J. Animal and Poultry Prod., Mansoura Univ., Vol. 6 (12): 755 - 765, 2015

EFFECT OF FLAXSEED OIL ON DIGESTIBILITY, BLOOD PARAMETERS, IMMUNO-RESPONSE AND PRODUCTIVE PERFORMANCE OF SUCKLING FRIESIAN CALVES

Abu El-Hamd,M.A.;Y.M.El-Diahy; M.M.El-Maghraby and M.A. Elshora

Animal Production Research Institute, Agricultural Research Center, Giza, Egypt.

ABSTRACT

Aim of this study was to investigate the effect of flaxseed oil supplementation on the digestion, immunoglobulin concentration, some blood parameters, average daily gain, feed conversion and economic efficiency of suckling Friesian calves. A total of 28 newly born Friesian calves with weighing 31.42±1.9 kg were divided into two similar groups, 14 calves in each group. The first group (G1) was served as a control, while the second group (G2) was supplemented with 0.2 ml/kg LBW from flaxseed oil in suckling milk from birth up to weaning. Results showed that digestibility coefficients of DM, OM, CP, CF, EE and NFE and feeding values as TDN and DCP as well as feed intakes as TDN and DCP were higher (P<0.05) in G2 than in G1. Blood plasma immunoglobulins concentrations were higher (P<0.05) during different suckling intervalsin G2 than in G1. Red and white blood cells count, percentages of monocytes, neutrophils and package cell volume, and haemoglobin concentration increased (P<0.01) in G2 than in G1. Percentages of basophils, eosinophils and lymphocytes were not affected by supplementation. Concentration of total protein, albumin and globulin in plasma were increased (P<0.05-P<0.01), while, albumin to globulin ratio and concentration of total lipids, creatinine and urea-N concentrations decreased (P<0.01) in G2 than in G1. Plasma glucose concentrations and AST and ALT activities were nearly similar in both groups. Live body weight, average daily gain and feed conversion improved (P<0.001) in G2 than in G1. Economic efficiency was higher (P<0.05) in G2 than in G1.

It could be concluded that flaxseed oil supplementation in milk of suckling Friesian calves (0.2 ml/kg LBW) during the suckling period improved growth performance and economic efficiencies as well as immune-response of Friesian calves without adversity effects on digestibility, haematological and biochemical parameters.

Keywords: Calves, Omega-3 fatty acids, immunity, gain, blood, economic efficiency.

INTRODUCTION

Interest of medicinal plants has burgeoned due to increased efficacy of new plant-derived drugs and the growing interest in natural products. Because of the concerns about the side effects of conventional medicine, the use of natural products as an alternative to conventional treatment in prevention and treatment of various diseases has been on the rise in the last few decades. Large numbers of these plants and their isolated constituents have shown beneficial therapeutic effects, including anti-oxidant, anti-inflammatory, anti-cancer, anti-microbial, anti-parasitic and immune-modulatory effects (Abd El-Hafeez *et al*., 2014).

Omega-3 fatty acids are known to be able to decrease the risks of cardiovascular diseases, hypertension and arthritis as well as having

important impacts on the development of the nervous system (Parodi, 1997; Sinclair *et* al., 2002). Flaxseed oil is an excellent source of α- linolenic acid, a member of the omega-3 fatty acids (Sinclair *et al.,* 2002). The fraction of flaxseed oil is approximately 0.55 omega-3α-linolenicacid (Mustafa *et al.,* 2002). It is essential fatty acid that is not synthesized in humans (Petit and Cortes, 2010) and also known to increase concentration of polyunsaturated fatty acids in milk, but usually they do not exceed 3 to 4% of total fatty acids (Kennelly, 1996). Alpha linolenic acid (ALA), an essential omega-3 fatty acid that is a precursor for eicosapentaenoic acid (EPA), which in turn is a precursor for the formation of eicosanoids. Eicosanoids are hormone-like compounds that play an essential role in immune response. Additionally, some evidence suggests EPA can elongate further to docosahexanoic acid (DHA), an omega-3 fatty acid that is essential for cell membrane integrity, as well as brain and eye health (Conners, 2000).

