Investigating the effects of fish oil supplementation as an Omega-3 fatty acid source during late gestation: milk yield and composition of does and growth performance of their offspring

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SUMMARY

The aim of the study was to evaluate the effects of fish oil as an Omega-3 source during late pregnancy of does on pregnancy and lactation performance, as well as on the growth performance of kids. Thirty German Fawn x Hair crossbreed does were used. On the 76th day of pregnancy, the does were separated into two groups and fed a total mixed ration (TMR) including 2.8% (as-fed) fish oil (n = 17) or protected fat (n = 13) until kidding. The does and kids were subjected to a standard feeding regimen between kidding and 60 days of lactation. Feed intake was monitored on a weekly basis. Milk production was recorded every two weeks, with samples analyzed for total solids, fat, protein, casein, lactose, and urea levels. Additionally, the feed intake and individual body weights of the kids were measured biweekly. The use of fish oil in the diet during the last period of pregnancy did not affect live weight except on the 128th day of pregnancy. Similarly, the duration of pregnancy, milk yield, and milk composition were not affected by fish oil. However, feed intake increased during pregnancy, while it caused a decline during the lactation period. The kids born to does fed with fish oil TMRs consumed less feed. In conclusion, the use of 2.8% fish oil in the rations of does in late pregnancy did not affect the live weight of the dam and offspring. Fish oil increased feed intake during pregnancy. In lactation, feed intake decreased in dams and kids of dams receiving fish oil during pregnancy. The length of pregnancy and the protein and casein levels in the milk may also be influenced by the type of delivery. These findings suggest that while fish oil supplementation can alter feed intake patterns, it does not adversely affect key performance metrics such as live weight and milk production. Further research could explore the underlying mechanisms and long-term effects of fish oil supplementation in the diets of pregnant does.

KEY WORDS

Fish oil; does; gestation; postpartum performance; kid growth.

INTRODUCTION

Nutrition during gestation can affect both maternal performance and foetal development. Adequate nutrition during gestation is important for the health of the mother and offspring as well as for optimal growth and production of the offspring (1). Especially, in the second half of gestation, both the pressure of the growing foetus or foetuses on the digestive system capacity of the mother and the increased nutritional requirements (for example, essential fatty acids) make it necessary to enrich the diets with nutrients or add supplements.

Omega-3 fatty acids are emphasized because of their role in the phospholipid structures of brain and retina cells, being the precursor of progesterone, and helping the immune system by reducing inflammatory agents (2). In addition, the Omega-3 fatty acids were also considered as important factor that can modulate animals' metabolism especially during the transition period and have potential consequence on the new born through changes in composition of milk fatty acids (3).

The active biologic form of Omega-3 fatty acids is eicosapentaenoic acid (EPA) and docosahexaenoic (DHA) acid. Fish oil contains higher levels of these two fatty acids than vegetable or plant sources. Although some of plant sources (for example linseed) are rich in linolenic acid (another Omega-3 fatty acid), this fatty acid needs to be converted into EPA and DHA. However, this transformation in metabolism may not be efficient enough (4). Similarly, Thatcher and Staples (5) reported that biohydrogenation of EPA and DHA in the rumen occurs at a limited level. Therefore, it may be possible to show the expected results more effectively by using fish oil. In addition, with the increasing consumer demand and climate change small ruminant production has also tended to be intensive. As is known, in pasture or grazing based systems, fresh grass containing high levels of long-chain unsaturated fatty acids (especially, - linolenic acid) can be consumed in sufficient quantities and the requirements can be met. However, in new production systems, animals are fed with hay and silage. This is a situation that may cause problems in meeting long-chain unsaturated fatty acid requirements. Therefore, the use of long-chain unsaturated fatty acid sources in diets may yield positive results.

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Studies on the use of fish oil in the nutrition of ruminants have mostly focused on the lactation period and the evaluation of maternal performance. Most of these studies are on dairy cows and partly on sheep, but there are not enough studies on does. On the other hand, there are limited long-term studies that determine the effect of fish oil use on the performance of dams and offspring, especially in the last period of pregnancy, including after kidding. In light of this background, the objective of this study was to investigate the effects of supplemental fish oil on gestation and lactation performance of does and growth performance of kids. In the study, considering that foetal development accelerated especially in the second half of pregnancy, fish oil was added to the diet starting from the 76th day of gestation.

MATERIAL AND METHODS

The study was carried out at Research and Application Farm, Faculty of Agriculture, Cukurova University between August 2015 - April 2016. The farm has semi-intensive farming conditions. A specially designed pen with 6 compartments of equal size (6 x 12 m, width x length) was used during the experiment. The study lasted 4.5 months in total (2.5 months of gestation and 2 months of lactation period).

