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Effect of Flaxseed Oil on Feeding Dairy Friesian Cows on the Fatty Acid and Chemical Composition of Milk and Physiochemical Properties of Yoghurt

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ABSTRACT

The aim of this study to evaluate the effect of flaxseed oil supplementation into Friesian cows on their productive, blood parameters, fatty acids composition of milk, and physic-chemical properties of yoghurt. Twenty-four Friesian cows averaged 607±22.5 kg live body weight were randomly assigned into two groups (12 cows in each group). Cows in group 1st (T1) was served as the control, while those in (T2) 2nd were treated with 2% of DM intake flaxseed oil from until 120 days post-partum. An average daily dry matter intake DM and TDN increased significantly ($P \leq 0.05$) with flaxseed oil, compared to the control. The intake DCP, protein, and solids-not-fat contents were nearly similar in both treatments. Concentrations of high-density lipoprotein, triglyceride, contents of fat, lactose and total solids were higher significantly ($P<0.05$) in T2 than the (T1). Daily milk yield and 4% fat corrected milk were higher significantly by 18.08 in T2 and 13.91% in T1, respectively. Treatment (T2) was slightly lower amounts of small-chain and medium-chain fatty acids (C4- C10), whereas (C12-C16) were slightly higher in control. DM, fat, ash and titratable acidity of yoghurt were significantly higher ($P \leq 0.05$) in treatment T2, whereas pH was similar in both treatments. Treatment (T1) was contained a fewer total bacterial count than the treatment (T2). Yeasts and Coliforms were not discovered in all treatments. The treatment (T2) contained the decreased value of the omega-6/omega-3 ratio. It could be concluded that flaxseed oil improved digestibility, increased the concentrations of polyunsaturated fatty acid, reduced the concentrations of saturated fatty acids, increased the (omega 3) in milk and yoghurt.

Keywords: Friesian cow, feed intake, polyunsaturated fatty acid, milk yield, flaxseed oil and yoghurt

INTRODUCTION

Flaxseed is one of the most important food sources of α-linolenic acid, which institutes 180 g/kg of the fatty acids and feeding oilseeds and vegetable oils is an effective method to manipulate fatty acid composition of cow's. The effects of lactic acid bacteria in yoghurt contain protection against gastrointestinal upsets, enhanced digestion of lactose and help the body adjust protein, iron and calcium (Mustafa, *et al.* 2003).

Making yoghurt with omega-3 fatty acids may be provide to an increase in omega-3 consumed among. Flaxseed is very healthy (Larsson *et al.*, 2004, (Marona and Pedrigon, 2004, DeClercq, 2006, Breslow, 2006, Gebauer*et al.*, 2006, and Ambrose *et al.*, 2006).

(Oba *et al.* 2009 and Mervat, *et al.*,2012) used flaxseed which contains the high level of (omega- 3 fatty acid) being essential for humans and necessary to add to milk products to increase their health effects.

Yoghurt made from cow milk obtained from cows fed with WLO and inculcated with *Bifidobacterium aldolescentis* ATCC 15704 was (20.0), followed by T9 treatment (yoghurt made from cow milk obtained from cows fed with WLS and inculcated with *Bifidobacterium aldolescentis* ATCC 15704,) was (20.08),followed by T2 treatment (yoghurt made from cow milk obtained from cows fed with WLM and inculcated with B. lactisBb.12) (20.99). The highest content of the (n-6/n-3 ratio) was 45.83, found in the control yoghurt. Feeding cows with whole linseed, linseed oil or linseed meal was considered successful strategy for improving the fatty acids profile of functional yoghurt as dairy products(Bibiana*et al.*, 2014a, Kholif *et al.*, 2016, and Abeer, *et al*. 2018)

The objectives of this work were to use of linseed oil as a source of energy and study its effect the chemical composition of milk and profile of fatty acid, feed intake, blood parameters and manufacture of yoghurt for their milk.

MATERIALS AND METHODS

Twenty four healthy Friesian cows with an average of 607±22.5 kg body weight (BW) and 23 parities were chosen at late pre-partum period (45 days pre-partum) to study the effect off supplementation flaxseed oil cows were divided into two similar groups, 12 animal in each. Cows were divided according to their BW, of previous season. Consisted of 35% concentrate feed mixture (CFM), 25% corn silage (CS) and 40% rice straw (RS) pre-partum and 55% CFM, 30% CS and 15% RS post-partum without oil supplement in group (T1) and served as the control, and supplemented with flaxseed oil at level of 2% of DM intake in group (T) from 45 days pre-partum until 120 days post-partum during the summer season.

