	0.62±0.002	< .0001
n-6/n-3	9.57±0.11	7.18±0.05	4.99±0.01	0.0003
LA/ALA	10.3±0.10	7.18±0.04	5.93±0.03	0.0004
AA/EPA	13.3±1.35	3.47±0.10	0.69±0.03	0.0418
PI	82.5±0.35	66.1±0.02	88.2±0.58	0.0004

*Commercial diet was reported only as data, and it was not statically analysed. T-diet, tallow diet; H-diet, hemp diet; SFA, saturated fatty acids; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids; LA/ALA, linoleic acid/α-linolenic acid; AA/EPA, arachidonic acid/eicosapentaenoic acid; PI, peroxidation index

Clinical Findings

Table 4. Main biochemical parameters

Par	U	T-Group	H-Group	p-value
AP	U/L	35.3±4.0	25.6±2.0	0.7144
CREA	µmol/L	103±8.55	87.0±11.0	0.0270
AST	U/L	49.6±6.66	30.7±3.01	0.0058
ALT	U/L	43.3±4.50	29.0±3.56	0.0101
BIL	µmol/L	3.12±0.28	2.19±0.83	0.1483
CHOL	mmol/L	5.59±0.45	4.41±0.63	0.0057
GLU	mmol/L	5.04±0.48	5.13±0.39	0.9489
CK	mmol/L	143±10.4	82.0±5.9	0.0105
Cl	mmol/L	113±3.25	112±3.27	0.6976

AP, alkaline phosphatase; CREA, creatinine; AST, aspartate transaminase; ALT, alanine aminotransferase; BIL, bilirubin; CHOL, cholesterol; GLU, glucose; CK, creatine kinase; CL, chloride.

These results could suggest a beneficial effect of diet supplemented with hempseed oil due to the high amount of PUFA, particularly the linoleic and a-linolenic acids as observed on liver function and lipid methabolism (Welch-White et al, 2013; Kaushal et al. 2020).

The higher PUFA concentration in H-diet could have also caused the significant reduction of creatinine, considered a biomarker of renal function. Brown et al., (1998). observed in short-term studies in dogs naturally affected by renal failure that detected that dietary supplementation with n-3 PUFA decreased glomerular capillary pressure and seems to be renoprotective. While n-6 PUFA showed the opposite effect.

Faecal bacterial cell counts

Table 5. Faecal bacterial cell evaluation of dogs fed diets (log/g sample wet weight)

Bacteria Cell Count	T-Group	H-Group	p-value
Lactobacillus spp	6.55±0.14	7.11±0.05	0.0142
Bifidobacterium spp	2.20±0.11	2.60±0.21	0.2008
Enterobacteria	6.66±0.13	6.91±0.10	0.1594
Clostridum coccoides cluster XIVa	9.77±0.05	9.86±0.04	0.1821
Clostridum Leptum cluster IV	8.57±0.10	8.05±0.22	0.1408

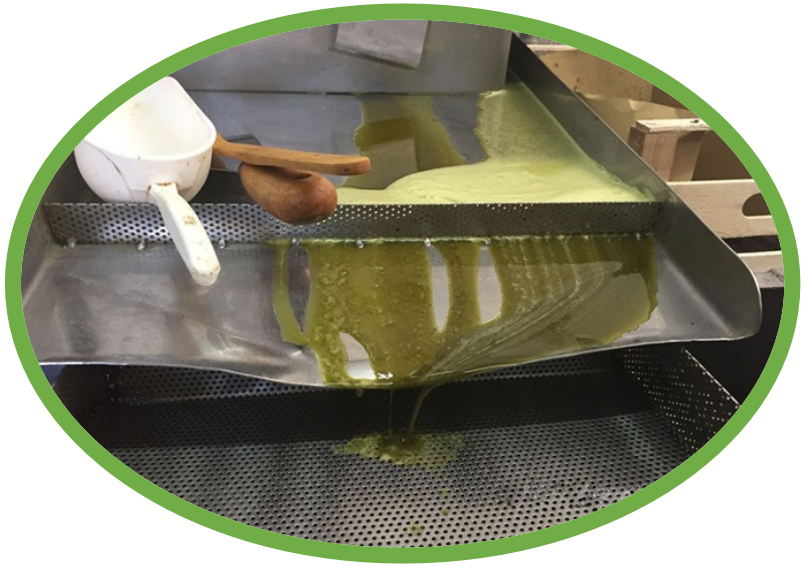
Kilburn et al. (2020) hypothesised that Lactobacillus would increase when dogs were fed a diet rich in fat, thanks to a specific bile salt hydrolase (BSH) activity which was to a cholesterol reduction (Kumar et al., 2012). Otherwise, the T group's faeces registered the highest Enterobacteria cell numbers, indicating a higher microbial protein fermentation in the large intestine (Kröger et al., 2017).

Table 6. Secondary metabolites in dog's faeces.

Items	Units	T-Group	H-Group	p-value
pH		7.11±0.03	6.97±0.04	0.0273
D-lactate	µL/g	0.43±0.14	0.25±0.03	0.6242
L-Lactate	µL/g	0.25±0.14	0.22±0.06	0.6473
Ammonia	µmol/g	59.3±5.46	42.7±2.24	0.0472
SCFA	mmol/g	134±9.97	87.2±2.98	0.0105
Acetate	% VFA	58.7±0.53	61.4±0.82	0.0209
Propionate	% VFA	23.1±0.50	25.9±0.45	0.0033
Iso-butyrate	% VFA	2.34±0.50	1.31±0.12	0.0008
Butiyate	% VFA	9.40±0.44	10.5±0.43	0.0633
Iso-valerate	% VFA	3.45±0.14	1.21±0.07	0.0008
Valerate	% VFA	2.94±0.11	0.30±0.02	0.0012

Conclusion

- ✓Supplementation with hemp seed oil appears to improve the fatty acid profile in the diet of dogs.
- ✓Salutary effects on animal health in terms of blood biomarkers of liver and kidney function and on the faecal microbial population were observed.
- ✓From these preliminary results it seems possible to suggest the use of this co-product as a source of polyunsaturated fatty acids for feeding dogs.



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Hemp Seed Cake as a Novel Ingredient for Dog's Diet

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Evaluation of the Effect of Different Dietary Lipid Sources on Dogs' Faecal Microbial Population and Activities

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