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Research Article

Effect of by-pass protein supplements on milk production of dairy cattle

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ABSTRACT

Bypass protein stimulates the voluntary feed intake, increase quality milk production and thereby improves the economic status of dairy cows farming. This study was conducted to assess the effect of supplementation of bypass protein on lactation performance of dairy cattle. The experiment was conducted by using 2 factorial completely randomized designs. Milk yield of individual animal was recorded daily and milk composition was recorded at fortnight interval. Results revealed that the average daily milk yield of cows fed with Heat treated soyabean cake-T1 (4.29 L) was greater than cows fed with formalin treated soyabean cake-T2 (3.56 L) followed by control group-T3 (2.62 L). . The fortnight average milk protein and fat percentages were 2.91, 2.94 and 3.18% and 5.52, 5.55 and 4.47% for T0, T1 and T2 groups respectively. The weekly average milk SNF and milk density were 8.12, 8.37 and 8.64 % and 25.67, 27.80 and 27.10%, for group T_0, T_1 and T_2 respectively. Experiment revealed that by-pass protein supplementation to lactating animals is one of the option for improving the milk production and milk composition and suggested that further study should be conducted to precise the optimum level of bypass protein supplementation and to quantify the experimental period.

Keywords: By-pass protein, dairy cattle, milk composition, milk production and soyabean cake

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INTRODUCTION

In Nepal, the economy is dominated by agriculture. The contribution of agricultural sector (agriculture, forest and fisheries) in total Gross Domestic Product is estimated to be 27.6 percent in the current FY 2017/18 which was 28.8 percent in the FY 2016/17. The annual growth rate of agriculture in the basic price level is estimated to be 2.7 percent in the current FY (MoF, 2018). Livestock plays significant role in the Nepalese economy contributing around 11% to the national gross domestic product.(MoLD, 2017). Around 6% come from the buffaloes (MoAD, 2016). Livestock has a high potential for growth in Nepal. At present, the total annual milk production of Nepal is 1911239 metric ton (Mt) (1245954 Mt from buffalo and 665285Mt from cattle). The population of cattle and buffalo of the country is estimated to be 7.347 and 5.177 million, respectively (MoLD, 2017).

Demand for energy is very high during early stage of lactation but supply is not commensurate with demand due to physiological stage or limited intake, it may affect production potential of animal in the whole lactation length (Sirohi *et al.*, 2010). Protein supplements are more expensive and increase the feed cost. The utilization of dietary protein in the ruminant animal is lower than a simple hydrolytic digestion process because the digestion in ruminant animal depends essentially upon a fermentative process in rumen before the enzymatic digestion (Satter and Roffler, 1975). Highly degradable proteinous oil cakes when ingested by ruminants, result in large scale ammonia production, much of it gets wasted as urea excreted through urine. Even the animal has to spent energy to convert ammonia into urea in liver. In order to increase the efficiency of protein utilization from the highly degradable cakes, these proteins need to be protected from excessive ruminal degradation and can be used as bypass protein, so that the amino acids from these protein feeds are absorbed intact from the intestines of the animal for tissue protein synthesis as well as for the process of gluconeogenesis in liver (Walli, 2005).

The term "bypass protein" describes dietary protein that, either by some means of alteration or because of type of protein, is resistant to degradation by the rumen microbes. This undigested dietary protein would "bypass" the rumen and would be potentially available to meet the protein needs of the host animal after digestion in the small intestine.

Soybean meal (SBM) is the most commonly used protein supplement in beef and dairy diets. It is very palatable and has a good amino acid balance and high availability. Its bypass essential amino acid index is just next to ruminal microbial protein beating all other un-degradable protein sources (Chandler, 1989). Relative to other commonly used feed proteins, Soybeans (SB) are rich in lysine but methionine, valine and isoleucine are the first, second and third limiting amino acids, respectively (Schingoethe, 1996). In fact, of the common plant proteins used in animal feeds, SBM has one of the highest percentages of essential amino acids (47.6%) as a percent of crude protein (Schwab *et al.*, 1995). Some of the techniques, e.g., extrusion, roasting, expeller, lignosulfonate, formaldehyde have been successfully used to protect SB and SBM from ruminal degradation. Treating SB and SBM by these methods increases its ruminal bypass protein content up to 70% (Waltz and Stern, 1989).The objectives of the study were to analyze the benefits of supplementation of by-pass protein on milk production and milk composition of dairy cattle.