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Fresh cow milk was obtained from the herd supply of the Sakha station, Animal Production Research Institute, Agriculture Research Center, Giza, Egypt. This experiment was carried out at Sakha the Experimental Station of Animal Production Research Institute belonging to Agriculture Research Center during summer season 2014-2015. Milk samples, control (T1) and (T2) donated from animals fed control diet or linseed oil respectively.

Yoghurt starters were obtained from Chr. Hansen's laboratory, (Copenhagen, Denmark), Linseed oil was obtained from Eldemerdash factory for the extraction of vegetable oils, (Al Mahalla al-Kubra, Gharbia Governorate, Egypt).

Blood samples were biweekly collected and separated by centrifugation at 4000 rpm for 10 min. by the methods used by Gornall *et al*., 1949 and Wichselarm, 1946).

Milk analysis using a milkoscan (130 series type 10900 FOSS electric– Denmark).

For making yoghurt, the portions; from cow milk obtained from cows fed with control diet, which used as control (T1). The second portion of milk obtained from cows fed ration supplemented with 3% linseed oil (T2), heated 90ºC/10 min and cooled to 42ºC then inoculated with (3%) of yogurt culture and inoculated samples were incubated at 42ºC until coagulation, packed in plastic cups and analysis the chemical, microbiological ,fatty acid and sensory evaluation after 1, 7, and 14 days .Three replicates were carried out from all treatments when fresh and after 7 and 14 days.

Yoghurt analyzed for titratable acidity, pH values, total solids and fat contents. The pH value was measured by using a laboratory microprocessor pH meter model. Hanna HI 852, Germany. Fat and omega 3 content of the cow milk (obtained from cows fed with ration supplemented with linseed oil were determined according to the AOAC (1998).

Total bacterial, coliforms, moulds & yeasts determination were carried out according to the Zekai, (2003). Organoleptic evaluation was carried by fifteen panelists from the staff members of the Dairy Science Dept., Animal Production Research Institute. yoghurt samples were sensory evaluated fresh and during the cold storage period at 5ºC, according to the scheme described by Nelson and Trout (1981).

Fatty acids of milk samples and functional yoghurt samples were extracted and methylated according to method 996.06 of the AOAC (1998). Tritridecanoin (Sigma, Oakville, ON, Canada) was used as the internal standard. Individual FA was identified by comparison of gas chromatography peaks with known standards (GLC-463; Nu-Chek Prep Inc.). Fatty acid methyl esters were separated on an Agilent 6890 GLC fitted with an Agilent autosampler (model 7683, Agilent injector, Agilent Ltd., Mississauga, ON, Canada) and a flame ionization detector. Agilent Chemstation Rev. B.01.03 (204) software was used for chromatogram integration and analysis. Samples were introduced onto a 100m Supelco (Oakville, ON, Canada) SP- 2560 column (part number 24056) via 1µl splitless injections. The temperature program was: level one, 45ºC held for 4min; level two, 45-150 ºC at 13.00/min increments, then held for 47 min; level three, 150–215ºC at 4ºC / min increments, then held for 35 min. The injector temperature was set at 250 ºC and the detector was set at 260ºC. Column head pressure was set at 30 psi. A 4 mm i.d.splitless injection liner (Agilent Ltd., Mississauga, ON, Canada) was used for all injections. Gas flow rates were: helium (carrier) 1.1 ml/min, helium (makeup) 25 ml/min, compressed 350 ml/min and hydrogen 35 ml/min.

Data collected for lactation, digestibility trials and milk and, functional yoghurt were subjected to statistical analysis as one-way analysis of variance using SAS (1999), according to the model. (Duncan, 1955) was used to separate means when the dietary treatment effect was significant ($P \leq 0.05$).

RESULTS AND DISCUSSION

Average daily feed intake by Friesian cows the total DM and TDN intake post-partum increased significantly ($P \leq 0.05$) with flaxseed oil supplementation, but DCP intake was nearly similar for the two groups. Feed intake reflects the variation in TDN and DCP. The observed Zachut *et al* (2011). Milk yield was 6.4% higher in flaxseed than in control, and fat content was 0.4 unit lower in flaxseed cows than in control. Feeding flaxseed oil at 0, 5, 10 and 15 per cent of diet DM of cattle and found that when fed at 5 per cent increased DM intake. Higher alfalinolinc acid by 187% was detected in cows fed flaxseed oil than cows fed sunflower oil 22%, however, linoleic acid increase 122% in sunflowers than flaxseed oil 74%. Fed whole or processed (rolled or ground) flax, included at 8 per cent of diet DM, and reported significant increases in gain and gain efficiency (Drouillard *et al*.2002, Maddock *et al*. 2004 and Ambrose *et al*., 2006)

Data in Table (1) showed that pH values were not significantly affected by flaxseed oil supplementation. While, TVFA concentration increased, but NH3-N concentration decreased significantly ($P \leq 0.05$) with flaxseed oil supplementation. These results illustrated that flaxseed oil supplementation stimulates the growth of rumen microorganisms utilizing ruminal NH3-N and fermented the carbohydrates producing TVFA. These results confirmed with increasing CF digestibility with linseed oil supplementation (Table 1). The results agreement with, Chen and Russell (1989) affirmed that the reduction of NH3-N concentration may be related to the depression effect of unsaturated lipids on the population of gram positive bacteria, notably the amino acid-fermenting mandatory group, to supply their energy and protein requirements.

