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Effect Of Oil Seed Cakes Supplements On Milk Fatty Acid Profile Of Lactating Damani Goats

Muhammad Zeeshan*[1], Muhammad Jamil[2], Ali Zaman[1], Sayed Mubashir Hasan[1], Habib Ullah[1], Muhammad Mubeen[1], Sidra Maryam[1], Muhammad Inamullah Malik[1], Saqib Ali Rustam1, Sayeda Adia Fatima[3]

[1]*Faculty of Veterinary and Animal Sciences, Gomal University, Dera Ismail Khan-29050-Pakistan*

[2]*PARC Arid Zone Research Center, Dera Ismail Khan-29050-Pakistan*

[3]*Faculty of Animal Husbandry and Veterinary sciences, The University of Agriculture Peshawar, Khyber Pakhtunkhwa-25120- Pakistan.*

ABSTRACT

Goat milk fat is of prime importance because of its beneficial effects on human health. Twelve lactating Damani goats of same age, body weight and lactation number were selected and distributed into 4 groups (n=3). Trial was continued for four weeks with adaptation period of a week. Animals were allowed to graze for 06 hours on natural grasslands each day i.e. Control diet (CD-Diet) while other 3 groups were offered with Rape seed cake (RS- Diet), cotton seed cake (CS-Diet) as well as maize cake (MC- Diet) along with Diet-CD respectively. Medium chain fatty acids (MCFA) are caproic, caprylic as well as capric acid. Capric acid was recorded highest (P<.0001) (10.1±0.006%) for MC- Diet and lowest (9.31±0.006%) for CD-Diet. Mono unsaturated fatty acids (MUFA) including Myristoleic acid, Oleic acid, Elaidic acid etc. Myristoleic acid were recorded highest (P<.0001) (0.11.±0.006%) for CS- Diet and lowest (0.6.±0.006%) for CD-Diet. Poly unsaturated fatty acids (PUFA) are Linoleic acid, Linolelaidic acid, Linolenic acid and Arachidonic acid etc. Linoleic acid was recorded highest (P<.0001) (3.29.±0.004%) for MC- Diet while lowermost was recorded (2.69.±0.004%) for CD-Diet. Saturated fatty acids (SFA) including Stearic acid, Archidic acid, Palmitic acid etc. Stearic acid was recorded highest (P<.0001) (14.9.±0.006%) for CD-Diet its lowest values were recorded (7.76±0.006%) for CS- Diet. It was notice that oil seed cake supplementation have significantly improved the MCFA, MUFA and PUFA while the percentage of SFA was observed lower in the milk of treatment groups animals.

Key words: Cotton seed cake, Fatty acid, Goat milk, Maize oil cake, Mustard seed cake

Introduction

Goats are well-admired universally for supplying food i.e. milk, meat as well as their products. Goats are also are well-embedded in our country culture and too are publically acceptable for decreasing worldwide poverty mainly in the poor countries and probably for this reason goat is globally acknowledged as "Poor person's cow" (Arshad *et al*., 2008). Developing world bear approximately 90% of global population of the goat, Asia is the continent that can produce 80 % of the global goat milk. Iran, India, Bangladesh,

Turkey, China and Pakistan are the countries with maximum population of goats (Khan *et al.,* 2003).

In Pakistan due to shortage of green fodder more than 50 % of dietary requirements are meet by the crop residues which due to their low nutritive value cannot meet the nutrient requirements of animals (low crude protein, high fiber and lignin contents) (Habib *et al.,*2005, Aregheore, 2000). Agro-industrial byproducts like Oilseed cakes which are cheapest source of quality protein are best to use in above situation to fulfill the nutrient requirements of animals (Sarwar *et al.,* 2006).Goat milk as well as its meat both have great importance, beside their importance goat milk fatty acid (FA) also get special attention and the reason behind this is the benefits of few long chain FA on human health (Nudda *et al.,* 2006). Intake of oil seed cakes is considered as one of the main and best tool for altering FA profile of milk. The use of oil seed cakes as supplements along with the basal diet can maximize the percentage of unsaturated FA i.e. conjugated linoleic acid (CLA). CLA has numerous advantageous effects including antiatherosclerotic, anticarcinogenic as well as immunomodulating effects (Mcguire, *et al.,* 2000). Human diet contain huge amount of SFA however there excessively high percentage at the end results to chronic diseases like coronary artery disease, atherosclerosis as well as obesity (Germen *et al.,* 2009). Ongoing study was performed to investigate that how change in the FA profile of milk is made with supplementation of oil seed cakes.

