



Effect of Supplementary Crushed Rapeseed on Ewes and Lambs Performance of Salt Range Sheep

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ABSTRACT

Study was designed with aim to determine varying levels of supplementary crushed rapeseed (CRS) a month before and two months after lambing on ewe's and lamb's performance in Salt Range sheep. Pregnant sheep (n = 12) were chosen and divided into 3 equal treatment groups. Ewes in control (T₀), T₁ and T₂ treatment groups were supplemented with CRS at 0, 25 and 50 g/d, respectively. Data of parameters were collected and analyzed through ANOVA technique using SAS 9.3 Portable and Sigma Plot Software under Completely randomized design. Weight gain of ewes was increased (P<0.05) substantially throughout period with CRS 25g/d and 50g/day but difference amongst treatment was not significant. The weight of the lambs at birth and 7th day age was increased (P<0.05) with CRS 25g/d and 50g/d as compared to control but no difference (P>0.05) was found between treatments. The higher survival rate of lambs (P<0.05) was found in CRS 25 g/d, followed by 50 g/d and then 0 g/d. Milk constituents; solid not fat, density, lactose, minerals and protein were increased (P<0.05) with increasing rate of dietary supplementation of CRS except fat percentage. In case of blood parameters, effect of dietary supplementation of CRS was found variable. It is concluded that 25 g/d CRS is an optimum dietary supplementation level a month before and two months after lambing for adequate weight gain and milk quality in terms of all constituents except fat percent in Salt Range ewes as rapeseed has gross energy 6420 kcal/kg and crude proteins 18.6% which plays an important role in nutritional and food applications. This dietary supplementation level in grazing ewes can also trigger better birth weight and survival rate in newly born lambs.

Article Information

Received 13 May 2022

Revised 18 June 2022

Accepted 05 July 2022

Available online 12 September 2022 (early access)

Authors' Contribution

MR performed experimental work. MF designed the study and helped in preparing the manuscript. MM supervised the research work and helped in data analysis. UN helped in data collection and sample collection. ES and MA provided technical help for hematological analysis and research material for lab analysis.

Key words

Salt range sheep, Dietary supplementation, Crushed rapeseed, Ewe's weight gain, Lamb survival and Hematology

INTRODUCTION

Sheep has become potential source of livelihood for farmers in Pakistan through significant contribution in mutton with fiber production and generally lambs are well accepted for sacrificial purposes at higher prices. Lamb production has increased dramatically over the world, particularly in arid areas, to meet the demands of a growing

population (Morshedy *et al.*, 2020). Pakistan is blessed with 31.6 million sheep recently (GOP, 2020-2021). Salt Range is prominent and single fat tailed sheep breed of Punjab province. It's delicious meat, better carcass yield and well-adjusted habitat makes this breed quite popular among farmers and consumers (Qureshi *et al.*, 2020). Salt Range is well known in Pothwar region; which spans four districts in Punjab: Attock, Jhelum, Chakwal, and Rawalpindi.

Meat and meat products of sheep is rich source of omega (n-3) poly-saturated fatty acids (Chikwanha *et al.*, 2018) and is a key source of protein, vital vitamins, and minerals (Sohaib and Jamil, 2017). However, adult female sheep (ewes) are struggling to fulfill their energy requirements due to limited rainfall and poor vegetation cover which leads to two important problems: lamb mortality and inadequate milk yield. Lambs died possibly due to reduced production of ewes (Cruz *et al.*, 2017) which

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0030-9923/2022/0001-0001 \$ 9.00/0



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may be followed by low birth weight. The first month after birth is very crucial for lambs making their organs fully functional (Ibrahim *et al.*, 2018). Feed supplementation with enriched energy source may influence productivity of ewes as well as lambs.