Table 1. Average Daily Feed Intake (kg/head) and Rumen Fermentation Activity as Affected by Flaxseed Oil Supplementation, Throughout the First 120 Days of Lactation.

Item	Treatments	
	Control	Treatment
CFM (kg)1	10.43	10.73
Corn silage (kg)1	14.54	14.96
Rice straw (kg)1	2.80	2.88
Oil (g)	00	350
Total DM (kg)	17.01± 0.21b	17.85± 0.21a
TDN (kg)	11.11± 0.18b	12.45± 0.18a
DCP (kg)	1.32± 0.05a	1.39± 0.05a
Some rumen fermentation act ivity (n=12)		
PH value	6.31± 0.02a	6.26± 0.02a
TVFA's (meq/100ml)	9.48± 0.41b	11.33± 0.41a
NH3-N (mg/100ml)	18.45± 0.52a	16.30± 0.52b

Results Table (2) showed that the daily milk yield and 4% fat corrected milk yield were significantly higher ($P \leq 0.05$) with flaxseed oil the ration than those of the control group.

Also, flaxseed oil during the first 120 days of lactation improved fat and total solids percentages as compared to the control, but protein, lactose and solids percentages not fat were not significant. This may indicate that flaxseed oil during the first 120 days of lactation has a positive reflection on the yield of fat and protein (Table 2).On the other hand, flaxseed oil reduced (P≤0.05) somatic cell count in milk of treated group as compared to the control.

Table 2. Milk Yield, the Composition of Milk and Somatic Cell Count as Affected by Flaxseed Oil supplementation, Throughout the First 120 Days of Lactation.

Item	Treatments	
	Control (T1)	Treatment (T2)
Average daily mi lk yield (kg/day):		
Actual milk yield	15.38±0.8b	18.36±0.8a
4% fat corrected milk	13.91±0.7b	18.08±0.7a
Milk compositi on (%):		
Total solids	10.45±0.65b	11.13±0.65a
Fat	3.36±0.10b	3.90±0.10a
Protein	2.45±0.08a	2.49±0.08a
Lactose	4.04±0.09a	4.04±0.09a
Solids not fat	7.09±0.87a	7.23±0.87a
Somatic cell count (103/ml):	365.5±12.95a	254.6±12.95b

Cows treated with flaxseed oil diet improved (P≤0.05) daily milk production and 4% fat corrected milk of 19.37 and 29.99%, respectively, compared with control. The present results come in line with the findings of the higher milk yields being obtained by Petit *et al*., 2001; 2004 and Moallem (2009). Zachut *et al*. (2011) found that milk yield was 6.4% higher in flaxseed than in control and fat content was 0.4 unit lower in flaxseed cows than in control.

Iimmune response detected in Table (3) shows that flaxseed oil supplementation significantly (P<0.05) improved the immune response of treated cows. Treated cows showed significantly higher lymphocytes in control and significantly (P≤0.05) reduction of monocytes, as compared to the control. Alfa-linolinc acid is an essential flaxseed oil which immune response animal. Supply of flaxseed oil improves performance, health, and immune function. These results might optimize resistance to diseases by enhancing the lymphocytes population These changes in deferential leucocytes count may refer to improve the immune response in the body (Ndiweni and Finch,1995, and Abu El-Hamd *et al*., 2015).

Table 3. Immune Response and Concentration of Biochemical Parameters in Serum as Affected by Flaxseed Oil Supplementation, Throughout the First 120 Days of Lactation.