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MATERIALS AND METHODS

The study was conducted at National Cattle Research Program, Rampur, Chitwan.

Experimental animals: For this trial, 12 crossbred cows of same breed (J x HF), age, parity and milk yield were selected. The average stage of lactation of selected cows was around 3-5 weeks after parturition. The selected cows were divided into three groups with four animals in each group. Each animal was randomly located regarding one animal as one replication.

Plan and design of experiment: The selected cows were divided into three groups, viz. T_0, T_1 and T_2 of four cows each. The group T_0 served as control and received concentrate mixture routinely used on farm. Group T_1 served as treatment and fed as per group T_0 and supplemented with bypass protein (1.5kg heat treated soya cake) and group T_2 served as treatment and fed as per group T_0 plus supplementation of bypass protein (1.5kg formaldehyde treated soya cake). During trial period, the observations pertaining to milk yield and feed intake was recorded on daily basis, milk composition were recorded at 15 days interval for all the groups. The milk composition was studied in terms of lactose, milk fat, protein, density and SNF. At the end, the economics of milk production was also studied over the feed cost. The experiment lasted for 9 weeks. The experiment was conducted in two factorial completely randomized designs. Animals were randomly located with one animal assigned to one treatment. Each of the animals was regarded as one treatment. The data was analyzed at 5% level of significance.

Formaldehyde treatment of soybean cake: Soybean cake was treated with 1-1.2g formalin (40%)/100 g crude protein (CP) as suggested by (Thomas et al., 1979). At first, one part of formalin was diluted in nine part of water. Then after formalin diluted solution was sprayed over cake and mixed manually then the cake was stored in plastic bags for seven days.

Heat treatment of soya bean cake: Heat treatment was done as suggested by Suresh et.al, 2009 (125-150^{o}c for 2-4 hours in hot air oven).

Housing, management and health care: The experimental animals were housed in ideal sheds with proper ventilation, flooring and tying arrangements. Normal standards of hygiene, management, feeding practices, vaccination and deworming programs were followed for all the experimental dairy cows throughout the experimental period. Animals were let loose daily in paddock for roughage feeding, watering and exercise.

Feeding regime: Animals were kept for adaptation period of 1week. Half dose of the concentrate mixture was provided in the morning and half dose in the evening before milking. After milking animals were allowed to graze for 3 hours in the NCRP grazing lands. In the evening, after milking animals of both groups were provided adlib amount of green grass. In the day time animals were kept in open yard and they had easy access of fresh drinking water.

Data analysis
The ANOVA of two factorial CRD design was used. The experimental data were processed

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using Excel 2010 and analyzed by using Genstat 13.2. The treatment means were compared by the Least Significant Difference (LSD) test at 5% level (Gomez & Gomez, 1984; Baral *et al*., 2016; Sharma *et al*., 2016; Shrestha, 2019; Kandel & Shrestha, 2019; Jan *et al*., 2009).

RESULTS AND DISCUSSION

Milk yield: The average daily milk yield of cows from group T_1 and T_2 was higher than group T_0. Further, it was also observed that average daily milk yield of cows from group T_1 was higher than group T_2. This suggested that feeding of bypass protein in lactating cows is beneficial in increasing milk production. The higher milk yield in bypass protein supplemented cows may be due to increased supply of amino acids for absorption in small intestine. Similar results of increased milk yield fed with by-pass protein were presented by (Kunju *et al.*,1990; Kumar *et al.*, 2006).Similarly, Chaturvedi *et al.* (2001), Schor (2001), Garg *et al.* (2002a), Garg *et al.* (2003b) and Mishra *et al.* (2006) recorded significantly higher average milk yield in cows due to supplementation of bypass protein.