It was reported that immunoglobulin concentration ranged from 2719 to 8850 mg/dL in colostrums of Holstein cows (Vaz *et al*., 2004), while immunoglobulin G (IgG) concentration in bovine colostrum collected in the first milking of Holstein cows was 1540 mg/dL (Soares Filho *et al*., 2001). Immunoglobulin G1 is transferred to colostrum from blood (Barrington *et al*., 1997). Bovine IgG is distributed between two subclasses, IgG1 and IgG2 (Larson *et al*., 1979).

Objective of this study was to investigate the effects of flaxseed oil (FSO) supplementation on the digestibility, immunoglobulin concentration, some blood parameters, average daily gain, feed conversion and economic efficiency of suckling calves during suckling period (105 days).

MATERIALS AND METHODS

The current work was carried out at Sakha Animal Production Research Station, Animal Production Research Institute, Agricultural Research Center.

Animals and treatments:

A total of 28 Newly born suckling Friesian calves with average live body weight (LBW) of 31.42±1.9 kg was divided into two similar groups (14 calves in each group) . Calves in the two groups were suckled their dam colostrum for three days. Then, all calves were fed on whole milk, starter and fresh berseem according to the recommended requirements of Animal Production Research Institute (1997) as shown in Table (1).

Calves in the 1st group were unsupplemented and served as a control (G1), while those in the 2nd one were supplemented with flaxseed oil (0.2 ml flaxseed oil/kg LBW) in the milk of morning suckling during the whole suckling period. Chemical analysis of representative biweekly samples of feedstuffs were analyzed for CP, CF, EE, (NFE) and ash on DM basis according to the official methods of the AOAC (2000). Chemical composition of feedstuffs is presented in Table (2).

Experimental procedures:

Calves were artificially fed whole milk in plastic bucket twice daily at 7 a.m. and 6 p.m. during the experimental period. From the beginning of the

third week, calves were given the starter once daily at 9 a.m. and fresh berseem at 11 a.m. Water was available all the day round.

Table (1): Daily amounts of feedstuffs (kg/head) fed to calves during suckling period.

Feedstuff (kg/h)	Age (week)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Whole milk	3.5	4.0	4.5	5.0	5.5	6.0	5.5	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0
Starter*	-		0.25		0.50		0.75		1.00		1.25		1.50		1.75
Fresh berseem	-		1.0		1.5		2.0		2.5		3.0		4.0		5.0

*** Starter consisted of 15% soybean meal, 10% linseed cake, 34% ground yellow corn grain, 20% wheat bran, 15% rice bran, 3% molasses, 2% limestone and 1% common salt.**

Table 2: Chemical analysis of feed stuffs (% on dry matter basis).

Item	Starter	Whole milk	Fresh berseem
Dry matter, DM	91.58	12.80	16.58
Organic matter, OM	90.68	94.46	88.19
Crude protein, CP	17.43	24.71	14.32
Crude fiber, CF	5.96	0.00	24.67
Ether extract, EE	4.91	30.50	6.04
Nitrogen free extract	62.38	39.25	43.16
Ash	9.32	5.54	11.81

Live body weight and fee intake from whole milk, starter, fresh berseem were determined for each calf every week, then average daily gain was calculated. Also, feed conversion was calculated as the amounts of dry matter intake (DMI), crud protein intake (CPI) and total digestible nutrients intake (TDNI) required per 1 kg live weight gain.

Digestibility trial:

Digestibility trial was conducted at the last week of suckling period using 6 calves (3 from each group) to determine nutrients digestibility coefficients and nutritive values using acid insoluble ash as a natural marker (Van Keulen and Young, 1977). Feces samples were taken from the rectum of each calf twice daily with 12 hours interval for consecutive five days. The samples of starter, fresh berseem and feces were composted and representative samples were dried in a forced air oven at 65 ^{o}C for 48 hours, ground and analyzed according to AOAC (2000). Whole milk samples were analyzed using Milko-Scan (133 B Foss Electric).