Item	Treatments	
	Control (T1)	Treatment (T2)
Lymphocytes (%)	63.56±b	69.62±1.95a
Monocytes (%)	13.68±a	10.46±1.05b
Granulocytes (%)	22.31±a	19.60±1.24a
Globulin (g/100 ml)	3.25±0.01b	3.67±0.01a
Total cholesterol (TCH, mg/dL)	170.4 ±3.12a	161.2 ±3.12b
High density lipoprotein (HDL,mg/dL)	67.19±3.80b	90.15±3.80a
Triglyceride (mg/dL)	27.35±0.85b	40.00±0.85a
Low density lipoprotein (LDL, mg/dL)	97.18±4.62a	63.05±4.62b

Data concerning the biochemical parameters in blood in Table (3) show that the concentrations of globulin of cows blood serum was significantly (P≤0.05) higher with adding flaxseed oil the ration, as compared to the control during the first 120 days of lactation. Flaxseed oil is essential polyunsaturated fatty acids deficiency. The data revealed that the concentration of TCH and LDL were significantly declined with flaxseed oil ration compared with these of control ration. Inversely trend between treatments was occurred in respect of HDL and triglyceride items these results came Ndiweni and Finch,1995, Mustafa *et al*., 2002; Petit, 2003 and Bianchi *et al*. 2014) .

Results in show cow oil (T2) medium (C4- C12) were in stated compared. Feeding flaxseed supplementation properties. It could be found that higher alfalinolinc acid by 187% in cows fed flaxseed oil than cows fed control, and that milk yields of dairy cows supplemented with linseed oil decreased while there was no negative effect on dairy cows supplemented with crude linseed or extruded linseed oil. The produced cows fed rations supplemented with linseed oil treatment (T2) contained higher DM, fat and Ash contents compared with the control while, protein and pH were coincidence Ambrose *et al*.2006, Martin *et al*. (2008), however Zhang *et al*. 2006 and Dhiman *et al*. (1999).

Table 4. Fatty Acids Composition of Milk Supplemented with Flaxseed Oil Throughout the First 120 Days of Lactation.

Fatty acids (g/100g F A)	Treatments	
	Control	Treatment
Butricacid (C4:0)	1.67	1.21
Caporic acid (C6:0)	1.19	1.09
Coprirlic acid (C8:0)	0.67	0.52
Capric acid (C10:0)	1.51	1.25
Luric acid (C12:0)	1.81	1.56
Myrsatic acid (c14:0)	7.98	6.84
Palmitic acid (C16:0)	28.55	23.1
Margaric acid (C17:0)	0.92	0.81
Stearic acid (C18:0)	8.12	10.2
Elaidic acid C18:1 (trans -9)	3.88	1.39
Oleic acid C18:1n-9	2.98	1.08
Linoelaidic C18:2 (trans 9-12)*	0.25	0.55
Linoleic C18:2(cis 9-12)*	2.04	1.97
α- Linolenic acid C18:3n3 (cis 6-9-12)**	0.26	1.22
y- Linolenic acid C18:3 n6 (cis 9-12-15)*	0.59	6.46
CLA cis9,trans11	1.55	23.45
CLA trans 9-11	0.12	0.32
Total CLA	1.67	23.77
C20:5n-3 EPA**	0.01	0.06
C22:4n-6*	0.02	0.04
Arachidonic C22:5n3**	0.03	0.06
C22:6n3 DHA**	0.01	0.07
*n6/n3**	7.83	0.37

Data present in Table (5) show that there is a slightly different in chemical composition of functional yoghurt between all treatments. Table (5) also show that Titratable acidity and pH value of functional yoghurt samples when fresh and during the storage period at 4°C +2 for 21 days. The data indicated that acidity increased and pH values decreased with increasing storage period in both treatments. The findings Mehanna and Gonc 1988) and (El-Shibiny *et al*. 2005). Also, the data showed that the pH value was decreased the two of linseed oil.

As with total bacterial count in Table (6), which lesser the treatment linseed (Kankaanpää *et al*. 2001). Moulds, Yeasts and Coliforms were not detected in both treatments

(Xu *et al*. 2008) Complete inhibition of F. gramineous by different concentrations of flaxseed flour. Moulds and yeasts have appeared after 14 days in the control and treatment.The presence of proteolysis bacteria in yoghurt could be due to the presence of starter culture of *Streptococcus thermophilus* and *L. casei.S thermophilus* contains two unique peptidases, oligopeptidase and amino peptidase, which have multiple functions in bacterial growth The dietary lipid influences the gastrointestinal microbiology and especially the population level of lactic acid bacteria. Higher concentrations of PUFA inhibited the growth and mucus adhesion of selected lactobacilli. Free PUFA in the growth medium induces changes in bacterial fatty acids in relation to the regulation of the degree of fatty acid unsaturation, cyclization, and proportions of CLA and PUFA containing 20 to 22 carbons. (Ringo *et al*. 1998, Fernandez *et al*. 1999, Kankaanpaa *et al*. (2001) and Kankaanpaa *et al*. (2004)

Table 5. Physic-Chemical Properties of Yoghurt made from Cows Milk Supplemented with Flaxseed Oil during Storage Period at 5°C for 14 Days.