Animal material, estrous synchronization, feeding regime until d 76 of pregnancy

Eighty does (German Fawn × Hair crossbreds) varying in age between 2 and 5 years were separated from the farm herd. To minimize the effects of the environmental factors (e.g. feeding regime change, climate change) on the lactation period and the growth performance of does and kids, estrous cycles were synchronized. Estrous was induced and synchronised using intravaginal sponges containing flugestone acetate for 12 days. Intra-intramuscular injection of 400 IU pregnant mare serum gonadotropin (Chronogest / PMSG, 6000 IU, Intervet) and 75 mcg d-cloprostenol (Synchronine, Vetas) were injected 2 days before removal of the sponges. The estrous detection was performed by using a teasing buck (6). Mated does were recorded and the first mating day was considered as day 0. After 24 h teasing buck was used for re-checking mating does, and does still in estrous were mated for the second time with the same buck. Pregnancy diagnosis was carried out on day 76 using a ultrasonography device (Pie, Medical, Falco, The Netherlands). In the study, the pregnancy was segmented to 2 periods, 1) 0 (mating day) - to 75 d and 2) 76 d - delivery day. During the first period, all animals were fed a diet supplemented with protected fat. Thirty six multiparous does with similar live weights [48.9 ± 2.09 kg (mean±SE)] were selected among the pregnant does on d 76 of pregnancy.

Feed material

The selected does were divided into two groups and half (*n*= 18) were fed fish oil supplemented diet, while the other half (*n*= 18) were fed protected fat (Lactofat R100, Farmann, Germany) supplemented diet. Protected fat was used because of keeping ration composition similar. The does were distributed into 6 compartments or subgroups according to their feed material. The feeding system for the does was total mixed ration (TMR) containing 45% alfalfa hay and 15% wheat straw, and 40% concentrate feed. The fat sources (protected fat and fish oil) were added at the rate of 7% (on an air-dry basis) during

Table 1 - TMR content and nutrient composition used in the late pregnancy (day 76 to kidding).

Ingredients	%	
Barley	8.00	
Corn	2.00	
Wheat bran	10.00	
Corn bran	2.59	
Sunflower meal (25% crude protein)	10.43	
Molasses	2.40	
Fat[1]	2.80	
Alfalfa hay	45.00	
Wheat straw	15.00	
Limestone	1.42	
Salt	0.32	
Vitamin-Mineral[2]	0.04	
Nutrient composition (%)	**Protected fat TMR**	**Fish oil TMR**
Dry Matter	92.3	92.1
Crude protein	16.7	17.3
Fat	4.6	4.6
ADF	28.9	29.7
NDF	45.1	45.5
Ash	6.6	7.2

[1]Fish Oil or Protected Fat.
[2]Vitamin-Mineral (kg): 15.000.000 IU vitamin A, 3.000.000 IU vitamin D3, 30.000 mg Vitamin E, 150.000 mg niacin, 10.000 mg Cu, 800 mg I, 150 mg Co, 150 mg Se, 50.000 mg Mn, 50.000 mg Fe, 50.000 mg Zn, 6.800 mg organic Mn, 1.400 mg organic Cu, 6.800 mg organic Zn, 6.800 mg organic Fe, 50 mg organic Se.

production process of the concentrate feed. The compositions of protected fat or fish oil supplementation in the rations of does are summarized in Table 1.

During lactation period, the TMR was formulated based on NRC [7] requirements as isocaloric and isonitrogenic. Roughage : concentrate ratio was 40:60, and alfalfa hay was used as roughage (Table 2). The does were fed twice daily at 08:00 and 17:00 h and had access to fresh water throughout the experiment.

Data collection

During the experiment, feed intake was measured weekly based on the subgroups. Individual body weight was taken every 2 week. Milk production was recorded biweekly interval starting 14 days after kidding. Milking was performed by hand milking twice daily. All the kids were separated from their mothers 12 hours before morning milking and were not allowed to reach their mothers until end of the evening milking. Milk samples were collected as reported by Tessari (8) and Fiore et al. (9). Briefly, the udders were washed and dried and milking was carried out after the foremilk was checked. For chemical composition of milk, a 50 ml plastic tubes (Corning, England) were used for collection of milk samples at each milking. The tubes were preheated at +40°C in a water bath and then mixed gently. Percentage of total solid, fat, protein, casein, lactose and urea levels were determined by infrared spectroscopy (FT-120, Milkoscan, FOSS, Denmark). A weighted average was calculated for each component based on morning and afternoon milk yields.