Blood sampling:

Blood samples were collected from all calves biweekly for immune-globulins determination and at the end of suckling period for haematological and plasma parameters. Blood samples (5 ml) were collected at morning before feeding and drinking from jugular vein using heparinized vacutainer tubes. Blood samples were centrifuged at 4000 rpm for 15 minutes and plasma were carefully separated and stored at -20 ^{o}C until analysis.

Haematological parameters including count of red blood cells (RBCs), white blood cells (WBCs), packed cell volume (PCV%), and hemoglobin (Hb) concentration were determined in fresh whole blood using fully digital haematology counter (Laboratories, USA).

Determination of levels of immune-globulins (IgG) in blood plasma was done by bovine IgG (ELISA kits) according to the procedure outlined by manufacturer (Alpha Diagnostic International, Texas, USA and Kamiya Biomedical Company, Seattle, Washington, USA, respectively).

Concentration of total proteins, albumin, urea-N, creatinine and glucose in blood plasma were determined using commercial kits (Diagnostic System Laboratories, Inc., USA). Plasma globulin was calculated by subtracting concentration of albumin from total proteins.

Economic efficiency:

Economic efficiency expressed as average daily feed cost, feed cost/ kg gain, the price of average daily gain (ADG) and economic efficiency as the ratio between the price of ADG and average daily feed cost were calculated according to the prices of 2015.

Statistical analysis:

Statistical analyses of the obtained data were carried out applying the package of SAS (2004) according to the following models: ***Yij = μ + Hi + ei,*** Where: Yij =the studied dependent variable, μ = the overall mean, Hi = the effect of treatment (i, 1 & 2) and eij = random residual effect.

RESULTS AND DISCUSSION

Nutrients digestibility and nutritive values:

Nutrients digestibility coefficients and nutritive values were significantly improved with flaxseed oil supplementation (G2) as compare to control (G1) (Table 3). This may be attributed to flaxseed oil that enhanced nutrients digestibility. The digestibility coefficients of DM, OM, CP, CF, EE and NFE in flaxseed oil treated group increased by 10.04, 9.38, 8.29, 9.71, 7.18 and 6.76% as compared to the control group, respectively. The corresponding increase in TDN and DCP values were 8.10 and 6.36%, respectively. Similar results were obtained by Khattab *et al*. (2011), when buffalo calves were fed on black seed oil.

Table (3): Effect of flaxseed oil on nutrients digestibility coefficients and nutritive values.

Item	G1 (Control)	G2 (Flaxseed oil)	Significance	Change (%)
DM	59.64±0.50	65.63±1.49	**	10.04
OM	61.62±0.74	67.40±1.06	**	9.38
CP	64.83±2.05	69.72±1.03	**	8.29
CF	47.47±1.32	52.08±0.86	**	9.71
EE	71.91±0.39	77.07±0.74	**	7.18
NFE	63.33±1.04	67.61±1.10	*	6.76
TDN	68.61±0.52	74.17±0.56	**	8.10
DCP	12.11±0.38	12.88±0.19	*	6.36

*** Significant at P<0.05. ** Significant at P<0.01.**

Also, Mohsen *et al*. (2011) reported that the digestibility of DM, OM, CP and EE, and the TDN and DCP values of goats increased by feeding sunflower seeds.

Growth performance:

Live body weight and average daily gain:

Data in Table (4) showed that effect of flaxseed oil on live body weight (LBW) and average daily gain (ADG) was significant. Live body weight of calves in G2 significantly increased by 13.54% (P<0.05) at 5 weeks, 17.51 and 17.16% (P<0.01) at 10 and 15 weeks compared with those in G1, respectively. Also, ADG during different suckling intervals was significantly higher in G2 than in G1 (Table 4). ADG increased by 35.85, 27.59, 16.05 and 25.00% during the intervals 0-5, 6-10, 11-15 and 0-15 weeks, respectively. These results agreed with those obtained by Khattab *et al*. (2011), who found that buffalo calves fed on black seed oil diet grew faster than those fed on control diet. Also, Maddock *et al*. (2004) found that feeding beef cattle on whole (rolled or ground) flaxseed (8% of diet DM) significantly increased gain and gain efficiency.