Properties	Storage (days)	Treatments Control	Treatment	Mean
DM	1	12.88± 0.14	13.96± 0.14	13.42B
	7	13.31± 0.14	13.88± 0.14	13.59A
	14	13.01± 0.14	13.41± 0.14	13.21C
	Mean	13.07b	13.75a	
Fat	1	3.147±0.01	3.124±0.01	3.20AB
	7	3.193±0.01	3.170±0.01	3.22A
	14	3.163±0.01	3.140±0.01	3.19B
	Mean	3.17b	3.24a	
Protein	1	3.44±0.011	3.42±0.011	3.43B
	7	3.48±0.011	3.46±0.011	3.47A
	14	3.46±0.011	3.48±0.011	3.47A
	Mean	3.46a	3.45a	
Ash	1	0.86±0.012	0.94±0.012	0.90B
	7	0.88±0.012	0.97±0.012	0.92B
	14	0.92±0.012	1.03±0.012	0.98A
	Mean	0.89b	0.98 a	
PH	1	4.64 ±0.011	4.61±0.011	4.63
	7	4.54±0.011	4.67±0.011	4.50
	14	4.43±0.011	4.41±0.011	4.42
	Mean	4.54a	4.49a	

Table 6. Microbial Analysis of Yoghurt made from Cows Milk supplemented with Flaxseed Oil during Storage Period at 5°C for 14 Days.

Components	Storage (days)	Treatments Control	Treatment
total bacterial counts, (log cfu/g)	1	7.3±0.15	8.8±0.15
	7	7.8±0.15	7.7±0.15
	14	7.3±0.15	7.3±0.15
Viability of Lactobacilli	1	7.3±0.15	7.3±0.15
	7	6.267±0.15	6.267±0.15
	14	6.400±0.15	6.400±0.15
Coliform	1	ND*	ND
	7	ND	ND
	14	ND	ND
Yeasts and moulds	1	ND	ND
	7	ND	ND
	14	1	1

* ND**: Not detected**

Table (7) shows that yoghurt made from milk obtained from cows fed control diet and yoghurt made from milk obtained from lactating cows fed linseed oil contained slightly higher amounts of C18:1 trans-9 in control than treatment. It could also, be seen from table 4 that all treatments of functional yoghurt made from milk obtained from cows fed of linseed oil significantly increased the total concentrations of CLA and omega-3 fatty acids than the milk obtained from cows fed a control diet .These results could be due to the high amount of α - linolenic acid (50.51%) and omega-3 fatty acids (46.51%) in the linseed oil. These results agree with those of Kholif *et al*., (2016) who found that increasing of the past few years, and among all oilseeds, flaxseed is preferred as it has the highest proportion of n-3 α-linolenic acid constituting 54.4 ± 4.7 g/100 g of total fatty acids.

Table 7. Fatty Acid of Yoghurt (g/100g FA) Made from Cows Milk Supplemented with Flaxseed Oil during Storage at 5°C After one Day

Fatty acids (g/100g F A)	Treatments Control	Treatment
C18:1 (trans -9) Elidonic acid	3.18	1.26
C18:1(cis-9) Oleic acid	2.91	1.18
C18:2(trans 9-12)	0.35	2.38
C18:2(cis 9-12)	2.14	1.86
C18:3(cis6-9-12) Linoleic acid (n6)	0.34	1.48
C18:3 (cis 9-12-15) α- Linoleic acid (n3)	0.65	6.89
CLA cis9,trans11	0.84	24.99
CLA trans9-11	0.33	0.29
Total CLA	1.17	25.18
n6/n3	0.52	0.21

Yoghurt made from milk obtained cows fed linseed decrease value of omega-6/omega-3 ratio was 0.21g /100g FA while, highest n-6/n-3 ratio found in the control yoghurt (0.52), this could be due to the low ratio of n-6/n-3 in linseed (0.321:1). Abeer , *et al.* (2018) feeding cows with whole linseed, linseed oil or linseed meal represents a successful strategy for improving the fatty acids profile of functional yoghurt as dairy products, through an increase of omega 3 fatty acids and decreases the value of omega-6/omega-3 ratio (n-6/n-3 ratio) in milk and both treatments.

Organoleptic properties of yoghurt samples are given in Table (8). Shows the body and texture of control and treatment were the highest when fresh, but body and texture of all treatments decreased with increasing the storage period. Highest appearance score recorded when fresh and during storage period. Appearance tended to decrease with storage. A total score of yoghurt of both treatments decreased with increasing storage period.

Table 8. Organoleptic Properties of Yoghurt Made from Milk Cows Flaxseed Oil Supplementation during Storage at 5°C.

