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# Growth Performance of Goats Fed with Increasing Levels of Rapeseed Cake Substituted with Soybean Meal in Tanki (*Bauhinia Purpurea*) Fodder-Based Diets

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**A B S T R A C T**

The effects of replacing the soyabean cake in a predetermined feed formula with rape seed cake were studied over the course of 90 days in the Gorkha district of Nepal. The replacement levels ranged from 0% to 33.33%, 66.66% to 100%. Twenty young local Khari male goats, aged 5-6 months, were chosen at random and assigned in a CRD design with four treatments and five replications. Four types of feed formula were prepared and fed to young male goats, each with 1.5% concentrate of their body weight (BW; BW taken fortnightly and amount fed calculated on 1.5% BW basis) and an ad lib amount of Tanki (Bauhinia purpurea) fodder. The effects of diet on feed intake, average daily gain, and total body weight were not statistically similar (P>0.05). The results showed that soyabean cake could be substituted from rapeseed cake in Tanki (Bauhinia purpurea) fodder-based diets in growing goat diets with no negative effects on body weight gain as well as feed intake. In parallel, incorporating local available fodder (Bauhinia purpurea) in ad lib with rapeseed cake could have better nutrition as well as better overall production parameters of young goats with higher economic possibilities.

Keywords: Dry matter intake, Goat production, Rapeseed cake, Soyabean cake, Weight gain

## INTRODUCTION

Due to its exceptional adaptability and resilience in challenging environments, goats play a crucial role in subsistence agriculture (Pokharel et al. 2009; Sharma 2015). Goats are likely to be useful in a variety of ways, including as a source of food, milk, hide, hair, and even manure. All cultures recognize the religious significance of goat meat. For example, (Dhakal and Subedi 2020) many countries in Africa and Asia suffer from low animal production because of a severe lack of feedstuffs and an insufficient supply (Osti 2019; Pokharel et al. 2009). The needs of small ruminants far outweigh their ability to obtain adequate nutrition. Entrepreneurs and investors have a lot to gain from the goat meat industry because it is expected to expand at a faster rate than the average business (Dhakal and Subedi 2020; Dhungana et al. 2012; Pokharel et al. 2009). All of the country's communities, for cultural reasons, have a strong preference for goat meat, indicating great potential for the goat market and goat meat production. This has been shown to be the case (Pokharel et al. 2009; Sharma 2015). The number of goats and their productivity have both been on the rise recently, but domestic supply still only meets 86% of the country's need, with the rest coming from the neighboring country (Anon n.d.; Osti 2019). According to 2017 figures, major livestock species are on the rise, with goats showing a faster rate of growth than any other species

Every region of Nepal's agroecological system relies heavily on shrubs and fodder trees for livestock production (Dhakal et al. 2020). Livestock herders frequently browse the foliage of fodder trees either while still on the trees or after they have been lopped (Dhakal et al. 2019, 2020).They can also be purchased in prepackaged forms for easy processing and feeding.

The high protein content (CP) of Tanki *(Bauhinia purpurea)* fodder trees (160-250 g per kg) makes them an important part of Neplese livestock diets (Dhakal et al. 2019; Dhakal and Subedi 2020)). There has been inconsistency and variability in the published literature regarding the effect of tree forages on the productivity of ruminants.

Production of chevon is often capped due to protein and energy feed shortages around the world (Morales, Alcaide, and Sampelayo 2008; Sanz Sampelayo et al. 1999). Several researchers (Morales et al. 2008) came to this conclusion. For livestock, soybean meal (SBM) is the primary source of protein in their diets (Morales et al. 2008). As its use in making food, animal feed, and fuel continues to rise, the price of soybeans on the global market has risen (Morales et al. 2008). Therefore, the economic viability of livestock production decreases when soybeans are included in their diets (Meissner 1997). As a result, it is critical to discover low-cost protein feed resources that are comparable to or superior to SBM in terms of their ability to sustain and enhance chevon production and quality. Potential protein sources include rapeseed cake (RSC), a byproduct of rapeseed (*Brassica napus)* oil factories.