Table (4): Live body weight and average daily gain of calves in the experimental groups.

Age (week)	G1 (Control)	G2 (Flaxseed oil)	Significance	Change (%)
Live body weight (kg):				
At birth	31.32±1.6	31.52±2.3	NS	0.64
5	49.85±1.8	56.60±1.9	*	13.54
10	70.26±4.5	82.56±5.6	**	17.51
15	98.5±5.1	115.4±4.9	**	17.16
Average daily gain (Kg):				
Birth ~ 5	0.53±0.058	0.72±0.052	***	35.85
6 ~ 10	0.58±0.039	0.74±0.045	***	27.59
11 ~ 15	0.81±0.034	0.94±0.025	**	16.05
Birth ~ 15	0.64±0.027	0.80±0.034	***	25.00

NS not significant, * Significant at P<0.05. ** Significant at P<0.01.

Feed intake:

Average daily feed intake by suckling Friesian calves are shown in Table (5). Total DM intake was nearly similar for the two groups, while TDN and DCP intakes were significantly (P<0.01) higher in G2 than in G1. Intake from TDN and DCP increased by 9.17 and 9.52% in G2 compared with G1. The increase of TDN and DCP intakes was attributed to the higher TDN and DCP values (Table 3). These results agreed with those obtained by Mohsen *et al*. (2011), who found that DM intake increased by feeding whole sunflower seeds supplementation.

Table (5): Average daily feed intake (kg/head/day) of calves in the experimental groups.

Item	Control (G1)	Flaxseed oil (G2)	Sig.	Change (%)
Whole milk (kg/h)	3.73	3.73	-	-
Starter (kg/h)	0.94	0.94	-	-
Fresh berseem (kg/h)	2.54	2.54	-	-
TDMI (kg)	1.75±0.06	1.77±0.08	NS	1.14
TDNI	1.20±0.04	1.31±0.07	**	9.17
DCPI	0.21±0.007	0.23±0.005	**	9.52

NS: Not significant. ** Significant at P<0.01.

Feed conversion:

Results in Table (6) revealed that FSO supplementation significantly improved feed conversion of suckling calves as amount (kg) of DM, TDN and DCP required per kg gain compared with control group.

The amount of DM, TDN and DCP decreased (P<0.01; P<0.05; P<0.05) by 19.05, 12.77 and 12.12% for G2 compared with G1.These results are attributed to improving ADG rather than decreasing feed intakes in G2 (Table 5). These results agreed with those obtained by Khattab *et al*. (2011), who found that feed conversion values of buffalo calves were significantly better for groups supplemented by black seed oil than the other groups.

Table (6): Feed conversion of calves in the experimental groups.

Item	Control(G1)	Flaxseed oil (G2)	Significance	Change (%)
Feed conversion:				
DM	2.73±0.09	2.21±0.11	**	-19.05
TDN	1.88±0.06	1.64±0.09	*	-12.77
DCP	0.33±0.01	0.29±0.01	*	-12.12

*** Significant at P<0.05. ** Significant at P<0.01.**

Concentration of total immune-globulins (Ig, mg/ml) in blood plasma:

Results shown in Table (7) revealed that plasma immunoglobulins concentrations at different ages of the suckling period were significantly higher in G2 than in G1. Total immunoglobulins concentrations in plasma of calves in G2 increased at a range from 10.22 to 18.30% as compared to G1. In addition, plasma immunoglobulins concentrations increased gradually with advancing age from birth up to weaning in both groups.