Materials and Methods

Recent work was performed at the FVAS, Gomal university goat's farm. Initially selection of 12 milking Damani goats of same age as well as lactation number was made and these selected animals were distributed on the basis of lactation number, milk production as well as the body weight into 04 dietary groups i.e. each group having 03 goats (n=3) by applying randomize complete block design (RCBD) model. The four diets were comprises grazing on grassland for 6 h every day and serving of Barseem mixed with gram husk *adlibitum* (CD-Diet). Animals of other 03 treatment groups were offered with CD-Diet as basal feed together with the supplements i.e. Cotton seed cake (CS-Diet), Rape seed cake (RS-Diet) as well as Maize oil cake (MC-Diet) in the evening. In CS-Diet the amount of cotton seed cake was given 305grams per day per animal while in RC-Diet the amount of Rape seed cake was given 215 gram per animal daily, finally in MC-Diet the amount of Rape seed cake was given 418 gram daily to each animal of its respective group on iso-N basis. Supplementation of these oil seed cakes can provide up to 40% of the goat total nutrient necessities (NRC, 2001). Experimental period was of 30 days with first week

was given so that animals become adopt the change in their diet. Data regarding feed provided, time of grazing as well as feed refused was noted. For fatty acids analysis sample out four successive milking per week were taken in germ-free categorized tubes and were send to PCSIR laboratories located in District Peshawar in box having ice packs. Proximate composition including Crude Fiber, Ether Extract, Ash, Crude Protein as well as Dry Matter were taken using standard techniques of AOAC (1990) of samples of gram husk, bar seem, gram husk, all supplements as well as of grazing pasture in Animal Nutrition laboratory of FVAS Gomal University.Chloroform plus methanol in 2:1 proportion were used for extraction of fat from the sample (Folch *et al*., 1957). 150 mg of inner standard (C13:0) in every 1000ml of chloroform methanol was added and the filtration of takeout fat was done by using the climax tubes. These climax tubes were then shaken strongly after addition of distilled water up to 2.2 ml and was then put into the centrifuge for 5 min and the speed of centrifuge was set 2000 rpm. Subsequently centrifugation the supernatant was discarded repeated washing was done and then washing was done with solution comprising 470, 30 as well as 489 ml of salt solution, chloroform as well as methanol respectively. From bottommost layer up to 3 ml was taken and via applying both base as well as acid catalysed procedure the FA were Trans (esterified), Sodium hydroxide methanolate having 0.5 normality was added in the tubes up to 0.5 ml and then for ten min at the temperature of 140 ^{o}F the tubes were heated. Hcl methanol in the proportion of 1:1 was added for free FA methylation. For the purpose of collection of methyle esters (FAMEs) of the FA hexane up to 2 ml was added. For obvious separation of the hexane layer first a saturated Nacl sol was used followed by and keeping it in the centrifuge machine for 5 minutes at the speed of 2000 rpm and finally the obtained hexane was shifted to GC vials. FAMEs were quantifying GC along with a capillary column having 100m × 0.25mm as well as film thickness was joined to it. Subsequent GC temperature plan was applied: during initial 4 min temperature was 284 ^{0}F, then was raised at 39.2 ^{o}F per minute so that it finally touched to 464 ^{0}F and then temprature was maintained at that level for next 20 minutes. Temperature for detector was set at 536^{0}F while temperature of injector was 482^{0}F. Identification of FAMEs was performed via external standards. Calculation of specific FAMEs substances was done from highest area of the FAME.

Results

Chemical Composition of different feed ingredients

Proximate composition including DM, CP, EE, CF, and ASH on dry matter basis of collected samples from supplements, Gram husk as well as chopped Barseem was

performed in the Animal Nutrition lab of FVAS Gomal University. Collected data is summarized in the table 1.

Table 1. **DM basis chemical composition of offered feed stuff**

Feed Ingredients	Crude Protein	Dry Matter	ASH	Crude Fat	Crude Fiber
Mustard seed cake	32.1	91.9	12.2	9.7	19.8
Gram Husk	6.1	90.9	13.7	0.6	44.8
Maize oil cake	16.7	94.7	1.7	12.8	9.9
Cottonseed cake	23.6	91.6	6.8	8.8	27.9
Barseem fodder	15.3	23.3	20.8	2.6	26.4