Rapeseed cake is a by-product of cold-pressed oil processing, which has high crude protein (CP) content (341 ± 50.4 g/kg dry matter; DM) with relatively balanced amino acid composition (Kalogianni et al., 2022). Both previous and subsequent studies (Choi et al. 2015; Schingoethe, Beardsley, and Muller 1974) ethanol extract (116 15.5 g/kg dry matter) RSC has significantly more neutral detergent fiber (NDF; 395 40.7 g/kg DM) than SBM (40 15.9; 125 17.6 g/kg DM)(Choi et al. 2015).

The main source of protein in goats' diets has historically been soya bean meal (SBM) (Ciurescu 2009; Nega 2018). However, other agro-industrial feedstuffs like rapeseed meal (RSM) are available and may provide a cheaper and more sustainable source of protein for livestock diets. Rapeseed meal (RSM) is a byproduct of oil extraction from rapeseed, and it is rich in protein (30-40%) and retains an amino acid profile that is similar to that of conventionally used SBM (Choi et al. 2015; Elling-Staats et al. 2022).

## MATERIALS AND METHODS

### *Experimental Animals*

From November 2018 to February 2019, this experiment was conducted at a commercial goat farm in Siranchok VDC, Gorkha. Twenty goats, aged 4-6 months, and all of a similar body weight, were randomly assigned to each of four treatment groups with five animals each (CRD) as each animal. They drenched to combat the possibility of parasites within their body.

### *Experimental Diets*

The dry matter (DM) requirement of goats was calculated on a body weight basis using a 1.5% concentrate. To replace soyabean meal with rapeseed seed meal, a formula with the appropriate protein level that is required to feed the growing buck was first prepared. The rapeseed cake was then gradually replaced in three equal proportions in the prepared controlled diet, up to complete replacement, as shown in Table 1.

**Table 1. Formulated diets for the experimental animals**

| Feedstuffs | Formula 1 | Formula2 | Formula 3 | Formula 4 |
|---|---|---|---|---|
| Maize % | 30 | 30 | 30 | 30 |
| Wheat bran% | 37 | 37 | 37 | 37 |
| Mineral mixture % | 2 | 2 | 2 | 2 |
| Common salt % | 1 | 1 | 1 | 1 |
| Roasted soyabean% | 30 | 20 | 10 | 0 |
| Rapeseed cake% | 0 | 10 | 20 | 30 |
| Total | 100 | 100 | 100 | 100 |
| Replacement % | 0 | 33.33% | 66.66% | 100% |

### *Treatment composition of feed*

The feed treatment composition consisted of feeding one control diet (T1) and three subsequent formulations. The formulated feed was divided into treatment groups. The control or check-up groups consisted of 30% soyabean diets, with 10% rapeseed cake added in the second (T2), third (T3), and fourth (T4) groups with ad lib Tanki food (*Bauhinia purpurea)*

**Table 2. Treatment combination**

| Treatments | Feeds |
|---|---|
| T1 | Formula 1 ration with 1.5% concentrate of the body weight (BW) (BW taken fortnightly and amount calculated on 1.5% BW basis) + Ad lib amount of Tanki (*Bauhinia purpurea)* fodder |
| T2 | Formula 2 ration with 1.5% concentrate of the body weight (BW) (BW taken fortnightly and amount calculated on 1.5% BW basis) + Ad lib amount of Tanki (*Bauhinia purpurea)* fodder |
| T3 | Formula 3 ration with 1.5% concentrate of the body weight (BW) (BW taken fortnightly and amount calculated on 1.5% BW basis) +Ad lib amount of Tanki *(Bauhinia purpurea)* fodder |
| T4 | Formula 4 ration with 1.5% concentrate of the body weight (BW) (BW taken fortnightly and amount calculated on 1.5% BW basis) +Ad lib amount of Tanki *(Bauhinia purpurea)* fodder |

### *Nutrient analysis*

The samples of concentrate mixture and ingredients were sent for approximate analysis to the Animal Nutrition Division, NARC, Khumaltar, Lalitpur. Dry Matter (DM), Crude Protein (CP), Crude Fat (CF), and Ash contents were determined for representative samples (TA).