The present results are in agreement with those reported by Jezek *et al*. (2009), who found that concentration of IgG decreased after birth up to the 3rd weeks of age and increased from 12 to 20 weeks of age, thereafter. Also, Mohammadi *et al*. (2014) found that cows fed extruded linseed had higher IgG, being 8.57, 9.20 and 9.78 g/ml in days 1, 7 and 14, respectively. Moreover, Farren *et al*. (2002) found that flax-fed steers had significantly higher levels of haptoglobin in blood as a positive indicator of immune response compared with control steers.

Table (7): Concentration of total immune-globulins (Ig, mg/ml) in blood plasma of calves in the experimental groups.

Age (week)	Control (G1)	Flaxseed oil (G2)	Significance	Change (%)
1	24.42±0.99	27.95±1.11	*	14.46
3	26.25±1.15	30.54±1.12	**	16.34
5	29.45±0.98	32.56±0.92	**	10.22
7	32.23±1.14	36.12±0.96	**	12.07
9	33.45±1.19	37.58±1.20	*	12.35
11	35.57±1.21	39.57±1.13	***	18.30
13	37.89±1.31	42.65±1.27	**	12.56
15	39.35±0.96	44.82±0.87	*	13.90

*** Significantly at P<0.05. ** Significant at P<0.01. *** Significant at P<0.001.**

It was reported that, the immune system of newly born calves is not able to respond at the level of adult animals and they are more susceptible to infection in this period. It is essential they get colostrum soon after birth to effectively absorb colostral immunoglobulin G (Rajala and Castren, 1995). The generally accepted serum limit of the IgG should be at least 10 g/L within 24-48 h postpartum (Besser *et al*., 1991). In relation with the immune-response, some authors found that supplementing milk with omega-3 PUFA may provide a more appropriate inflammatory response in calves (Ballou, 2012; Frei *et al*., 2012).

Haematological parameters:

Results of haematological parameters presented in Table (8) revealed significantly higher values of red (RBCs) and white (WBCs) blood cells counts, monocytes percentage (P<0.001), PCV value (P<0.01), haemoglobin (Hb) concentration and neutrophils percentage (P<0.05) in G2 than in G1. However, percentages of basophils, eosinophils and lymphocytes were not affected by flaxseed oil supplementation. Counts of RBCs and WBCs and percentages of neutrophils and monocytes increased in G2 compared with G1 by 15.41, 24.06, 6.18 and 12.85 %, respectively. The corresponding increase in PCV value and Hb concentration were 16.52 and 18.66%, respectively. The observed improvements of haematological traits observed in calves fed flaxseed oil may be due to improvement in immune system responsiveness.

Biochemical parameters:

Data presented in Table (9) showed that the concentration of total proteins (TP), albumin (AL) and globulin (GL) in blood plasma of calves were significantly (P<0.01) higher in G2 than in G1 by 16.91, 13.26 and 20.20%, respectively. However, AL/GL ratio and concentration of total lipids, creatinine and urea-N were significantly lower (P<0.01) in G2 than in G1 by 14.43, 15.67, 18.89 and 12.72%, respectively. Yet, plasma glucose concentrations and AST and ALT activities were nearly similar in both groups. The present values of plasma total protein are within the normal range and in good

agreement with those obtained by several investigators (Al-Kudsi *et al.,* 2008; Lee *et al.,* 2008) on calves.

Table(8): Haematological parameters in blood of calves in the experimental groups.

Item	Control (G1)	Flaxseed oil (G2)	Sig.	Change (%)
Red blood cells ($\times 10^6/mm^3$)	8.24±0.27	9.51±0.32	***	15.41
Package cell volume (%)	29.85±1.45	34.78±1.16	**	16.52
Haemoglobin (g/dL)	10.02±0.54	11.89±0.61	**	18.66
WBCs ($\times 10^3/mm^3$)	9.564±0.36	11.865±0.42	**	24.06
Neutrophils (%)	41.58±1.7	44.15±1.8	*	6.18
Basophils (%)	0.29±0.06	0.27±0.06	NS	3.85
Eosinophils (%)	2.15±0.23	2.08±0.35	NS	1.46
Lymphocytes (%)	52.79±2.8	49.90±2.3	NS	3.78
Monocytes (%)	3.19±0.31	3.60±0.41	***	12.85

NS: Not Significant. * Significant at P<0.05. ** Significant at P<0.01. * Significant at P<0.001.**

Table (9): Biochemical parameters in blood plasma of calves.