Evaluation of kids performance

Kids birth weights, mother ear tag number, type of birth, gender, date of birth were recorded at birth, and the kids were housed with does for 2 weeks for whole day. Then kids were housed in a separate section formed within the pen after suckling their mothers in the morning and evening. From week 2, starter feed (Table 3) and water was freely provided to kids. Feed intake and individual body weights of kids were weighed biweekly before the morning feeding. The body weight gain was calculated by subtracting the previous weight from the last weighing and dividing the obtained value by the number of elapsed days. The feed conversion efficiency was determined by dividing feed consumption by body weight gain.

Feed analysis

Roughage and concentrate samples (about 1000 g) were collected weekly before TMR preparation and stored in plastic bags at −20°C until analysis. Dry matter, crude protein, ether extract, ash, neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined based on the AOAC official Method 973.18 (10). Heat stable -amylase and sodium sulphite were used in NDF and ADF analysis.

Statistical analysis

The collected data during the study period was compiled in Microsoft Excel (version 2013 of Microsoft Corp.). A total of 36 does were originally assigned to the experiment. The final number of does used in the data analysis was 30. A total of 6 does was had to be removed from the trial for reasons (injury and fluctuation in feed consumption) unrelated to the treatments. Therefore data on these does were not used in the analysis. All data were analysed using SAS (11). Normal distribution tests for the data were performed with the Shapiro-Wilk test using the Univariate procedure and transformation was per-

Table 2 - TMR content and nutrient composition used in lactation.

Ingredients	%
Corn	24.85
Barley	6.79
Soybean meal (48% crude protein)	10.20
Corn DDGS	9.00
Wheat bran	4.53
Fractionized Fat	0.91
Molasses	1.81
Salt	0.45
Limestone	0.64
Vitamin-Mineral[1]	0.07
Sodium bicarbonate	0.75
Alfalfa hay	40.00
Nutrient composition	%
Dry Matter	91.1
Crude protein	17.20
Fat	8.48
ADF	34.1
NDF	44.4
Ash	5.86

[1]Vitamin-Mineral (kg): 15.000.000 IU vitamin A, 3.000.000 IU vitamin D3, 30.000 mg Vitamin E, 150.000 mg Niacin, 10.000 mg Cu, 800 mg I, 150 mg Co, 150 mg Se, 50.000 mg Mn, 50.000 mg Fe, 50.000 mg Zn, 6.800 mg organic Mn, 1.400 mg organic Cu, 6.800 mg organic Zn, 6.800 mg organic Fe, 50 mg organic Se.

Table 3 - Concentrate content and nutrient composition used in kids growth.

Ingredients	%
Corn	41.42
Barley	11.32
Soybean meal (48% crude protein)	17.00
Corn DDGS	15.00
Wheat bran	7.55
Fractionated fat	1.51
Molasses	3.02
Salt	0.75
Limestone	1.07
Vitamin-Mineral[1]	0.11
Sodium bicarbonate	1.25
Nutrient composition	%
Dry Matter	88.40
Crude protein	17.77
Fat	8.39
ADF	34.28
NDF	44.19
Ash	6.94

[1]Vitamin-Mineral (kg): 15.000.000 IU vitamin A, 3.000.000 IU vitamin D3, 30.000 mg Vitamin E, 150.000 mg Niacin, 10.000 mg Cu, 800 mg I, 150 mg Co, 150 mg Se, 50.000 mg Mn, 50.000 mg Fe, 50.000 mg Zn, 6.800 mg organic Mn, 1.400 mg organic Cu, 6.800 mg organic Zn, 6.800 mg organic Fe, 50 mg organic Se.

Table 4 - The effect of using fish oil as a source of Omega-3 fatty acid during late pregnancy on performance and pregnancy length of does.

	Diet (D)			P		
					Type of delivery	
Item	Protected fat	Fish oil	SEM[1]	D	(TD)[2]	D × TD
Body weight (kg)						
90 *d*	51.9	55.2	1.99	0.252	0.003	0.562
114 *d*	52.4	55.3	1.94	0.311	0.002	0.405
128 *d*	53.5	58.9	2.06	0.007	0.079	0.389
Kidding	49.8	53.9	1.99	0.213	0.245	0.359
Feed intake (kg/day)						
90 *d*	1.58	1.95	0.04	0.004	0.227	0.302
114 *d*	1.61	1.90	0.03	0.002	0.515	0.533
128 *d*	1.57	1.65	0.02	0.029	0.589	0.438
During pregnancy	1.62	1.80	0.03	0.008	0.278	0.658
Pregnancy length (d)	148.9	149.8	0.43	0.141	0.062	0.012

[1]SEM: Standard error of the mean
[2] Type of delivery (TD): Single or twin pregnancies

formed to achieve normality as needed. Analysis of variance (ANOVA) was then made using the GLM procedure, and when ANOVA indicated a significant effect at $P < 0.05$, post hoc pairwise testing of differences between least squares means was performed using the Tukey-Kramer test. P values ≤0.05 were considered significant, and $0.05 < P \leq 0.10$ were considered a tendency. In addition, when transformation was applied, means and standard errors were estimated from back transformed values, and P-values reflect statistical analyses of transformed data.