***Recording of data***

The animal is fed for a total of ninety days, including seven days for feed adaptation. Concentrate-based feeds are provided twice daily at a rate of 1.5% of body weight per day. The diet was adjusted every two weeks based on the weight gain achieved. During the experimental period, daily records were kept of the total amount of food consumed by the animals. The weight gain of each animal was measured every two weeks in the morning on an empty stomach.

***Statistical Analysis***

Data editing and validation checking were accomplished from Microsoft Excel, 2013. The descriptive statistics, graphs and charts were presented from same software. The statistical analysis was carried out form the Statistical Package for the Social Sciences (SPSS) version 20.0 for inferential statistics. ANOVA was used for to analyse mean difference on Completely Randomized Design (CRD) at 0.01 and 0.05 probability level.

## RESULTS

***Nutrient analysis of the feeds***

Different feed ingredients were analyzed for nutrient composition analysis. Though ratios were targeted to prepare with equal amount of the protein, second formulation have slightly higher amount of protein though it was statistically non-significant. Other nutrient parameters under the scope of this study were statistically similar along the prepared formulated diets. Since other nutritive parameter like mineral and anti-nutritional factor are not subjected to nutrient analysis due to the out of scope of this study.

**Table 3. Nutrient composition of feed ingredients**

| Nutrients composition | DM% | Ash% | CP% | EE% |
|---|---|---|---|---|
| Formula 1 ration | 81.42±1.23 | 18.58±1.67 | 16.67±1.54 | 7.4±0.61 |
| Formula 2 ration | 82.32±2.56 | 17.68±2.43 | 16.32±1.31 | 7.9±0.32 |
| Formula 3 ration | 81.77±1.77 | 18.23±1.21 | 15.63±0.43 | 8.12±0.45 |
| Formula 4 ration | 81.40±1.84 | 18.60±1.14 | 15.43±0.37 | 7.98±0.54 |
| P value | NS | NS | NS | NS |
| Other ingredients | | | | |
| Tanki | 36.77 | 16.3 | 19.4 | NA |
| wheat bran | 85.45 | 15.55 | 13 | NA |
| Soyabean cake | NA | NA | 43.12 | 6.99 |
| rapeseed cake | NA | NA | 38.32 | 10.3 |

Note: Data followed by ± represents SE; NS: No significant differences at P=0.05; NA: Not available

***Mean comparison of weight gain and intake potential on different treatments groups***

Monthly measurements were taken of the goats' weight gain within the experimental groups. The mean weight of bucks across all treatment groups was statistically equivalent (P>0.05). This signifies that replacement of the rapeseed cake with soyabean cake up to the 100% have no negative consequences on the average weight gain of the buck. These results demonstrated that rape seed cake can completely replace soya bean cake (SBC) in goat concentrate feed (RSC). In this experiment, other health and physical vitality parameters affected by treatment groups were not examined.

**Table 4. Mean comparison of weight gain and intake potential on different treatments groups**

| Treatments | Initial weight (kg) | Weight gain after one month feed supplement | Weight gain after one month feed supplement | Weight gain after one month feed supplement | Daily green fodder intake | DMI from green fodder |
|---|---|---|---|---|---|---|
| Control | 12.42±0.4 | 14.62±0.25 | 17.11±0.25 | 19.49±0.25 | 3.16±0.15 | 1.12±0.07 |
| Ration formulation 2 | 11.35±0.3 | 13.62±0.36 | 16.09±0.37 | 18.45±0.37 | 3.22±0.15 | 1.13±0.05 |
| Ration formulation 3 | 11.84±0.41 | 14.12±0.43 | 16.59±0.44 | 18.96±0.44 | 3.31±0.15 | 1.16±0.05 |
| ration formulation 4 | 11.25±0.46 | 13.42±0.49 | 15.88±0.49 | 18.22±0.50 | 3.51±0.12 | 1.23±0.04 |
| Total | 11.71±0.21 | 13.95±0.21 | 16.42±0.21 | 18.78±0.22 | 3.25±0.07 | 1.16±0.03 |
| P value | NS | NS | NS | NS | NS | NS |