Treatments	Storage (days)	Properties Flavour (50)	Consistence (40)	Appearance (10)	Total (100)
Control	1	43.67	28.00	6.67	78.33B
	7	46.00	31.00	7.00	84.00B
	14	41.00	29.00	6.33	76.33B
	Mean	43.56	29.33	6.67	79.56 B
Treatment	1	46.67	32.00	6.67	85.67A
	7	48.00	35.00	7.00	90.67A
	14	44.00	37.00	6.33	87.33
	Mean	46.22	34.67	6.67	87.89A

CONCLUSION

Linseed oil which known to increase concentrations of polyunsaturated fatty acid, this can be used as a nutritional strategy to reduce concentrations of saturated fatty acids and

Increase concentrations of (omega 3) fatty acids also increase the acceptability of milk and yoghurt. Further studies are required to improve the acceptability of dairy products (feed linseed oil supplementation to cows).

REFERENCES

Abeer E. A. Amer1, Shahera M. El-Ganini2 and M.A. Tag El-din,(2018).Effect of Omega 3 fatty acids from cow's milk obtained from cows fed different rations of flaxseed on functional yoghurt properties.Middle East Journal of AppliedSciences, 8 : 523-542

AOAC.,(1998). Association of Official Analytical Chemists, Official methods of analysis 16th vol. (2), Arlington, VA. USA.

Abu El-Hamd, M.A.; Y.M. El-Diahy, M.M. El-Maghraby and M.A. Elshora (2015). Effect of flaxseed oil on digestibility, blood parameters, immuno-response and productive performance of suckling Friesian calves.

Ambrose, D.; J.P. Kastelic; R. Corbett; P.A. Pitney; H.V. Petit; Small and P. Zalkovic (2006). Lower pregnancy losses in lactating dairy cows fed a diet enriched in alphalinolenic acid. J. Dairy Sci., 89: 3066-3074.

Bibiana,I. Joseph,S. and Julius,A. (2014). Physicochemical, microbiological and sensory evaluation of yoghurt sold in Makurdi metropolis. Afri. J. Food Sci. and Technol. 5: 129-135.

Bahagat, K. W., (2010). Utilization of Some Functional Foods for Lowering Blood Lipids. Ph .D.Thesis. Faculty of Agriculture, Ain Shams University, Shobra El-Khema, Egypt.

Bianchi, A.E.; V.P. Macedo; R.T. France; S.T. Lopes; L.M. Stefani; A. Volpato; L. Lima; D. Paiano; G. Machudo and S. Dasilva (2014). Effect of adding palm oil to the diet of dairy sheep on milk production and composition, function of liver and kidney, and the concentration of cholesterol, triglycerides and progesterone in blood serum. Small Ruminants Res.,117:78-83.

Breslow, J. L., (2006). N-3 fatty acids and cardiovascular disease. Am. J. Clin. Nutr. , 83 Suppl: 1477- 1482.

Chen, G. and J.B. Russell (1989). More monensin-sensitive, ammonia producing bacteria from the rumen. Applied and Environmental Microbiology, 55:1052-1057.

DeClercq, D.R.(2006). Quality of western Canadian flaxseed 2006. Canadian Grain Commission. www. grainscanada.gc.ca

Dhiman, T. R., E. D. Helmink, D. J. McMahon, R. L. Fife and M. W. Pariza, (1999). Conjugated linoleic acid content of milk and cheese from cows fed extruded oilseeds. J. Dairy Sci.82:412 419.

Drouillard, J.S.; E.J. Good; C.M. Gordon; T.J. Kessen; M.J Sulpizio,; S.P. Montgomery and J.J. Sindt (2002). Flaxseed and flaxseed products for cattle: Effects on health, growth performance, carcass quality and sensory attributes. Proc. 59th Flax Institute, March 21-23, 2002, Fargo, N.D. pp 72-87.

Duncan, D. B., 1955. Multiple range and multiple F- tests. Biometrics, 11: 1-42.

El-Shibiny, S. Metwally, M.M. S. Abd El-Gani, A.M. Abd El-Fattah and A.Y.M. Okda, (2005). Manufacture of probiotic products from ultrafiltration milk retentate. Egyptian J. of Dairy Sci., 33: 215-277.

Fernandez-Espla, Dolores, M. and R. Françoise, (1999). FEBS PepS from Streptococcus thermophilus: A new member of the aminopeptidase T family of the rmophilic bacteria. Eurn. J. Biochem., 263:502- 510.

Fortes, C.; N. Agabiti; V. Fano; R. Pacifici; F. Forastiere; F. Virgili; P. Zuccaro; C.A. Perruci and S. Ebrahim (1997). Zinc supplementation and plasma lipid peroxides in an elderly population. European J. Clinical Nutrition 51, 97–101.