Feeding optimum diet is the most effective way to upgrade the milk profile in ruminants (Perez *et al.*, 2020). Nutritionally rich milk can be obtained by using oil seeds (Kennelly, 1996). High-energy diet like adding fat or oil to the diets of ruminants can help in covering the requirements of high energy for high milk yield (Ghoniem and Atia, 2020). Diet enriched with protein and having high energy can help to improve the performance of sheep. Rapeseed (*Brassica napus*) is well enriched with gross energy 6420 kcal/kg and crude proteins 18.6% (Feedinamics, 2022) that may improve nutritional value, functional properties and play important role in food as well as non-food applications (Chmielewska *et al.*, 2020). Its protein profile in terms of essential amino acid is far better than cereals (Nega and Woldes, 2018) and has become important nutrient for ruminants in late pregnancy (Koushki *et al.*, 2019). That's why rapeseed has great feeding value for animals. Natural additive supplementation has improved the nutritional value of milk as well as the lactation performance (Khatab *et al.*, 2020). The current study was designed with aim to investigate the influence of varying dietary supplementation levels of crushed rapeseed in Salt Range ewes during pre-lambing and post-partum period for optimum production performance and survivability of newly born lambs. The possible outcome might be improved status of available nutrients pool which could be required for ewes to nourish their lambs adequately. It was hypothesized that Salt Range ewes' production performance and lamb survivability might or might not be improved by different dietary supplementation levels of crushed rapeseed.

MATERIALS AND METHODS

Experimental site

University Research Farm, Koont Tehsil Gujar Khan District Rawalpindi, Punjab, Pakistan, was used for the research. This experimental site is located in Dhudial, a well-known village in the District Chakwal, at 33°3'52N 72°58'24E, around 70 kilometers from Pakistan's capital city, Islamabad. The average annual temperature ranges from 36° to 101°F, rarely falling below 31° or rising over 108° F. Location has an arid to semi-arid environment with 500 to 1000 mm of yearly rainfall.

Experimental treatments

Advance pregnant sheep of similar age and body condition (n = 12) were chosen from the salt Salt Range

flock at University Research Farm Koont and put into three equal weight groups: Control treatment group, treatment-1 group, and treatment-2 group. Each group consisted of four ewes. The diet of pregnant ewes in the control group (To) was supplemented with crushed rapeseeds (CRS) at a rate of zero g per day, whereas animals in T1 and T2 received supplements at rates of 25 g per day and 50 g per day, respectively. Dietary therapy was assigned to sheep at random using a Completely Randomized Design. The research trial was started in October, 2021 and ended in January, 2022. The overall research period was of 90 days. The trial began 30 days before expected lambing and ended on the 60th day of the post-lambing phase. According to ethical standards, experimental animals were given five freedoms from hunger, thirst, pain, stress, and an environment that let them to behave normally. Animals were allowed for range grazing in day and kept in small ruminant sheds in the evening. The concentrate was provided uniformly to all animals as per their requirements under uniform housing and management conditions.

Parameters studied

Pre-partum weight (kg at -30 d), postpartum weight (kg at 30 d), postpartum weight (kg at 60 d), birth weight of lambs (kg), lamb weight (kg at 7, 30, 60 d), milk composition fortnightly (milk fat percent, solid not fat percent, density, lactose percent, minerals percent, protein percent, and pH) and blood parameters were used to determine the effect of supplementing crushed rapeseed (hemoglobin, red blood cells, white blood cells, packed cell volume, mean corpuscular volume, mean corpuscular hemoglobin, lymphocyte, eosinophils, blood cholesterol, high density lipids, low density lipids, total lipids and triglycerides).

Data collection

The ewes were weighed before the trial began, and their weight was measured weekly with a digital dial balance both pre-lambing and post-lambing. Lambs were weighed shortly after birth, then again at seven days, thirty days, and sixty days. Milk samples were taken in test tubes fortnightly and analyzed through Lactostar. Blood samples were taken from jugular vein in EDTA tubes once in a month. Both samples were kept in ice-cooler for the safe delivery to the lab, for analysis. The lamb survival rate was calculated by counting the number of dead and alive animals and calculating their percentage.