Note: Data followed by ± represents SE; NS: No significant differences at P=0.05

***Analysis of variance (ANOVA) of weight gain and daily dry matter intake (DMI) from the fodder***

The ANOVA of body weight gain revealed that all treatment groups were statistically equivalent (P>0.05). This indicates that there were no significant differences in weight gain between feeding different formulated rations, leading to the conclusion that 100% substitution of SBC with RSC has no negative effect on the growth performance of growing bucks. The daily green forage intake and dry matter intake of the young buck yielded comparable results. The substitution of SBC with RSC in concentrate ratios has no appreciable effect on the consumption rate of DMI derived from forage. The digestible metabolizable energy (DMI) from the concentrate was omitted from the table because all of the concentrate offered to the animals was consumed and no refusal amounts were measured.

**Table 5 ANOVA of weight gain and daily dry matter intake (DMI) from the fodder**

| Parameters | | | Sum of Squares | Df | Mean Square | F | Sig. (P=0.05 level) |
|---|---|---|---|---|---|---|---|
| Initial weight of goats (kg)*treatments | Between Groups | (Combined) | 4.273 | 3 | 1.424 | 1.825 | .183 |
| | Within Groups | | 12.489 | 16 | .781 | | |
| | Total | | 16.762 | 19 | | | |
| Weight gain after one month feed supplement*treatments | Between Groups | (Combined) | 4.329 | 3 | 1.443 | 1.885 | .173 |
| | Within Groups | | 12.246 | 16 | .765 | | |
| | Total | | 16.575 | 19 | | | |
| Weight gain after two months feed supplement * Treatments | Between Groups | (Combined) | 4.594 | 3 | 1.531 | 1.939 | .164 |
| | Within Groups | | 12.638 | 16 | .790 | | |
| | Total | | 17.232 | 19 | | | |
| Weight gain after three months feed supplement * Treatments | Between Groups | (Combined) | 4.780 | 3 | 1.593 | 1.974 | .159 |
| | Within Groups | | 12.913 | 16 | .807 | | |
| | Total | | 17.694 | 19 | | | |
| Daily green forage intake * Treatments | Between Groups | (Combined) | .786 | 3 | .262 | 3.051 | .068 |
| | Within Groups | | 1.181 | 16 | .074 | | |
| | Total | | 1.967 | 19 | | | |
| Daily dry matter intake (DMI) * Treatments | Between Groups | (Combined) | .039 | 3 | .013 | .914 | .456 |
| | Within Groups | | .227 | 16 | .014 | | |
| | Total | | .266 | 19 | | | |

***DMI of Tanki (Bauhinia purpurea) fodder***

The figures illustrates the amount of forage intake by the young buck. Figure 1 revealled that there was no changes in the feed intake by the animals by incorporation of the RSC in the diets in increasing manner within sucessive treatment from T