RESULTS AND DISCUSSION

The litter size in the groups was as follows: 7 does producing twins, 6 does producing single in the protected fat group, 10 does producing twins, 7 does producing single in the fish oil group.

Gestation period

Performance and length of pregnancy are given in Table 4. There were no difference in body weight of group at 90d (P= 0.252) and 114 d of pregnancy (P= 0.311). However, at 128 d of pregnancy, body weight of fish oil group was higher than protected fat (P= 0.027). Indeed, during the pregnancy, the feed intake of TMR containing fish oil group was higher than those fed protected fat (P= 0.008). Feed intake depends on palatability, changes in ruminal fermentation, fiber digestion, digesta flow rate, release of gut hormones, and other dietary factors, including FA chain length and form (12). Further more, studies on the supplementation of fish oil to the diet of sheep and does have found similar feed intake between groups that did not receive the supplementation (13, 14), although a higher live weight was observed in the latter (14). On the other hand, studies have shown that the supplementation of fish oil to the diet of sheep can reduce feed consumption (15). Differences between the studies may arise from variations in the composition of ration nutrients and the type of forage used.

The average length of gestation in the current study was 149.4 days. Fish oil supplementation had no effect (P= 0.141) on the pregnancy period, the type of delivery had a tendency effect (P= 0.062), and those two main factors had interaction effect (P= 0.012, Figure 1). Fish oil supplementation extended the duration of gestation by 2.89 days in single pregnant does (151.3 days in single pregnant does *vs.* 148.4 days in twin pregnant does). Whereas, in group supplemented protected fat extended the pregnancy period by 0.4 day (148.7 days in single pregnant does against 149.1 days in twin pregnant does). These results suggest that the use of fish oil may shorten the duration of pregnancy in twin pregnant does.

It has been proposed that Omega-3 fatty acids enter into competition with Omega-6 fatty acids, namely linoleic acid, for access to the 6-desaturase and cyclooxygenase enzymes. This competition reduces the production of prostaglandins from the two series and increases the production of prostaglandins from the three series (4). Prostaglandins from the three series are less potent than those from the two series in inducing uterine contractions (16). In these circumstances, pregnancy is prolonged, and delivery is delayed. Additionally, some studies, conducted by different authors, have reported that multiple pregnancies decrease the gestation period. Previous experiments in sheep and observations in women (16) have shown that a supplement of fatty acids from the Omega-3 family prolongs the duration of gestation. Furthermore, when the length of gestation is increased by a fish oil supplement, birth weight can also be increased (17). An important difference between the present experiment and experiments that showed an effect on gestation length is the choice of lipid source. Although linoleic acid (linseed) and DHA and EPA (fish oil) are from the same Omega-3 family of fatty acids, they may not have the same effect on the production of prostaglandins. Therefore, the impact on the length of gestation could be different.

Lactation period

Table 5 shows results of lactation performances of does fed supplemented fish oil as a source of Omega-3 oil during the last period of pregnancy. Fat type had no effect on BW. There was