Statistical analysis

The data was analyzed through ANOVA technique using SAS 9.3 software under Completely Randomized Design (CRD), whereas blood parameters were analyzed using Sigma Plot Software. The Duncan Multiple Range

Test was applied to conduct mean comparison.

RESULTS

Effect of feeding supplementary crushed rapeseed a month before and two months after lambing on production performance in Salt Range ewes during pre-partum and postpartum period was determined through following parameters.

Weight gain in ewes

Results regarding weight gain in ewes are illustrated in Table I. Weight gain in ewes was increased ($P < 0.05$) during prepartum and postpartum periods through 25g/d and 50g/day supplementation of crushed rapeseed as compared to control but difference between the two dietary levels observed was not substantial ($P > 0.05$). The same pattern was followed in post-partum period (30 days and 60 days).

Birth weight and weigh gain in lambs

The birth weight of newly born lambs was increased ($P < 0.05$) for treated groups in contrast to control but birth weight of newly born lambs was not different ($P > 0.05$) amongst treated groups. The same pattern was found in the case of weight in lambs 7 days after birth as mentioned in Figure 1. The higher survival rate of lambs ($P < 0.05$) was found in the group treated with 25 g, followed by 50 g and then zero gram crushed rapeseed (control).

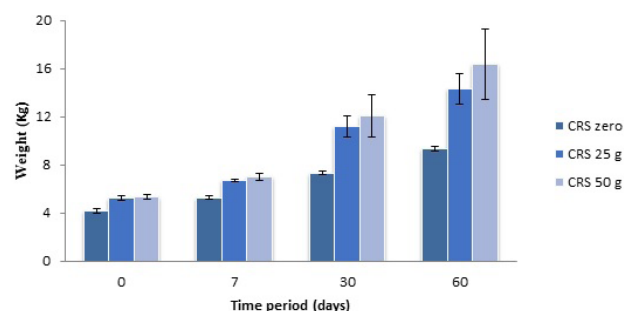


Fig. 1. Effect of dietary supplementation of crushed rapeseed on lambs weights (Mean±SE) of Salt Range ewes.

Milk composition

Effect of feeding supplementary crushed rapeseed a month before and two months after parturition on milk composition in Salt Range ewes during postpartum period was mentioned in Table II. Percentage of milk constituents in ewes, solid not fat, density, lactose, minerals and protein are increased ($P < 0.05$) with increasing rate of dietary supplementation of crushed rapeseed except fat percentage. Milk fat was decreased ($P > 0.05$) in the group treated with 25g/d of crushed rapeseed as compared to control, whereas, it was also increased ($P < 0.05$) in the group fed 50g/d of crushed rapeseed as compared to the group fed 25g/d crushed rapeseed. The pH was not different ($P > 0.05$) amongst treated groups with 25g/d CRS and 50g/d CRS, but decreased ($P < 0.05$) as compared to that of control treatment.

Table I. Effect of supplementing feed with crushed rapeseed on pre-partum and post-partum production performance in Salt Range ewes (Mean ± SE).

Body Wt. (Kg)	Day	Dietary treatments		
		T ₀ : CRS zero g (Control)	T ₁ : CRS 25 g	T ₂ : CRS 50 g
Initial weight	0	51.50 ± 0.64 ^a	51.33 ± 0.88 ^a	52.50 ± 1.19 ^a
Pre partum weight	-30	52.25 ± 0.32 ^b	55.66 ± 0.33 ^a	56.50 ± 1.32 ^a
Postpartum weight	30	46.50 ± 0.50 ^b	56.00 ± 2.64 ^a	57.50 ± 2.66 ^a
Postpartum weight	60	45.50 ± 0.28 ^b	60.66 ± 3.38 ^a	62.00 ± 6.16 ^a

CRS, Crushed rapeseed; ^{ab}, Means with varying superscripts in rows are different ($P < 0.05$).

Table II. Effect of supplementing feed with crushed rapeseed on post-partum milk profile of ewes (Mean ± SE).