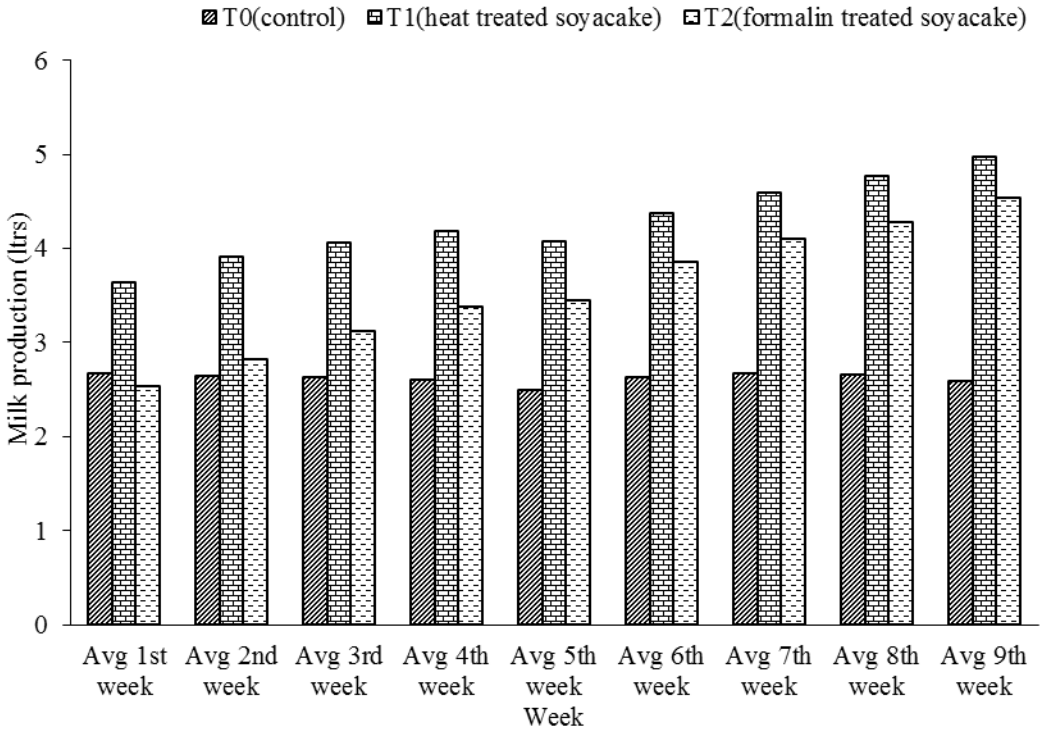

Figure 1. Weekly average daily milk yield (ltr) of cows fed different types of feed

Milk composition: Average milk fat percentage for groups T_0, T_1 and T_2 was 5.52, 5.55 and 4.47%, respectively. Thus, it was seen that highest fat percentage of milk was recorded in group T_1 receiving heat treated soya cake as bypass protein supplement followed by group T_0 receiving control feed. This group was followed by group T_2 receiving another source of bypass protein.Treatments had significant ($P<0.05$) effect on milk fat percentage. However, between the treatment groups milk fat percentage of group T_2 was significantly ($P<0.05$) higher than group T_1.This effect on milk fat percentage may be due to more availability of fatty acids for absorption in intestine due to protection of fat and these fatty acids are directly

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incorporated in milk fat after absorption from intestine, leading to increase in milk fat. Similar finding were observed by Kuen *et al.* (2002) Shelke *et al.* (2012), Garg *et al.* (2002b), Garg *et al.* (2009).

Average milk protein percentage for groups T_0, T_1 and T_2 was 2.91, 2.94 and 3.18%, respectively. Thus, it was seen that highest protein percentage of milk was recorded in group T_2 followed by group T_1 and control. This effect on milk protein percentage may be due to increased availability of essential amino acids for absorption in intestine due to protection of protein. The results of present study are in agreement with Garg *et al.* (2002a) and Garg *et al.* (2002b) who found significantly ($P<0.01$) higher milk protein percent in cows and buffaloes supplemented with rumen protected protein-fat. Similar results were observed by Maiga and Schingorthe (1997), Mishra *et al.* (2006).

Average milk SNF percentage for groups T_0, T_1 and T_2 was 8.12, 8.37 and 8.64 %, respectively. It was seen that T2 had significant effect on milk SNF percentage followed by T_1 and then followed by control. Similar results were reported by Mishra *et al.* (2004), Chaturvedi *et al.* (2001), Garg *et al.* (2002b), Mishra *et al.* (2006) and Chandrasekharaiah *et al.* (2008).

Average milk sugar percentage for groups T_0, T_1 and T_2 was 4.36, 4.48 and 4.36 %, respectively. Thus, it was seen that milk sugar percentage in group T_1 was slightly higher than control and T_2.

The average milk sugar from all experimental groups ranged from 23.78 to 28.69 %. Average milk density percentage for groups T_0, T_1 and T_2 was 25.67, 27.80 and 27.10 %, respectively. Thus, it is seen that milk density percentage in group T_1 and T_2 was higher than control.