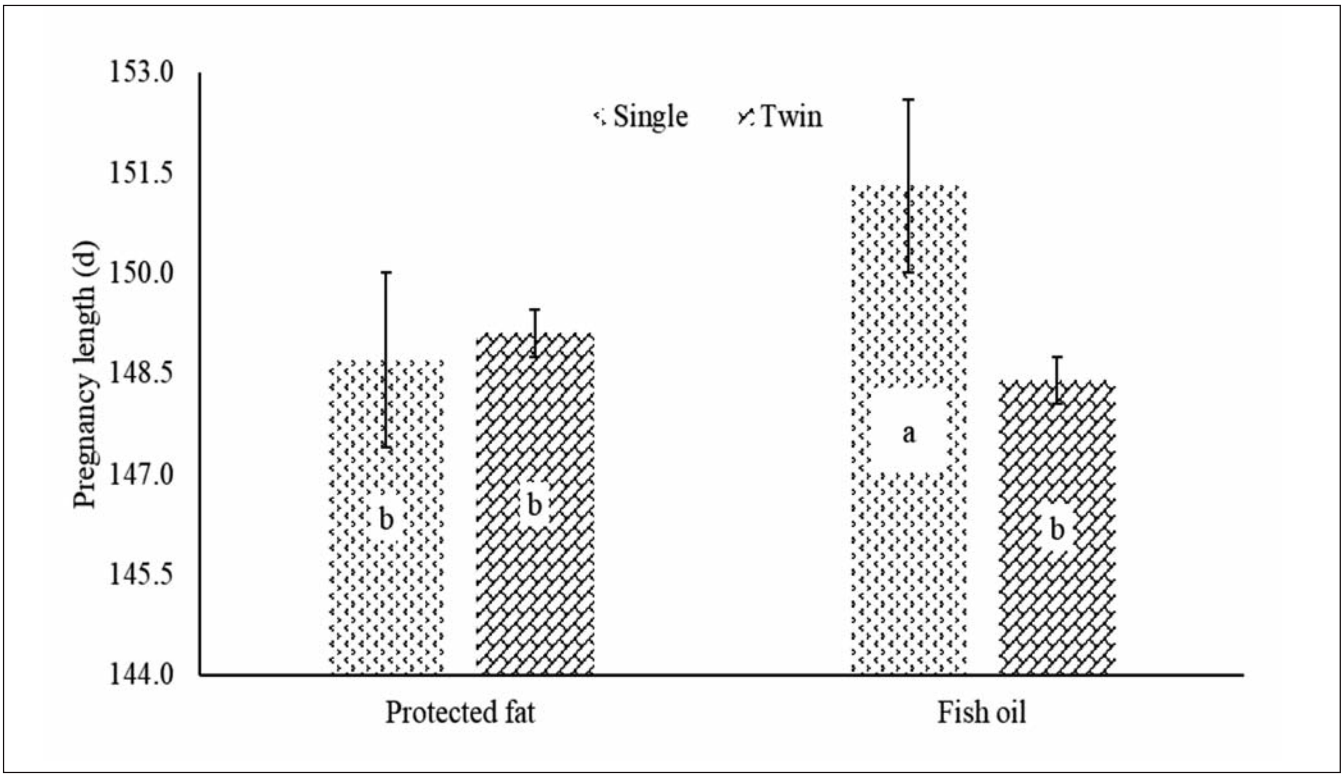

Figura 1 - The effect of using fish oil as a source of Omega-3 fatty acid during late pregnancy on pregnancy length of does (data are presented as the LSmean of the Diet×Type of delivery, P= 0.012 and standard error of mean= 1.73).

a tendency (P= 0.087) for TD to affect live weight on the 14th day of lactation. D × TD interaction had no effect (P= 0.118) on body weight as it was diet effect.

Feed intake during lactation was higher on does fed a diet supplemented protected fat. The average feed intake for the first two months of lactating does fed with TMR contained protected fat was 24% higher (P =0.009). However, milk yield remained unchanged compared to feed intake. There was no statistical difference (P= 0.705) between groups.