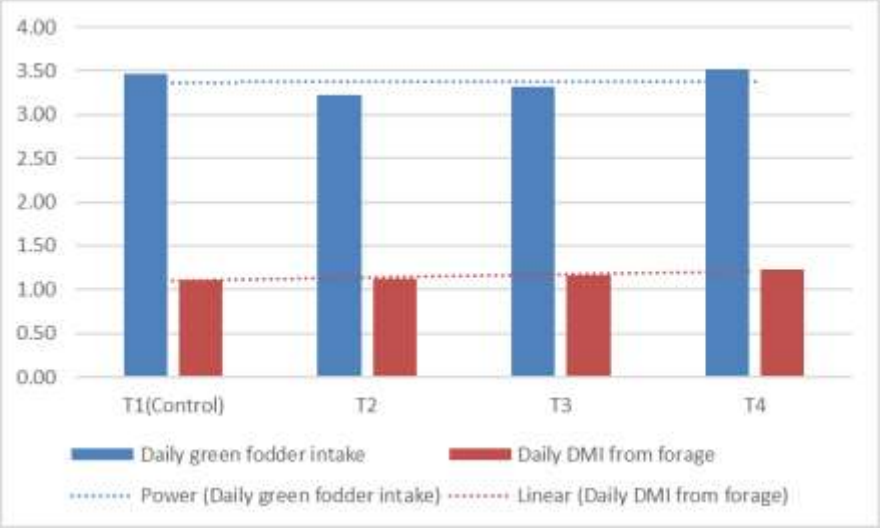


**Figure 1. DMI of Tanki *(Bauhinia purpurea)* fodder**

***Weight gain of animals***

At least monthly 2 kg of the weight is gain by all the experimental animals. The highest wight gained after the experiment was 19.49±0.25 kg in an average in control (T1) groups whereas minimal value (18.22±0.50 kg) was obtained in 100% replacement groups with statistically no significant differences (P>0.05). At the stating of the experiment, the initial weight of the animals was 11.71±0.21 kg while the value was 18.78±0.22 kg at the completion of the trial period.

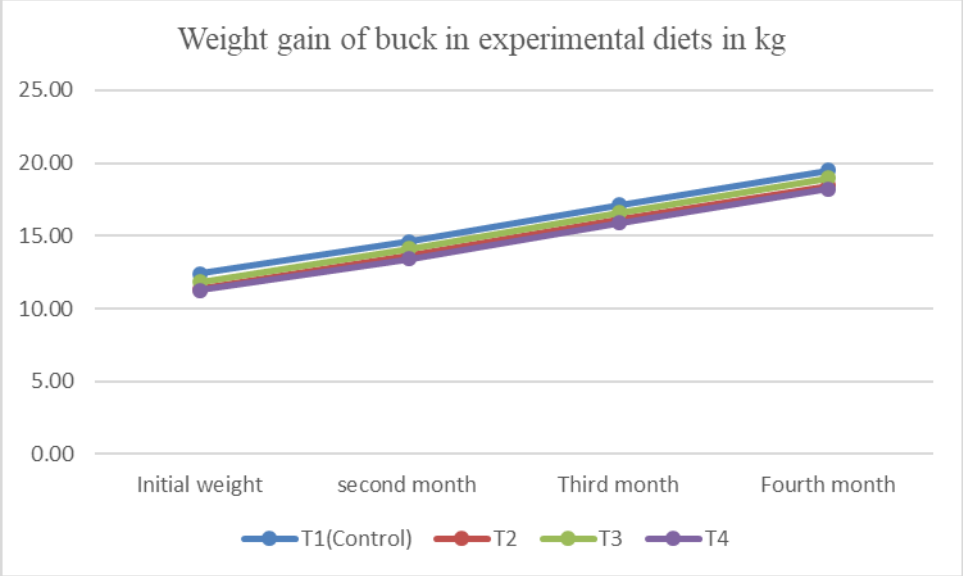


**Figure 2 Average three months weight gain of the buck after experimentation**

## DISCUSSIONS

Mustard cake has no effect on the feed intake, feed efficiency, nitrogen balance, mineral balance, or growth performance of developing goats (Swati, Sehwag, and Das 2015). Our finding suggests that rapeseed cake (RSC) can replace soyabean cake (SBC) without any constraints in a formulated concentrated diets of goats containing 30% SBC. Similar to our findings, various studies claim that Rapeseed meal (RSC) is an excellent protein source due to its relatively high protein content (30-40%), Lysine, Methionine, and Tryptophan levels (Ciurescu 2009) and that it can be used without adverse effects in ruminants (Ciurescu 2009; Kalogianni et al. 2022a, 2022b) but to a lesser extent in poultry (Elling-Staats et al. 2022). Despite the fact, researcher also claim that the protein from rapeseed meal is less digestible than that of soybean meal (72% vs. 88%), but the amino acids balance is similar, even better than in the soybean meal (for the sulphur amino acids) (Nega 2018). Rapeseed meal is rich in Calcium, Phosphorous, Selenium, Iron, and Manganese, but up to 65% of its P content is present as P-phytate, reducing its bioavailability (Nega 2018; Swati et al. 2015).