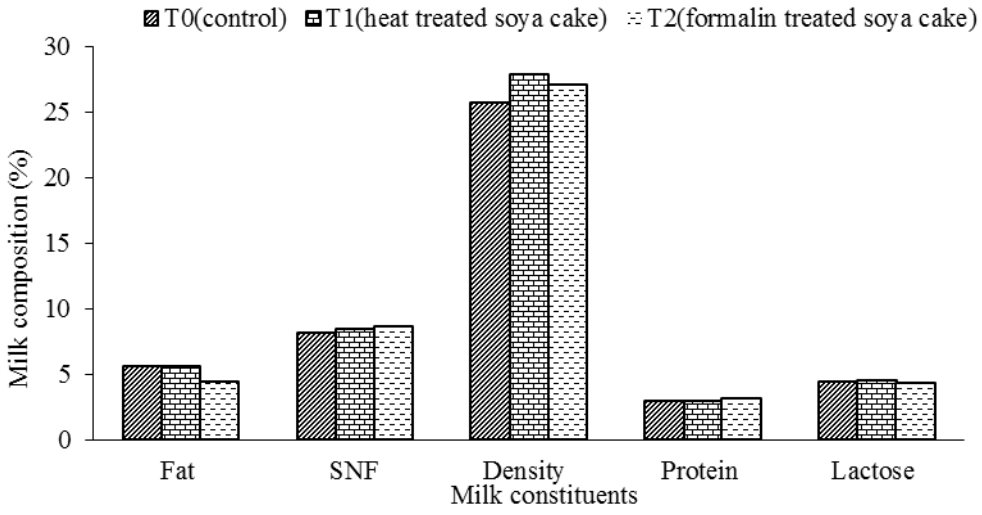

Figure 2. Fortnight average milk composition (%) of cow fed different types of feed

Effect of time interval on milk composition: Higher fat percentage was observed at 5th time interval (5.35%). Maximum SNF percentage was observed at 5th time interval (8.66%)

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followed by 3rd (8.44%) and 2nd (8.31%) time interval and minimum was recorded in 1st time interval (8.12%).Maximum protein percentage was observed at 5th time interval (3.14%).

Maximum milk density was observed in 5th time interval (27.83) followed by 3rd time interval (27.49) and minimum was observed in 1st time interval (25.56). Maximum lactose percentage was observed at 5th time interval (4.46%).

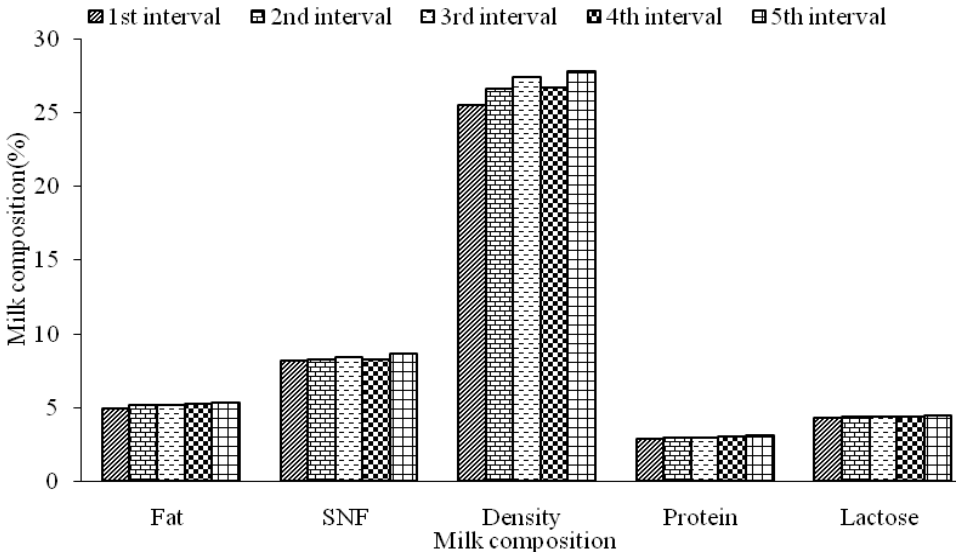

Figure 3. Fortnight average milk composition (%) of cow at different milking time interval

Economics: The total milk production per animal during 65 days of experiment was 339.95 liter, 446.93 liter and 367.58 liter for T_0, T_1 and T_2, respectively. The milk selling rate of local market was NRs 70/liter. Income from the selling of milk was calculated based on selling rate of local market which accounted NRs 23796.5, NRs 31285.1 and NRs 25730.6 for T_0, T_1 and T_2, respectively.