FA profile of goats supplemented with oilseed cakes

Data is given in the table 2. MCFA in goat milk are Caproic, Caprylic and Capric acids. Caproic acid was noted (2.96%) for the RC-Diet and was the uppermost (P<0.001) tailed with the (2.87%) for MC-Diet and (2.65%) for CS-Diet while (2.42%) the lowest C6:0 was recorded for CD-Diet. Capric acid was recorded highest (P<0.001) (10.1%) for MC-Diet followed by (9.99%) and (9.45%) for CS-Diet and RS-Diet respectively while lowest Capic acid was documented for CD-Diet (9.31%). Caprylic acid values were recorded insignificant among all groups. MUFA are Myristoleic acid, Heptadecenoic acid, Oleic acid, Elaidic acid and Erucic acid. Highest (P<0.001) Myristoleic acid was recorded (0.11%) for CS-Diet followed by for the MC-Diet and RS-Diet having (0.09%) and (0.07%) while lowest Myristoleic acid was recorded for CD-Diet having (0.06%). Similarly other MUFA including `Heptadecenoic acid, Oleic acid, Elaidic acid and Erucic acid were recorded highest (P<0.001) (0.37%), (10.1%), (0.40%) and (0.14%) for MC-Diet, CS-Diet, CS-Diet and RS-Diet respectively while lowest (0.25%) (9.50%) (0.09%) and (0.12%) were recorded for CD-Diet. PUFA present in goat milk are Linoleic, Linolelaidic, Linolenic, Arachidonic, Eicosatrienoic as well as the Eicosapentaneoic acid. C18:3n3 was documented the uppermost (P<0.001) (3.29%) for MC-Diet tailed with (2.91%) as well as (2.77%) for CS-Diet as well as for RC-Diet respectively while lowest Linoleic acid was noted (2.69%) for CD-Diet. Linolelaidic acid was noted highest (P<0.001) for CS-Diet (0.62%) while lowest Linolelaidic acid was noted for (0.37%) for CD-Diet. Linolenic acid was recorded highest (P<0.001) (1.65%) for RS-Diet and lower most values of Linolenic acid were observed (0.95%) for CD-Diet. Arachidonic acid was recorded highest (P<0.001) (0.10%) for MC-Diet while its lowermost percentage was noted (0.02%) for CD-Diet. Eicosatrienoic acid and Eicosapentaneoic acid were recorded highest (P<0.001) (0.33%) and (0.17%) for MC-Diet and RS-Diet respectively while Lowermost values of afore said FA was noted (0.26%) and (0.08%) for CD-Diet. SFA in goat milk are Palmitic

acid, Myristic, Margaric, Stearic, Archidic, Heneicosylic, Behenic, Lauric, Tridecylic as well as Pentadecylic acid. Palmitic acid was recorded highest (P<0.001) (29.1%) for Diet-CD while lowest (25.2%) was recorded for CS-Diet. Myristic acid was also recorded highest (P<0.001) (17.9%) for CD-Diet while lowest value of Myristic acid was noted (15.2%) for RS-Diet. Stearic acid was also recorded highest (P<0.001) (14.9%) for RS-Diet while lowest stearic acid values were recorded (7.76%) for CS-Diet. Lauric acid was recorded highest (P<0.001) (7.43%) in the milk of goats offered with CD-Diet while lowest lauric acid was recorded (6.39%) for RS-Diet. So finally it was the outcome that Supplementation of oil seed cakes can increases the percentage of MCFA, MUFAs and PUFAs while the percentage of almost all SFA was recorded lowest for treatment groups.

Table 2. FA profile of goats supplemented with oil seed cakes

FAs		**CD - Diet**	**CS-Diet**	**RC - Diet**	**MC - Diet**	**SEM**	**P Value**
MCFA	C6:0;Caproic acid	2.42^{d}	2.65^{c}	2.96^{b}	2.87^{a}	0.089	0.0023
	C8:0;Caprylic acid	3.73	3.60	3.69	3.91	0.084	0.1066
	C10:0;Capric acid	9.31^{d}	9.99^{b}	9.45^{c}	10.1^{a}	0.006	0.0001
SFA	C11:0;Undecylic acid	0.14^{a}	0.13^{b}	0.12^{c}	0.13^{b}	0.003	0.0014
	C12:0; Lauric acid	7.43^{a}	6.84^{c}	6.39^{d}	6.86^{b}	0.029	0.0014
	C13:0;Tridecylic acid	0.26^{a}	0.24^{c}	0.25^{b}	0.24^{c}	0.003	0.0001
	C14:0;Myristic acid	17.9^{a}	16.5^{b}	15.2^{d}	16.1^{c}	0.006	0.0001
	C15:0;Pentadecylic acid	3.98^{a}	3.59^{c}	3.66^{b}	3.08^{d}	0.004	0.0001
	C16:0;Palmitic acid	29.1^{a}	25.2^{d}	27.3^{b}	26.1^{c}	0.001	0.0001
	C17:0;Margaric acid	2.87^{a}	2.80^{b}	2.20^{d}	2.66^{c}	0.004	0.0001
	C18:0;Stearic acid	8.24^{c}	7.76^{d}	14.9^{a}	11.3^{b}	0.006	0.0001
	C20:0;Archidic acid	1.13	1.27	1.12^{c}	1.05	0.00	0.000