Gebauer, S. K., Psota ,T. L., Harris, W. S., Kris-Etherton, P. M. (2006). N-3 Fatty acid dietary recommendations and food sources to achieve essentiality and cardiovascular benefits. Am J. ClinNutr. 83:1526S-1535S.

Gornall, A.G.; G.J. Bardawill; G.J. and M.M. Daved, (1949). J. Biol. Chem. 177: 751. C. F. Hartmann and Lascelles.

Kankaanpää, P. E., Salminen, S. J., Isolauri, E. and Lee, Y. K. (2001). The influence of polyunsaturated fatty acids on probiotic growth and adhesion. FEMS Microbiol. Letters 194: 149-153.

Kankaanpaa, P., B. Yang, H. Kallio, E. Isolauri, and S. Salminen, 2004. Effects of polyunsaturated fatty acids in growth medium on lipid composition and on physicochemical surface properties of lactobacilli. Appl. Environ. Microbiol., 70: 129-136.

Kholif, AE *et al*. (2016). Effect of supplementing diets of Anglo-Nubian goats with soybean and flaxseed oils on lactational performance. Journal of Agricultural and Food Chemistry, 64 (3)6163-6170.

Kholif, S. M., T. A. Morsy, A. A. Abedo, N. El-Bordeny and M. M., Abdo, (2011). Milk production and composition, milk fatty acid profile, nutrients digestibility and blood composition of dairy buffaloes fed crushed flaxseed in early lactation. Egy. J. Nutri. Feeds, (in press).

Maddock, T.D.; M.L. Bauer; K. Koch; V.L. Anderson; R.J. Maddock and G.P. Lardy (2004). The effect of processing flax in beef feedlot rations on performance, carcass characteristics and trained sensory panel ratings. Proc. 60th Flax Institute, March 17-19, 2004, Fargo, N.D. pp 118-123.

Marona D, PedrigonG (2004). Yoghurt feeding inhibits promotion and progression of cancer. Med SciMonit, 10: 96 104.

Martin, C.; J. Rouel; J.P. Jouany; M. Doreau and Y. Chilliard(2008). Methane output and diet digestibility in response to feeding dairy cows crude linseed, extruded linseed, or linseed oil. J. Anim. Sci., 86: 2642-2650.

Mehanna, N. M. and S. Gonc, (1988). Manufacture of yoghurt from milk fortified with whey powder.Egyptian J. of Dairy Sci., 18: 425-431.

Moallem, U. (2009). The effects of extruded flaxseed supplementation to high-yielding dairy cows on milk production and milk fatty acid composition. Anim. Feed. Sci. Technol., 152, 232–242.

Mervat I. Foda, S. M. Kholif, SaharH. S. Mohamed and T. A.Morsy (2012).Evaluation of Ground Flaxseed Supplementation to Lactating Buffaloes Ration versus Control Milk Samples formilk and Stirred Y oghurt Production. J Life Sci, 4(1): 11-18.

Mustafa, A.F., P.Y. Chouinard, and D. A. Christensen, (2003). Effects of feeding micronisedflaxseedon yield and composition of milk from Holstein cows. J. Sci. Food Agric., 83: 920- 926.

Mustafa, A.F.; J.J. McKinnon; D.A. Christensen and T. He (2002). Effects of micronization of flaxseed on nutrient disappearance in the gastrointestinal tract of steers. Anim. Feed Sci. Technol., 95: 123-132.

Nelson, J.A. and Trout, G.M. (1981). Judging of Dairy Products, 4th Ed. INC Westport, Academic Press, 345-567.

Ndiweni, N. and J.M. Finch (1995). Effect of in vitro supplementation of bovine mammary gland macrophages and peripheral blood lymphocytes with α-tocopherol and sodium selenite: Implications for udder defenses. Vet. Immuonl. Immunopathol., 47:111-121.

Oba, M. G., T. M. Dehghan-banadaky and D. J. Ambrose, 2009. Unprocessed whole flaxseed is as effective as dry-rolled flaxseed at increasing a-linolenic acid concentration in milk of dairy cows. Livest. Sci., 122: 73-76.

Petit, H.V., 2003. Digestion, milk production, milk composition, and blood composition of dairy cows fed formaldehyde treated flaxseed or sunflower seed. J. Dairy Sci. 86: 2637-2646.

Petit, H.V.; R.J. Dewhurst; J.G. Proulx; M. Khalid; W.Haresign and H. Twagiramungu (2001). Milk production, milk composition and reproductive function of dairy cows fed different fats. Can. J. Anim. Sci., 81: 263-271.