Table 1. Cost benefit analysis

Parameter	T1	T2	T3
Total milk production/ animal, liter	339.95	446.93	367.58
Milk cost, NRs	70	70	70
Income, NRs	23796.5	31285.1	25730.6
Feed cost, NRs	341 kg x 31.5 = 10741.5	372 kg x 31.5 = 11718	341 kg x 31.5 = 10741.5
Soybean cost, NRs	0	93 kg x 50 = 4650	93 kg x 50 = 4650
Straw cost, NRs	177.32 kg x 4 = 709.28	181.04 kg x 4 = 724.16	210.18 kg x 4=840.72
Labor cost, NRs	2040.83	2040.83	2040.83
Total cost, NRs	13490.78	19132.99	18273.05
Net income, NRs	10305.72	12152.11	7457.55

Feed soybean cake and straw cost was taken from the market whereas green grass cost was not accounted because of grazing and cultivated in the land of NCRP. One labor was hired for 12 lactating cattle milking, feeding, grazing and others. Therefore, cost of labor for one cattle accounted NRs 2040.83. The total cost of production was accumulated NRs 13490.78,

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NRs 19132.99 and NRs 18273.05 for T_0, T_1 and T_2, respectively. Net income was calculated by deduction of total cost from income of milk selling. The highest net income was noted in T_1 (NRs 12152.11) followed by T0 (NRs 10305.72) and T_2 (NRs 7457.55).

CONCLUSION

Thus, it is inferred that supplementation of bypass protein whether it is heat treated or formaldehyde treated soya bean cake is beneficial in improving milk production, milk composition, and also cost effective. As both the source of bypass protein either heat treated and formaldehyde treated soya cake increases the milk yield we can use any one source of bypass protein based on their availability and their cost. It also can be concluded that bypass protein should be supplied with different arrangement or in different quantity for increasing milk yield. This shows the further more need of research in this area. This provides the scope for further research for interested student in this field. Therefore, it is suggested that under those situations, where animal's basal diet is poor, comprising straw/stovers, grasses etc., bypass protein supplementation can lead to increase in milk yield. We also can increase the efficiency of high quality protein through the various treatment i.e. heat treatment and chemical treatment method.

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Authors Contribution

Puja Thapa designed and performed experiments, analysis of data and wrote the paper, Thaneshwar Pandey and Bhargab Dhital helped during the experiments and recording the observation and Rabin Acharya guided during analysis and write-up of the paper.

Conflict of authors

The authors declare that there is no conflict of interest regarding the publication of this paper.

REFERENCES

Baral, B. R., Adhikari, P., & Shrestha, J. (2016). Productivity and Economics of Hybrid Maize (*Zea mays* L.) in the Inner Terai Region of Nepal. *Journal of AgriSearch*, *3*(1), 13–16.

Chandler, P.T. (1989). Achievement of optimum amino acid balance possible. *Feedstuffs*, *61* (26), 24.

ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v2i1.26062

Chandrasekharaia, M., Sampath, K.T., & Praveen, U.S. (2008). Effect of feeding bypass protein on milk production performance crossbred cow. The Indian journal of animal sciences, *78*(5), 0367-8318

Chaturvedi, O. H., & Walli, T.K. (2001). Effect of feeding graded levels of undegraded dietary protein on voluntary intake, milk production and economic return in early lactating crossbred cows. *Asian-Australasian Journal of Animal Sciences*, *14*(8), 1118-1124.

Garg, M. L., Sherasia, P.L., Bhanderi,B.M., Gulati, S.K., & Scott, T.W. (2002a). Effect of feeding rumen protected nutrients on milk production in cows and buffaloes. *Indian Journal of Dairy Science*, *55*, 281-285.

Garg, M.R., Sherasia, P.L., Bhanderi, B.M., Gulati, S.K., & Scott, T.W. (2002b). Effect of feeding rumen protected nutrients on milk production in crossbred cows. *Indian Journal of Animal Nutrition*, *19*(3), 191-198.

Garg, M.R., Sherasia, P.L., Bhanderi, B.M.,Gulati, S.K., & Scott, T.W. (2003b). Effect of feeding rumen protected protein on milk production in lactating buffaloes. *Animal Nutrition and Feed Technology*, 3, 151–157.