Ruminant animals are less susceptible to glucosinolates and other anti-nutritional factors than mono gastric animals (Nega 2018)Rape seed cake, prime importance as a quality protein sources to be used as animal feed. (Cavallini et al. 2021; Choi et al. 2015; Ciurescu 2009; Elling-Staats et al. 2022; Kalogianni et al. 2022a, 2022b; Nega 2018; Schingoethe et al. 1974). Although researcher claim that low palatability of mustard cake is said to be the main problem for its utilization in ruminant diets (Cavallini et al. 2021; Choi et al. 2015). Despite the fact we found no any effect on the palatability of the forages as documented as parallel with our finding (Choi et al. 2015; Ciurescu 2009; Nega 2018).

Rape seed meal is used as a feed for cattle, poultry and aquatic animals; however, the information on percentage of feed to be given is scant and variable due to a number of limitations (Nega 2018; Swati et al. 2015). In case of goats, mustard cake does not affect feed intake, feed efficiency, nitrogen balance, mineral balance and growth performance of growing bucks (Nega 2018; Swati et al. 2015) which bolsters our finding that rapeseed cake did not effect on either daily weight gain as well as palatability of the fodder leading to similar dry matter intake either replaced or non-replaced diets of rapeseed in Khari goat. The presence of glycosylates restricts the use of RSC cakes for animal feeding, according to the researchers. However, the effect of RMC supplementation in the ration of ruminants has been reported to be variable probably due to variations in the glucosinolates content of various cultivars and their dietary levels. It has been reported that rapeseed on chewing produce pungent flavour and hot test due to glucosinolates metabolites that reduce its palatability (Kalogianni et al. 2022a).

The most common substitute protein sources for SBM in small ruminant diets worldwide (Halmemies-Beauchet-Filleau et al. 2018; Kalogianni et al. 2022a; York n.d.). The calves given concentrates containing high glucosinolates rapeseed meal recorded lower intake relative to other calves given soybean meal, sunflower meal or linseed meal. The feed intake reported to be higher for low- glucosinolate containing rapeseed mustard concentrate (Erbersdobler and Gropp 1973; Schingoethe et al. 1974).

The nutritional attributes of RSC make it a potential candidate to replace SBM partially or totally in goat diets as a protein, energy and PUFA source. RSC has been fed to sheep and goats with either neutral or positive effects on feed intake, nutrient utilization, growth performance, carcass and meat quality attributes (Klir et al. 2017; Morales et al. 2008; Murad and Azzaz 2010; Nudda et al. 2006). However, limited studies have examined the effects

of RSC feeding on the production and quality of chevon. Given that goats have superior fiber digestion efficiency and are more tolerant of plant secondary metabolites than sheep and cattle, they could utilize RSC, which contains more fiber and plant secondary metabolites than SBC, more effectively. In this regard, it was determined that complete substitution of RSC for soybean meal in goat grower diets could improve animal performance and meat quality, resulting in favorable effects on the production potential of soybean meal.

## CONCLUSION

The replacement of soyabean cake from rape seed cake within the concentrate mixture have no negative effect in total dry matter intake and weight gain of the young local Khari goats in total Tanki *(Bauhinia purpurea)* fodder-based diets. Therefore, present study suggested that inclusion of cheap and locally available rapeseed cake could be beneficial for goat feeding and help to get remedies from volatile but expensive market of soyabean cake aiming to reduce feed cost in goat growing diets. In parallel, incorporating local available fodder (*Bauhinia purpurea*) in adlib with rapeseed cake could have better nutrition as well as better overall production parameters. It showed the solid possibilities of incorporating locally available fodder in goat-based feed for higher economic return with vast nutrition potential. However, for the wide-range dissemination of the such technology within the farmer level, there need large scale verification of technology within the days to come.