The results of milk composition analysis performed on the 14th,

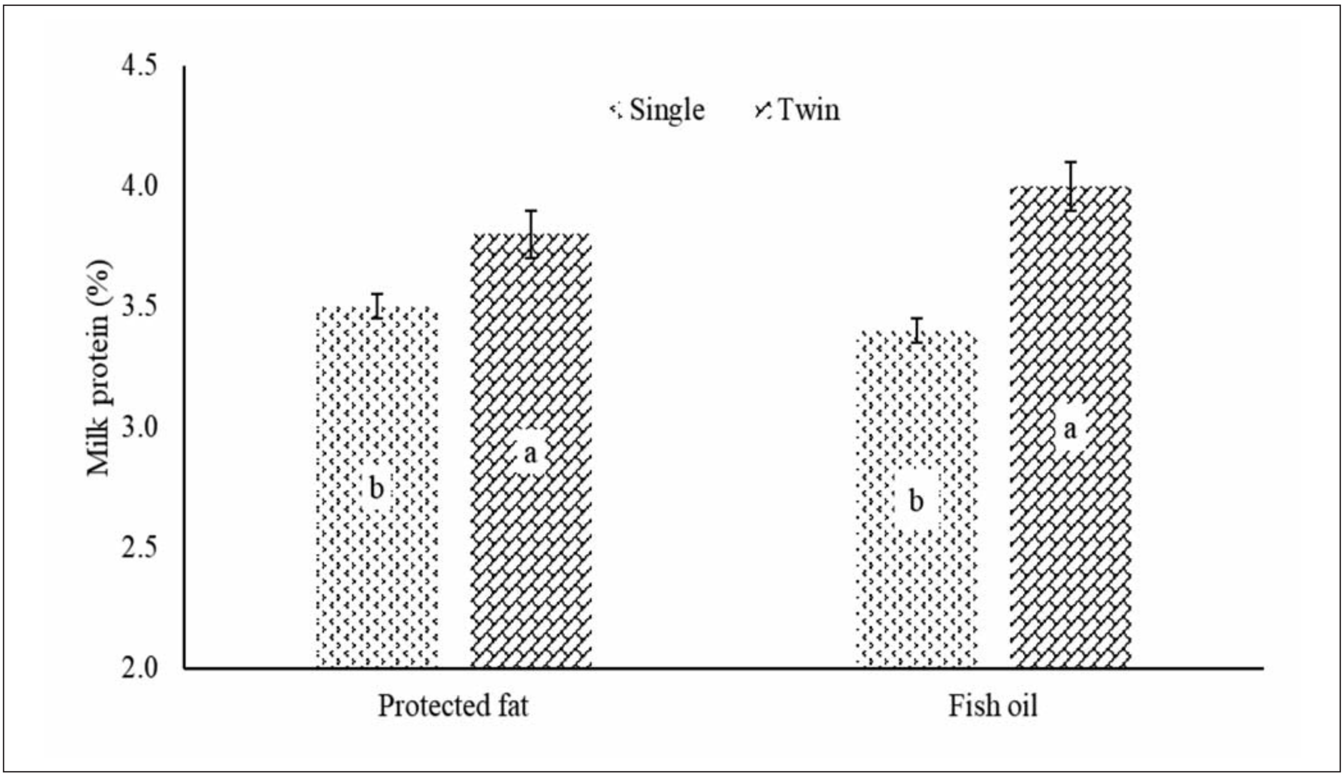

Figura 2 - The effect of using fish oil as a source of Omega-3 fatty acid during late pregnancy on milk protein at 14th day of lactation [data are presented as the LSmean of the type of delivery (single or twin pregnancies), P= 0.044 and standard error of mean= 0.13].