Parameters	Day	Dietary treatments		
		T ₀ : CRS zero g (control)	T ₁ : CRS 25 g	T ₂ : CRS 50 g
Milk fat (%)	30	6.23 ± 0.09 ^a	2.00 ± 0.05 ^c	5.40 ± 0.13 ^b
SNF (%)	30	8.99 ± 0.10 ^c	10.92 ± 0.27 ^b	14.48 ± 0.09 ^a
Density	30	28.21 ± 0.50 ^c	39.53 ± 0.73 ^b	50.40 ± 0.15 ^a
Lactose (%)	30	5.02 ± 0.16 ^c	5.94 ± 0.12 ^b	7.93 ± 0.03 ^a
Minerals (%)	30	0.72 ± 0.00 ^c	0.88 ± 0.01 ^b	1.19 ± 0.00 ^a
Protein (%)	30	3.28 ± 0.05 ^c	3.94 ± 0.07 ^b	5.31 ± 0.00 ^a
pH	30	2.50 ± 00 ^a	2.05 ± 00 ^b	2.05 ± 00 ^b

CRS, crushed rapeseed; ^{abc}, means with varying superscripts in rows are different ($P < 0.05$).

Blood parameters

Effect of feeding supplementary crushed rapeseed a month before and two months after parturition on blood parameters in Salt Range ewes is presented in Table III. Effect of time period on blood parameters and lipid profile is depicted in Table IV. Supplementation of varying crushed rapeseed levels did not influence ($P>0.05$) hemoglobin concentration, packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), lymphocytes, neutrophils and monocytes. However, RBCs and WBCs count decreased ($P<0.05$) in both treatment groups; CRS (25g/d and 50g/d) as compared to control but the decrease in group (25g/d) is significant as depicted in the Table. Whereas, platelets and eosinophils were increased ($P<0.05$) in the group fed 50g/d CRS as compared to control and the group fed 25g/d CRS. The MCH concentration increased ($P<0.05$) in both the treatment groups as compared to control. No change ($P>0.05$) was observed in cholesterol level, low density lipids, triglycerides and total lipids. However, high density lipids increased ($P<0.05$) in both treatment groups.

Table III. Effect of supplementing feed with crushed rapeseed on pre-partum and post-partum blood parameters of ewes (Mean \pm SE).

Parameters	Dietary treatments		
	T ₀ : CRS zero g (Control)	T1: CRS 25 g	T2: CRS 50 g
Hb (μ g/dL)	9.00 \pm 0.85 ^A	8.67 \pm 1.84 ^A	7.72 \pm 0.91 ^A
RBCs ($\times 10^6/\mu$ L)	8.72 \pm 0.98 ^A	6.82 \pm 1.71 ^B	7.03 \pm 0.94 ^{AB}
WBCs ($\times 10^3/\mu$ L)	118.00 \pm 51.92 ^A	47.15 \pm 24.97 ^B	79.91 \pm 45.23 ^A
Platelets ($\times 10^3/\mu$ L)	439.58 \pm 161.30 ^B	406.58 \pm 165.98 ^B	1211.33 \pm 310.39 ^A
PCV (g/dL)	29.42 \pm 3.7 ^A	25.15 \pm 7.56 ^A	28.43 \pm 4.22 ^A
MCV (fL)	34.38 \pm 2.75 ^A	38.11 \pm 3.1 ^A	38.69 \pm 4.56 ^A
MCH (pg)	15.2 \pm 3.87 ^A	12.09 \pm 2.12 ^A	20.31 \pm 5.32 ^A
MCHC (g/dL)	23.68 \pm 2.11 ^B	33.64 \pm 6.04 ^A	34.21 \pm 8.27 ^A
Lymphocyte (%)	63.50 \pm 4.59 ^A	60.66 \pm 25.75 ^A	51.66 \pm 12.73 ^A
Eosinophils (%)	01.00 \pm 0.54 ^B	02.00 \pm 0.54 ^B	08.91 \pm 2.89 ^A
Monocytes (%)	13.33 \pm 4.68 ^A	14.25 \pm 5.66 ^A	18.91 \pm 5.77 ^A
HDL (mg/dL)	26.33 \pm 4.49 ^B	46.25 \pm 11.16 ^A	52.83 \pm 13.76 ^A
LDL (mg/dL)	61.50 \pm 14.61 ^A	42.66 \pm 13.23 ^A	54.66 \pm 20.51 ^A
Cholesterol (mg/dL)	138.00 \pm 17.11 ^A	132.00 \pm 17.03 ^A	152.00 \pm 30.36 ^A
Triglycerides (mg/dL)	252.91 \pm 14.43 ^A	249.25 \pm 24.78 ^A	244.50 \pm 22.3 ^A
Total lipids (mg/dL)	874.00 \pm 44.73 ^A	948.66 \pm 93.77 ^A	928.33 \pm 58.26 ^A