Petit, H.V.; C. Germiquet and D. Lebel (2004). Effect of feeding whole, unprocessed sunflower seeds and flaxseeds on milk production, milk composition and prostaglandin secretion in dairy cows. J. Dairy Sci., 87:3889-3898.

Ringø, E., H. R. Bendiksen, S. J. Gausen, A. Sundsfjord and R. E. Olsen, (1998). The effect of dietaryfatty acids on lactic acid bacteria associated with the epithelial mucosa and from faecalia of Arctic charr, Salvelinusalpinus (L.). J. Appl. Microbiol., 85: 855-864.

SAS, 1999. User's Guide Statistics. Version 8.1 Edition.SAS Inst. Inc. Cary, NC.

Wichselarm, T.E. (1946). Method for determination of albumin in serum blood. Amer. J. Clin. Pathol ., 16:40.

Xu, Y., Hall, C., and Wolf-Hall, C. (2008). Fungistatic activity of heat-treated flaxseed determined by response surface methodology. J. Food Sci. 73: 250-256.

Zachut, M.; A. Arieli and U. Moallem (2011). Incorporation of dietary n-3 fatty acids into ovarian compartments in dairy cows and the effects on hormonal and behavioral patterns around estrus. Reprod., 141: 833–840..

Zhang, R., A. F. Mustafa and X. Zhao, (2006). Effects of flaxseed supplementation to lactating ewes on milk composition, cheese yield, and fatty acid composition of milk and cheese. Small Rum Res., 63: 233–241.

Zhang, W., X. Wang, Y. Liu, H. Tian, B. Flickinger, M.W. Empie, and S.Z. Sun, (2008). Dietary flaxseed lignan extract lowers plasma cholesterol and glucose concentrations: Hypercholesterolaemic subjects. Brit. J. Nutr., 99: 1301- 1309. effects of a-linolenic acid rich flaxseed oil on growth p.

تأثير إضافة زيت بذور الكتان فى تغذية ابقار اللبن الفرزيان على الأحماض الدهنية والتركيب الكيماوى للبن والخواص الفيزوكيماوية لليوجورت

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تهدف هذه الدراسة إلى تقييم تأثير إضافة زيت بذور الكتان على الأبقار الفريزيان على إنتاجيتها ، ومقاييس الدم ، وتكوين الأحماض الدهنية للحليب ، والخصائص الفيزيائية والكيميائية للزبادي. تم تقسيم 24 بقرة فريزيان بمعدل 607 ± 22.5 كجم من وزن الجسم الحي بشكل عشوائي إلى مجموعتين (12 بقرة في كل مجموعة). تم استخدام الأبقار في المجموعة الأولى (T1) كمجموعة كنترول ، بينما عولجت الأبقار في المجموعة (T2) الثانية بنسبة 2 ٪ من تناول زيت بذور الكتان DM حتى 120 يومًا بعد الولادة. زاد متوسط تناول المادة الجافة اليومية DM و TDN معنوياً (P≤0.05) بزيت بذور الكتان ، مقارنةً بالكنترول. كان تناول DCP والبروتين ومحتويات المواد الصلبة غير الدهنية متشابهة تقريبًا في كلا المعاملتين . كانت تراكيز البروتين الدهني عالي الكثافة والدهون الثلاثية ومحتويات الدهن واللاكتوز والمواد الصلبة الكلية أعلى معنويا (P <0.05) في T2 من (T1). كان إنتاج الحليب اليومي والحليب المصحح 4٪ دسم أعلى معنوياً بمقدار 18.08 في T2 و 13.91٪ في T1 على التوالي. كانت المعاملة (T2) بكميات أقل قليلاً من الأحماض الدهنية الصغيرة والمتوسطة السلسلة (C4- C10) ، بينما كانت (C12-C16) أعلى قليلاً في الكنترول. كان كل من DM والدهون والرماد وحموضة اللبن الزبادي أعلى معنويا (P≤0.05) في المعاملة T2 ، بينما كان الرقم الهيدروجيني متماثلا في كلا المعاملتين. تم احتواء المعاملة (T1) على عدد بكتيري إجمالي أقل من المعاملة (T2). لم يتم اكتشاف الخمائر والقولون في جميع العلاجات. احتوت المعاملة (T2) على انخفاض قيمة نسبة أوميغا 6 / أوميغا 3. يمكن الاستنتاج أن زيت بذور الكتان يحسن الهضم ، ويزيد من تراكيز الأحماض الدهنية المتعددة غير المشبعة ، ويقلل من تركيز الأحماض الدهنية المشبعة ، ويزيد من (أوميغا 3) في اللبن و الزبادي.