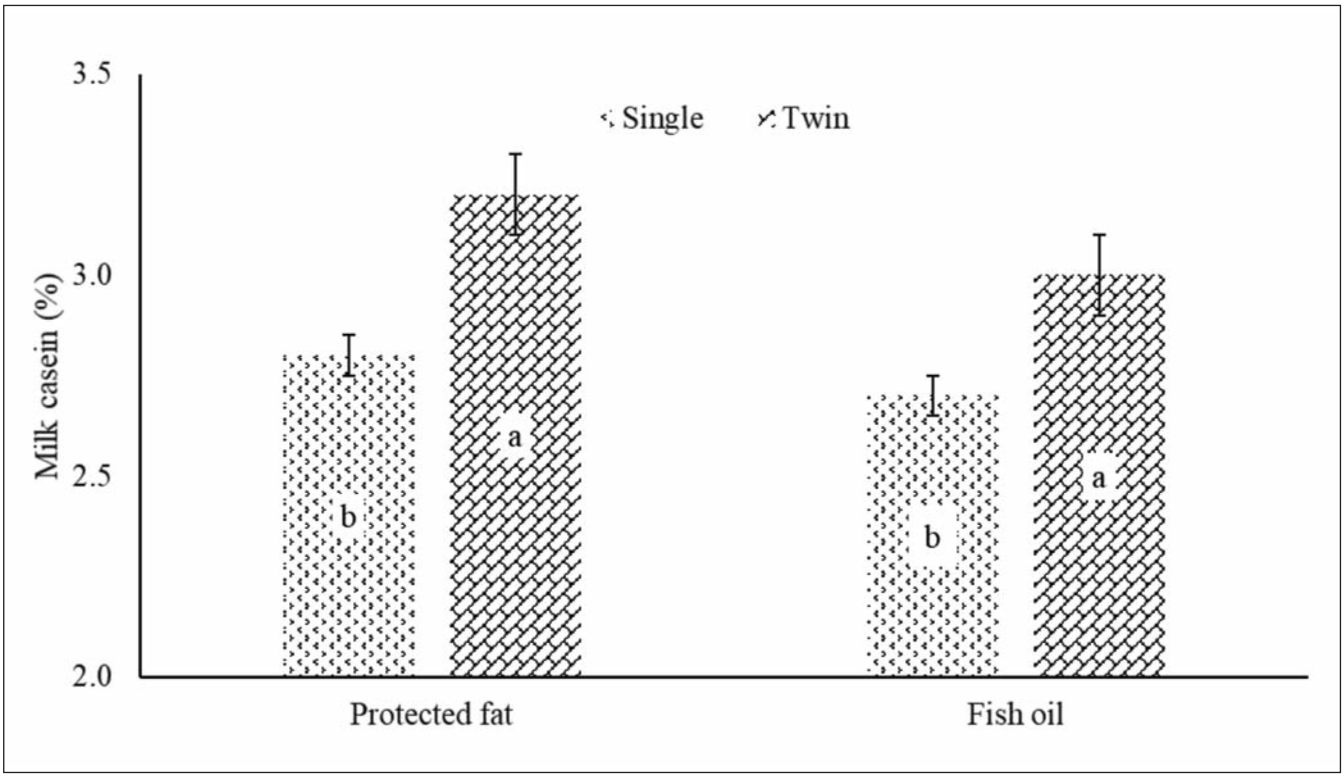

Figura 3 - The effect of using fish oil as a source of Omega-3 fatty acid during late pregnancy on milk casein at 14th day of lactation [data are presented as the LSmean of the type of delivery (single or twin pregnancies), P= 0.046 and standard error of mean= 0.10].

28th and 56th days of lactation are given in Table 6. The supplementation by fish oil during the last period of pregnancy did not affect the total solids (P= 0.394), fat (P= 0.104), protein (P= 0.178), lactose (P= 0.375), casein (P= 0.206) and milk urea-N levels (P= 0.799) in the lactation period. It was determined that the type of delivery affects milk protein (P= 0.044, Figure 2) and casein (P= 0.046, Figure 3) levels in milk samples at 14th day of lactation.

The fish oil supplementation during the last period of pregnancy did not affect live weight, milk yield and composition

Table 5 - The effect of using fish oil as a source of Omega-3 fatty acid during late pregnancy on lactation performance of does.

Item	Diet (D)			P		
	Protected fat	Fish oil	SEM[1]	D	Type of delivery (TD)[2]	D × TD
Body weight (kg)						
14 *d*	50.1	51.4	1.84	0.617	0.087	0.118
28 *d*	48.4	51.1	1.98	0.342	0.228	0.409
56 *d*	48.0	52.6	1.90	0.104	0.357	0.197
Average	49.6	51.4	1.87	0.169	0.253	0.470
Feed intake (kg/day)						
14 *d*	2.4	1.9	0.03	0.007	0.033	0.854
28 *d*	2.5	2.1	0.04	0.003	0.575	0.393
56 *d*	2.7	2.6	0.06	0.648	0.713	0.611
Average	2.6	2.1	0.04	0.009	0.369	0.400
Milk yield (kg/day)						
14 *d*	2.2	1.7	0.28	0.505	0.223	0.366
28 *d*	2.1	2.5	0.30	0.429	0.471	0.591
56 *d*	3.0	3.2	0.43	0.880	0.811	0.617
Average	2.3	2.2	0.24	0.705	0.613	0.443

[1]SEM: Standard error of the mean
[2] Type of delivery (TD): Single or twin pregnancies

Table 6 - The effect of using fish oil as a source of Omega-3 fatty acid during late pregnancy on milk composition.

	Diet (D)			P		
					Type of delivery	
Item	Protected fat	Fish oil	SEM[1]	D	(TD)[2]	D × TD
Total solids (%)						
14 *d*	11.3	12.0	0.42	0.280	0.466	0.481
28 *d*	12.1	11.8	0.70	0.744	0.264	0.879
56 *d*	11.4	11.7	0.30	0.456	0.597	0.345
Average	12.3	12.7	0.27	0.394	0.768	0.501
Fat (%)						
14 *d*	2.0	1.2	0.42	0.196	0.855	0.740
28 *d*	2.6	2.3	0.71	0.766	0.564	0.400
56 *d*	2.0	2.4	0.26	0.250	0.421	0.647
Average	2.8	3.3	0.22	0.104	0.864	0.714
Protein (%)						
14 *d*	3.8	3.7	0.11	0.556	0.044	0.574
28 *d*	3.7	3.6	0.12	0.405	0.113	0.522
56 *d*	3.5	3.3	0.11	0.264	0.369	0.439
Average	3.7	3.5	0.09	0.178	0.701	0.564
Lactose (%)						
14 *d*	5.2	5.2	0.06	0.692	0.846	0.346
28 *d*	4.9	5.0	0.07	0.510	0.503	0.649
56 *d*	4.8	4.8	0.05	0.464	0.187	0.506
Average	4.9	4.8	0.05	0.375	0.874	0.784
Casein (%)						
14 *d*	3.1	3.1	0.09	0.697	0.046	0.429
28 *d*	3.0	2.9	0.10	0.469	0.127	0.803
56 *d*	2.9	2.8	0.09	0.439	0.460	0.569
Average	3.0	2.9	0.07	0.206	0.566	0.700
Urea-N (mg/dL)						
14 *d*	29.4	28.0	1.01	0.350	0.799	0.803
28 *d*	27.7	25.2	1.63	0.297	0.237	0.710
56 *d*	22.0	22.1	1.12	0.948	0.602	0.478
Average	27.5	28.3	0.86	0.532	0.200	0.506