Hb, hemoglobin; RBCs, red blood cells; WBCs, white blood cells; PCV, packed cell volume; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin Concentration; HDL, high density lipids; LDL, low density lipids. ^{AB} Means with varying superscripts in rows are different ($P<0.05$).

Table IV. Effect of pre-partum and post-partum time period on hematology and lipid profile of Salt Range ewes.

Parameters	Pre partum (-30 d)	Post-partum (+30 d)	Post-partum (+60 d)	SEM	Sig
Hb (μ g/dL)	9.75 ^a	9.34 ^a	7.72 ^b	0.40	0.003
RBCs ($\times 10^6/\mu$ L)	8.52 ^a	8.89 ^a	5.18 ^b	0.37	<0.001
Platelets ($\times 10^3/\mu$ L)	110.86 ^a	117.95 ^a	16.75 ^b	15.19	<0.001
PCV (g/dL)	391.33 ^b	386.67 ^b	1567.16 ^a	184.87	<0.001
MCV (fL)	29.433 ^a	33.91 ^a	19.67 ^b	1.625	<0.001
MCH (pg)	10.313 ^b	10.51 ^b	20.32 ^a	1.075	<0.001
MCHC (g/dL)	30.933	27.68	32.93	2.052	0.208
Lymphocyte (%)	52.083 ^b	52.92 ^b	70.83 ^a	4.914	0.018
Eosinophils (%)	19.583 ^a	19.583 ^a	7.333 ^b	1.726	<0.001
Monocytes (%)	375.75 ^a	325.83 ^a	45.083 ^b	8.302	<0.001
HDL (mg/dL)	24.500 ^b	26.00 ^b	74.917 ^a	3.70	<0.001
LDL (mg/dL)	55.667	55.42	47.750	5.49	0.519
Total lipids (mg/dL)	1071.75 ^a	1178.75 ^a	501.25 ^b	24.33	<0.001

HDL, high density lipids; LDL, low density lipids. ^{ab} Means with varying superscripts in rows are different ($P<0.05$). See Table III for details of abbreviations.

DISCUSSION

Based on the findings of this study, it has been demonstrated that supplementation of crushed rapeseed has increased pre-partum and post-partum growth in relation to the weight gain of Salt Range ewes. Improved performance in ewe's growth is also reflected in published literature that supplementation of whole-grain foods can significantly increase the weight of ewes (Kott *et al.*, 2003) and dairy goats as well (Abdel-Gawad *et al.*, 2017). This may be due to the improved energy status feature as crushed rapeseed is a rich source of nutrients. Rapeseed has been reported as a rich source of protein, fiber and energy that can enhance nutritional value and functional properties (Chmielewska *et al.*, 2020). The other factor may be dietary protein which has become important nutrient for ruminants in late pregnancy (Koushki *et al.*, 2019). Similarly, Njoya *et al.* (2005) also reported positively that protein supplementation to grazing ewes with low energy diet had improved their body weight. Contrary to the findings of this study, Britt *et al.* (2019) reported different results; to reduce the weight of the animals. The reason for this divergence may be the use of endophytic fungi in such studies that may reduce weight loss by reducing dry

matter intake.