		b	a		d	2	1
	C21:0; Heneicosylic acid	0.38 a	0.25 d	0.33b	0.28c	0.002	0.0001
	C22:0; Behenic acid	0.47 c	0.49 b	0.39 d	0.51a	0.002	0.0001
MUFA & PUFA	C14:1C;Myristoleic acid	0.06 d	0.11 a	0.07c	0.09b	0.002	0.0001
	C17:1;Heptadecenoic acid	0.25 d	0.32 b	0.37 a	0.30 c	0.002	0.0001
	C18:1C;Oleic acid	9.50 d	10.1 a	9.75 c	9.88 b	0.165	0.0001
	C18:1n9t;Elaidic acid	0.09 d	2.40 b	1.42 c	2.05 a	0.005	0.0001
	C18:2c;Linoleic acid	2.69 d	2.91 b	2.77 c	3.29 a	0.004	0.0001
	C18:2t; Linolelaidic acid	0.62 d	0.37 c	0.56 a	0.48 b	0.003	0.0001
	C18:3n3;Linolenic acid	0.95 d	1.34 b	1.65 a	1.13 c	0.001	0.0001
	C20:2c; Arachidonic acid	0.02 d	0.04 b	0.03 c	0.10 a	0.001	0.0001
	C20:3n6; Eicosatrienoic acid	0.26 d	0.28 c	0.29 b	0.33 a	0.003	0.0001
	C20:5n3c;Eicosapentaneoic acid	0.08 d	0.14 b	0.17 a	0.12 c	0.003	0.0001
	C22:1n9; Erucic acid	0.12 d	0.13 b	0.20 a	0.12 c	0.002	0.0001

Mean of superscriptions (^{abcd}) inside column are significantly dissimilar (P<0.001), Standard error mean abbreviation is SEM

Discussion

Recent work was completed to check that how oilseed supplements like Rape seed cake, Cotton seed cake as well as Maize cakes can influence the milk FA profile of lactating goats of Damani breed. According to our work MCFA like caprylic, caproic and Capric are present at a higher rate in goat milk as compare to the cow milk and also it gave an exceptional flavour to the goat milk. (Haenlein, 1993) work's outcomes were similar to our outcomes he noted that MCFA i.e. caprylic as well as capric acid are present at a higher percentage in goat milk (15%) while their percentage is only 5% in the milk of

cow. (Kelly *et al.,* 1998) recorded that MCFA percentage in milk of goat is higher as compare to the MCFA percentage of cow milk and MCFA has beneficial impact on health of human. We were noted in our research that when oilseed cakes are used as supplements can significantly maximize the level of PUFA as well as MUFA. C18:2c as well as C18:1c are the unsaturated FA present in the milk and their percentage was maximized by the use of cotton seed cakes as nutritional supplement (Chilliard *et al.,* 2003). (Zhan *et al.,* 2006) findings were similar to our findings he used oilseed cakes in the diet as a supplement and noted that they can have positive impact on the unsaturated FA and MCFA. (Grummer, 1991; Palmquist *et al*., 1993) used oilseed cakes in the feed of dairy cows and noted that level of unsaturated FA was increased so finally they concluded that FA profile of the milk can be improved by nutrition. MCFA when present in higher fraction then it has many beneficial impacts like it dissolves the reservoirs of body fat and can also have anti-bacterial as well as anti-viral (Shingfield *et al.,* 2008). Goat milk is popular among the public of advance countries especially in those people having diseases of gastro intestinal tract and the people having allergy from cow milk (Chilliard *et al.,* 2006). Goat milk is often suggested by the physicians for young babies as well as the aged people and this because fat in the milk of goats are more digestible as compare to the fat present in the milk of cow and few reasons for this are first is the fat globular size and second one is the higher percentage of MCFA in the milk of goat (Bernard *et al.,* 2009). Intake of milk products are believe to enhance the low density lipids (LDL) is basically related to the concentrations of following FA i.e. Palmitic C16:0, lauric C12:0 as well as Myristic C14:0. So when there concentration is high in the milk products it leads to LDL which is the main cause of cardio vascular disease, however some SFA are good for human health because they increases the level of high density lipids effect since they increase HDL level According to our results SFA are lower with the supplementation of oil seed cakes (Parodi *et al.,* 2009). In our studies we observed that use of oil seed cakes in the diet can lower the percentage of FA related to the synthesis of LDL.

Conclusions

It was concluded that milk MCFAs, MUFAs and PUFAs levels of treatment group was noted higher as compare to the control group. Similarly at the same time animals of control group has high levels of milk SFAs as compare to milk SFAs level of treatment groups. So finally we recommend that the use of oil seed cakes in the diet of lactating Damani goats can improve the milk FA profile as it increases the percentage of MCFAs, MUFAs and MUFAs.

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