Item	Control (G1)	Flaxseed oil (G2)	Sig.	Change (%)
Total protein (g/dl)	7.63±0.32	8.92±0.35	**	16.91
Albumin (g/dl)	3.62±0.34	4.10±0.27	**	13.26
Globulin (g/dl)	4.01±0.26	4.82±0.23	**	20.20
A:G ratio	0.97±0.38	0.83±0.23	**	-14.43
Total lipids (mg/dl)	221.5±12.5	186.8±11.8	**	-15.67
Glucose (mg/dl)	68.53±4.37	70.88±6.50	NS	3.43
Creatinine (mg/dl)	1.79±0.06	1.45±0.07	**	-18.99
Urea-N (mg/dl)	28.78±1.10	25.12±1.20	**	-12.72
AST (U/L)	51.56±7.29	53.12±7.29	NS	3.03
ALT (U/L)	24.38±5.55	23.79±3.79	NS	-2.42

NS: Not Significant. ** Significant at P<0.01.

Economic efficiency:

Data in Table (10) showed that average daily feed cost was nearly similar for the two groups. The return of daily gain and economic efficiency were significantly (P<0.05) higher in G2 than in G1 by 25.00 and 22.75%, respectively. However, feed cost per kg gain was significantly (P<0.05) lower in G2 than in G1 by 18.49%. These results agreed with those obtained by Mohsen *et al*. (2011), by using whole sunflower seeds supplementation in goats.

Table (10): Economic efficiency of calves in the experimental groups.

Item	Control (G1)	Flaxseed oil (G2)	Sign.
Feed conversion (kg/kg gain)			
DM	2.73±0.09	2.21±0.11	**
TDN	1.88±0.06	1.64±0.09	*
DCP	0.33±0.01	0.29±0.01	*
Economic efficiency			
Daily feed cost (LE)	12.43	12.66	NS
Return of daily gain (LE)	26.24	32.80	***
Feed cost (LE)/ Kg gain	19.42	15.83	**
Economic efficiency	2.11	2.59	***

NS: Not significant. * Significant at P<0.05. ** Significant at P<0.01. * Significant at P<0.001. Price of one kg weight gain was 41 LE, price of starter was 2650 LE/ton, price of fresh berseem was 240 LE/ton, price of kg milk was 2.50 LE and price of Flaxseed oil was 16 LE/kg according to marketing price 2015.**

CONCLUSION

From these results, it could be concluded that flaxseed oil supplementation in milk of suckling Friesian calves (0.2 ml/kg LBW) during the suckling period improved growth performance and economic efficiencies as well as immune-response of Friesian calves without adversely effects on digestibility, haematological and biochemical parameters.

REFERENCES

A.O.A.C. (2000). Association of Official Analytical Chemists. Official Methods of Analysis, 17th Ed., Washington, DC.

Abd El-Hafeez, A.M.; M.A.E. Ali; M.A. Abu El-Hamd; A.A. Wahba and Kamla M. EL-Sayed (2014). Productive performance, immune status and metabolic activity of suckling bovine calves treated with *nigella sativa* oil. Egypt. J. Agric. Res., 92 (4): 1561-1574.

Al-kudsi, N.H.; A.Sh. Al-Kiasy and A.J. Al-Hadithy (2008). Effect of restricted milk feeding for different periods on some blood attributes of Friesian female calves in Iraq. Egyptian J. Nutr. and Feeds., 11 (1): 229-243.

Animal Production Research Institute, (1997). Animal Nutrition Scientifically and Practically. 1st Ed. Animal Production Re-search Institute, Agricultural Research Center, Ministry of Agriculture, Dokki, Giza, Egypt.