Dietary supplementation of crushed rapeseed during the pre-partum period of ewes not only benefited their selves with energy needs but also produced beneficial results in terms of birth weight and weight gain of newly born lambs. Positive influence on lamb's performance is substantiated in published literature that dietary supplementation in late pregnancy period has increased the birth weight of lambs (Idris *et al.*, 2010; El-Ghousein, 2010). Improved nutritional status of ewes directly influenced the growth rate of lambs in terms of better birth weight and considerable weight gain after birth Sadarman *et al.* (2021) as first month after birth is very crucial for the proper functioning of all organs in lambs (Ibrahim *et al.*, 2018). The positive impact on lamb's performance might be attributed to provision of adequate energy and protein required for embryonic and fetal growth as well as maintenance of animal physiological requirements (Idris *et al.*, 2010). In addition to above, lamb's survivability was also improved as birth weight plays crucial role in determining the mortality of kids (Turkson, 2003). As, mortality of the lambs is mainly followed by the low birth weight (Ibrahim *et al.*, 2018). Few other workers also substantiated that inclusion of oil or oil seeds/high energy feed in diet during pre-partum period triggered better survival of lambs (Encinias *et al.*, 2004; Cruz, 2017).

Milk constituents of ewes fed supplementation of crushed rapeseed was improved except fat content in this study. The significant increase in milk constituents and improved milk profile has been also reflected in published literature by dietary oil seeds (Ebeid *et al.*, 2019; Zhang *et al.*, 2006; Kholif *et al.*, 2015). However, significant decrease in fat content of milk yielded by ewes fed supplementary crushed rapeseed is also affirmed by few workers. Feeding oil seeds decreased fat but increased protein and SNF (Mohamed *et al.*, 1988). In case of blood parameters, effect of dietary supplementation of crushed rapeseed in Salt Range ewes was found variable. The findings of the present study on blood fractions are also consistent with previous practice (El-Ghousein, 2010; El-Hawy, 2018). Hemoglobin, PCV is unaffected by the use of oil seeds (El-Gohary *et al.*, 2012). Red blood cells are reduced by feeding seeds based on dietary pellets (Ojo *et al.* 2018). HDL increased as a result of feeding oil seeds (Buccioni *et al.*, 2017; Idris *et al.*, 2014). However, low density lipids (LDL) were not changed. The impact of CRS on blood parameters is not well understood, and more research is needed.

CONCLUSION

It is concluded based on findings of current study

that 25 g/d crushed rapeseed is an optimum dietary supplementation level a month before and two months after lambing for adequate weight gain and milk quality in terms of all constituents except fat percent in Salt Range ewes. This dietary supplementation level in grazing ewes can also trigger better birth weight and survival rate in newly born lambs.

RECOMMENDATIONS

The use of rape seeds has shown positive results in current research. We recommend that farmers and researchers may use it throughout pregnancy. It may help the animal to meet the energy and protein needs during the stressful gestation period especially when sheep underfed. Further research is needed to explore benefits of dietary supplementation of rapeseed in small ruminants.

ACKNOWLEDGEMENTS

Efforts of Mr. Muhamad Arif Veterinary Officer, Mr. Ameer Sultan Veterinary Assistant, Mr. Muhammad Atif Raza Research Associate and Miss Mehwish Kanwal M.Phil Scholar are highly appreciated for their kind support. Cooperation granted from staff of Physiology Laboratory, Department of Veterinary Biomedical Sciences, PMAS-Arid Agriculture University Rawalpindi is also acknowledged. The partial funding from PI of PSF/NSLP (861) project titled, "Traceable beef production: An innovative production system to develop consumer trust on food safety through traceability" enabled us for lab research and analysis.

Statement of conflict of interest

The authors have declared no conflict of interest.

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