Garg, M.R.,Sherasia, P.L., & Bhanderi, B.M. (2009). Effect of feeding different levels of bypass fat or protein supplement on the milk yield and composition in crossbred cows. *Indian Journal of Dairy Science*, 62(4)

Gomez, K, & Gomez, A.A. (1984). Statistical Procedures for Agricultural Research. 2nd edition. John Wiley and Sons Inc, New York, USA. 680 p.

Jan, M. T., Shah, P., Hollington, P. A., Khan, M. J., & Sohail, Q. (2009). Agriculture research: Design and analysis. A monograph. Peshawar Agricultural University

Kandel, M., & Shrestha J. (2019). Genotype x environment interaction and stability for grain yield and yield attributing traits of buckwheat (*Fagopyrum tataricum* Geartn). *Syrian Journal of Agricultural Research*, *6*(3), 466-476.

Kuen, C. J., Jan, D.F., Chiou, P.W.S., & Yang, D.W. (2002). Effects of dietary heat extruded soybean meal and protected fat supplement on the production, blood and ruminal characteristics of holstein cows. *Asian-Australian Journal of Animal Science*, 15(6), 821-827.

Kumar, M. R., Tiwari,D.P., & Kumar, A. (2006). Effect of undegradable dietary protein level and plane of nutrition on lactation performance in crossbred cattle. *Asian-Australian Journal of Animal Science*, *18*, 1407-1413.

Kunju, P. J. G., Mehta, A.K., & Garg, M.R. (1990). Effect of feeding of bypass protein to cross bred cows in india on straw based ration. *Asian Journal of Animal Science*, *5*(1), 107-112.

Maiga H.A., & Schingoethe, D. J. (1997). Optimizing the utilization of animal fat and ruminal bypass proteins in the diets of lactating dairy cows. *Journal of Dairy Science*, 80(2), 343-52.

Mishra, B. B., Swain, R.K., Sahu, B.K., & Samantaray, D.P. (2006). Effect of bypass protein supplementation on nutrientutilization, milk production and its composition in crossbred cows on paddy straw based ration. *Animal Nutrition and Feed Technology*, 6, 123-133

Mishra, S., Thakur, S.S., & Raikwar, R. (2004). Milk production and composition in crossbred cows fed calcium salts of mustard oil fatty acids. *Journal of Animal Nutrition*, *21*(1), 22-25.

ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v2i1.26062

MoAD. (2016). Statistical Information on Nepalese Agriculture, Ministry of Agricultural Development, 2016.

MoF. (2018). Economic Survey 2017/18, Ministry of Finance, 2018.

MoLD. (2017). Livestock statistics of Nepal, Ministry of Livestock Development, 2017.

Satter, L. D., & Raffler, R.E.(1975). Nitrogen requirement and utilization in dairy cattle. *Journal of Dairy Science*, *58*, 1219-37.

Schingoethe, D.J. (1996). Balancing the amino acid needs of dairy cows. *Animal Feed Science Technology*, *60*(3-4), 153-160.

Schor, A., & Gagliostro, G.A. (2001). Undegradable Protein Supplementation to Early-Lactation Dairy Cows in Grazing Conditions. *Journal of Dairy Science*, 84(7), 1597-1606

Sharma, H. P., Dhakal, K. H., Kharel, R., & Shrestha, J. (2016). Estimation of heterosis in yield and yield attributing traits in single cross hybrids of maize. *Journal of Maize Research and Development, 2(*1), 123-132.

Shelke S.K., Thakur, S.S., & Shete, S.M. (2012). Protected Nutrients Technology and the Impact of Feeding Protected Nutrients to Dairy Animals: A Review. *International Journal of Dairy Scienc*e, 7, 51-62.

Shrestha, J. (2019). P-Value: A true test of significance in agricultural research. Retrieved from *https://www.linkedin.com/pulse/p-value-test-significance-agricultural-research-jiban-shrestha/*

Sirohi S. K., Walli, T.K., & Mohanta, R.K. (2010). Supplementation effect of bypass fat on production performance of lactating crossbred cows. *Indian Journal of Animal Science*, 80(8), 733-736

Walli, T. K. (2005). Bypass protein technology and the impact of feeding bypass protein to dairy animals in the tropics: a review. *Indian journal of Animal Science, 75* (1), 135-142.

Waltz, D.M., & Stern, M.D. (1989). Evaluation of various methods for protecting soya-bean protein from degradation by rumen bacteria. *Animal Feed Science Technology*, 25, 111-122.