[1]SEM: Standard error of the mean
[2]Type of delivery (TD): Single or twin pregnancies

during lactation, but decreased feed intake. To authors knowledge, there are no study has examined the effect of fish oil supplementation to the ration in pregnant does during lactation. In studies conducted in sheep (18) and beef cattle (19), prepartum oil supplementation did not affect postpartum live weight, milk yield and milk composition. The effect observed with the use of fat in the ration in ruminants depends on the diet composition, starch level and amount and type of roughage (19).

Kids performance

Table 7 displays the effect of fat supplementation during late pregnancy of does on kids performance from birth to weaning. The nutritional regimen applied during late period of pregnancy had a tendency to affect the birth weight of kids (P = 0.086). Feeding TMR contained fish oil resulted in a reduction approximately 9% in kid's birth weight. The type of delivery statistically significant affected birth weight (P= 0.007). In addition, there was no differences for body weight measurements made on the 14th, 28th and 56th days of kids' growth period, daily live weight gain between groups.

It was determined that kids of does fed a TMR contained fish oil during late pregnancy consumed 20% lower feed (P<0.01). In addition, male kids tend to consume more feed (P=0.065) than female. Does feeding during pregnancy tended to influence the feed conversion efficiency of kids (P= 0.068). Kids of does fed with fish oil TMR during pregnancy had a tendency to gain more live weight against low feed consumption.

In the literature, some experiments (20) reported significant effect of kid's birth weight while others (21) was found sig-

Table 7 - The effect of using fish oil as a source of Omega-3 fatty acid during late pregnancy on the growth and development performance of the kids.

	Diet (D)					P			
Item	Protected fat		Fish oil				Type of delivery (TD)[2]		
Sex	Female	Male	Female	Male	SEM[1]	Diet		Sex	D×TD
Body weight (kg)									
Birth	3.6	3.5	2.9	3.5	0.23	0.086	0.007	0.300	0.124
14 *d*	5.8	7.7	5.7	6.4	0.51	0.196	0.419	0.014	0.903
28 *d*	7.6	10.0	7.6	8.5	0.61	0.246	0.225	0.012	0.684
56 *d*	10.6	13.3	11.4	12.1	2.94	0.850	0.211	0.081	0.908
Daily weight gain (g/day)	123.9	158.7	127.9	150.3	12.81	0.869	0.553	0.035	0.670
Feed intake (g/day)									
14 *d*	45.5	69.4	29.9	19.0	6.55	0.008	0.453	0.341	0.508
28 *d*	153.8	177.8	116.4	134.6	13.90	0.004	0.891	0.442	0.972
56 *d*	341.7	394.3	350.5	411.8	31.55	0.687	0.915	0.087	0.738
Average	156.9	187.3	136.4	141.1	9.00	0.002	0.562	0.065	0.683
Feed conversion (Feed intake/Average daily weight gain)	1.3	1.3	1.2	1.0	0.07	0.068	0.965	0.561	0.588

[1]SEM: Standard error of the mean
[2] Type of delivery (TD): Single or twin pregnancies

nificant effect of fat diet supplementation during pregnancy on kid's birth weight. Kezi et al. (22) reported that body weight gain was higher in Alpine male kids than female (129 g *vs.* 174 g). Similar results were also observed in different breed (22, 23). In the current study, type of delivery affected the birth weight. Similar to what Todaro et al. (24) and Lehloenya et al. (25) reported. Also, it has been suggested that the type of birth leads to decrease in birth weight (25).

CONCLUSIONS

The current study was to investigate the effect of fish oil (2.8% in TMR) as source of Omega-3 fatty acid during late pregnancy period (from the 76th day of pregnancy to kidding) on early lactation (kidding to 56th day of lactation) performance, milk composition and kid's growth performance. Fish oil did not affect the live weight of moms during pregnancy and lactation periods, but decreased feed intake.
Milk composition of moms was also not affected by fish oil. On the other hand, live weights of kids born to dams consuming fish oil during pregnancy were similar to those of kids born to dams consuming protected fat, while feed intake decreased. Future studies, more pregnant does would be necessary to investigate the mechanisms of the differences in performance parameters.

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Disclosure statement

The authors report there are no competing interests to declare.

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