Ballou, M. A. 2012. Immune responses of Holstein and Jersey calves during the preweaning and immediate postweaned periods when fed varying planes of milk replacer. J. Dairy Sci. 95:7319-7330.

Besser T.E., Gay C.C., Pritchett L. (1991) Comparison of three methods of feeding colostrums to dairy calves. J. Am. Vet. Med. Assoc., 198, 419-422.

Conners, W.E. (2000). Importance of n-3 fatty acids in health and disease. Am. J. Clin. Nutr. 71: 171S-175S.

Farren, T. B., J. S. Drouillard, D. A. Blasi, H. J. LaBrune, S. P. Montgomery, J. J. Sindt, C. M. Coetzer, R. D. Hunter, and J. J. Higgens. 2002. Evaluation of performance in receiving heifers fed different sources of dietary lipid. Pages 1-4 in Proc. 2002 Cattlemen's Day, Kansas State University, Manhattan.

Frei R, R. P Lauener, R. Crameri , and L. O'Mahony . 2012. Microbiota and dietary interactions – an update to the hygiene hypothesis? Allergy; 67: 451–461.

Jezek, J.; T. Malovrh and M. Klinkon (2009). Immunoglobulin dynamics with age in calves from farms in Slovenia. Bull Vet. Inst. Pulawy, 53:819-823.

Kennelly, J.J. (1996). The fatty acid composition of milk as influenced by feeding oil seeds. Anim. Feed Sci. Technology, 60(4): 137–152.

Khattab, H.M.; A.Z. El-Basiony; S.M. Hamdy and A.A. Marwan (2011). Immune response and productive performance of dairy buffaloes and their offspring supplemented with black seed oil. Iranian J. Applied Anim. Sci., 1(4): 227-234.

Larson, B.L.; H.L. Heary and H.L. Devery (1979). Immunoglobulin production and transport by the mammary gland. J. Dairy Sci., 63:665-671.

Lee, H.J.; M.A. Khan; W.S. Lee; H.S. Kim; K.S. Ki; S.J. Kang; T.Y. Hur; M.S. Khan and Y.J. Choi (2008). Growth, blood metabolites, and health of Holstein calves fed milk replacer containing different amounts of energy and protein. Asian-Australasian J. Anim. Sci., 21(2):198-203.

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.

Mohammadi M.; M. Babaei; A.Z. Shahneh and A.H. Adeljo (2014) Eeffect of using extruded linseed on colostrum production, composition, some blood parameters and overall health in Holstein dairy cows. Cibtech J. Zoology Vol. 3 (3): 93-99.

Mohsen, M.K.; M.I. BasslounI; H.M.a. Gaafar; M.H. el-shafley and Heba A.A. El-Sanafawy (2011). Effect of whole sunflower seeds supplementation on performance of zaraibi goats. Slovak J. Anim. Sci., 44 (4): 154-161.

Mustafa, A.F.; J.J. Mckinnon; D.A. Christensen and T. He (2002). Effects of micronization of flax seed on nutrient disappearance in the gastrointestinal tract of steers. Anim. Feed Sci. Technology, 95(4) 123–135.

Parodi, P.W. (1997). Cow's milk fat components as potential anti-carcinogenic agents. J. Nutr., 127(6) 1055–1060.

Petit, H.V. and C. Cortes (2010). Milk production and composition, milk fatty acids profile, and blood composition of dairy cows fed whole or ground flaxseed in the first half of lactation. J. Anim. Feed Sci.Technology, 158(2): 36-43.

Rajala, P. and H. Castren (1995). Serum immunoglobulin concentrations and health of dairy calves in two management systems from birth to 12 weeks of age. J. Dairy Sci., 78, 2737–2744.

SAS. (2004). SAS/STAT User's Guide: Volumes 1-7. SAS Institute Inc., Cary, North Carolina.

Sinclair, A.J.; N.M. Attar-Bashi and D. Li (2002). What is the role of a-linolenic acid for mammals? Lipids, 37(12): 1113-1123.

Soares Filho, P.M.; P.A.D. Belém; J.I. Ribeiro-Jonior and J.H.P. Salcedo (2001). Concentraçoes de imunoglobulinas G em colostro de vacas mestiças Holandês-Zebu. Ciência Rural 31(6):1033-1035.

Van Keulen, J. and B.A. Young (1977). Evaluation of acid insoluble ash as a digestibility studies. J. Anim. Sci., 44: 282.

Vaz A.K.; A.C. Furtado; A. Mrca and M.R. Paterno (2004). Qualidade do colostro bovino e transferência de imunidade aos bezerros recém-nascidos na regio leste de Lages, SC. Revta Ciênc. Agrovet., 3(2):116-120.

تأثير زيت الكتان علي الهضم ومكونات الدم واستجابة المناعية والكفاءة الإنتاجية في عجول الفريزيان الرضيعة

محمد عوض ابو الحمد، ياسر مبروك الديهي، محمود متولي المغربي و محمد احمد الشورة

معهد بحوث الإنتاج الحيواني ، مركز البحوث الزراعية ، الجيزة ، مصر.

تهدف هذه الدراسة إلي معرفة تأثير إضافة زيت الكتان علي الهضم والمناعة وبعض مكونات الدم ومتوسط الزيادة اليومية ومعدل تحويل الغذاء والكفاءة الاقتصادية للعجول الفريزيان الرضيعة. استخدم في هذه الدراسة ٢٨ عجل فريزيان حديث الولادة متوسط وزنها ٣١.٤٢±١.٩ كجم وقسمت إلي مجموعتين متشابهتين بكل مجموعة ١٤ عجل. المجموعة الاولي مقارنة والمجموعة الثانية تم إضافة زيت الكتان بمعدل ٠.٢/كجم وزن حيي في لبن الرضاعة خلال الفترة من الميلاد حتى الفطام. أظهرت النتائج ارتفاع معنوي في معاملات الهضم للمادة الجافة والمادة العضوية والبروتين والألياف وارتفاع القيمة الغذائية ل TDN وDCP وكذلك الغذاء المأكول ل TDN وDCP في المجموعة الثانية مقارنة بالمجموعة الأولي. وتركيز جلوبيونات المناعة فى بلازما الدم معنويا ($P<0.05$) في المجموعة الثانية مقارنة بالمجموعة الأولي. كما زاد تركيز كل من عدد كرات الدم الحمراء والبيضاء والنسبة المئوية وmonocytes وneutrophils وحجم كرات الدم وتركيز الهيموجلوبين في المجموعة الثانية مقارنة بالمجموعة الأولي. كما زاد تركيز كل من في المجموعة الثانية مقارنة بالمجموعة الأولي. كما زاد تركيز البروتين الكلي والألبيومين والجلوبيولين معنويا ($P<0.05$) في بلازما الدم في المجموعة الثانية مقارنة بالمجموعة الأولي. بينما نقص معنويا ($P<0.01$) تركيز كل من الألبيومين والنسبة بين الالبيومين والجلوبيولين والدهون الكلية والكرياتنين واليوريا في بلازما الدم في المجموعة الثانية مقارنة بالمجموعة الأولي. أما تركيز الجلوكوز والALT ,AST في بلازما الدم لم يظهر اي اختلافات معنوية بين المجموعتين. أدت المعاملة في المجموعة الثانية إلي تحسين وزن الجسم الحي ومتوسط النمو اليومي والتحويل الغذائي مقارنة بالمجموعة الأولي. كما ارتفعت الكفاءة الاقتصادية معنويا ($P<0.01$) في المجموعة الثانية مقارنة بالمجموعة الأولي.

وفي النهاية نستنتج من هذه الدراسة إضافة زيت الكتان بمعدل ٠.٢/كجم وزن حيي في لبن الرضاعة عجول الفريزيان الرضيعة خلال الفترة من الميلاد حتى الفطام حسنت كفاءة النمو والاستجابة المناعية وكذلك الكفاءة الاقتصادية للعجول الفريزيان بدون أثار ضارة علي الهضم ومكونات الدم.