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**REFERENCES**

Anon. n.d. “Steel, R.G.D., Torrie, J.H. and Dicky, D.A. (1997) Principles and Procedures of Statistics, A Biometrical Approach. 3rd Edition, McGraw Hill, Inc. Book Co., New York, 352-358. - References - Scientific Research Publishing.” Retrieved January 7, 2023 (https://www.scirp.org/(S(oyulxb452alnt1aej1nfow45))/reference/ReferencesPapers.aspx?ReferenceID=1855584).

Cavallini, Damiano, Ludovica Maria Eugenia Mammi, Giacomo Biagi, Isa Fusaro, Melania Giammarco, Andrea Formigoni, and Alberto Palmonari. 2021. “Effects of 00-Rapeseed Meal Inclusion in Parmigiano Reggiano Hay-Based Ration on Dairy Cows’ Production, Reticular PH and Fibre Digestibility.” *Italian Journal of Animal Science* 20(1):295–303. doi: 10.1080/1828051X.2021.1884005.

Choi, H. B., J. H. Jeong, D. H. Kim, Y. Lee, H. Kwon, and Y. Y. Kim. 2015. “Influence of Rapeseed Meal on Growth Performance, Blood Profiles, Nutrient Digestibility and Economic Benefit of Growing-Finishing Pigs.” *Asian-Australasian Journal of Animal Sciences* 28(9):1345. doi: 10.5713/AJAS.14.0802.

Ciurescu, Georgeta. 2009. “Efficiency of Soybean Meal Replacement by Rapeseed Meal and/or Canola Seeds in Commercial Layer Diets.” *Archiva Zootechnica* 12(1):27–33.

Dhakal, Bhojan, Naba Raj Devkota, Sabita Subedi, Chet Raj Upreti, and Maheswar Sapkota. 2019. “Fodder Production and Livestock Rearing in Relation to Climate Change and Possible Adaptation Measures in Manaslu Conservation Area, Nepal.” *International Journal of Applied Sciences and Biotechnology* 7(2):227–35. doi: 10.3126/IJASBT.V7I2.23973.

Dhakal, Bhojan, and Sabita Subedi. 2020. “ASSESSMENT OF MAJOR FEED RESOURCES AND ITS UTILIZATION IN MANASLU CONSERVATION AREA ( MCA ), NEPAL.” (January 2019).

Dhakal, Bhojan, Sabita Subedi, Bijaya Khanal, and Naba Raj Devkota. 2020. “ASSESSMENT OF MAJOR FEED RESOURCES AND ITS UTILIZATION IN MANASLU CONSERVATION AREA ( MCA ), NEPAL.” *Journal of Agriculture and Forestry University* (January 2019).

Dhungana, Sunita, Hari P. Tripathee, Lila Puri, Yajna P. Timilsina, and Krishna P. Devkota. 2012. *Nutritional Analysis of Locally Preferred Fodder Trees of Middle Hills of Nepal: A Case Study from Hemja VDC, Kaski District*. Vol. 13.

Elling-Staats, Miranda L., Arie K. Kies, Myrthe S. Gilbert, and René P. Kwakkel. 2022. “Over-Toasting Dehulled Rapeseed Meal and Soybean Meal, but Not Sunflower Seed Meal, Increases Prececal Nitrogen and Amino Acid Digesta Flows in Broilers.” *Poultry Science* 101(7):101910. doi: 10.1016/J.PSJ.2022.101910.

Erbersdobler, H., and J. Gropp. 1973. “Aspects of Protein Quality in Calf Nutrition. Problems and Possibilities of Milk Protein Substitutes.” *Proceedings of the Nutrition Society* 32(3):223–30. doi: 10.1079/pns19730043.

Halmemies-Beauchet-Filleau, A., M. Rinne, M. Lamminen, C. Mapato, T. Ampapon, M. Wanapat, and A. Vanhatalo. 2018. “Review: Alternative and Novel Feeds for Ruminants: Nutritive Value, Product Quality and Environmental Aspects.” *Animal* 12(s2):S295–309. doi: 10.1017/S1751731118002252.

Kalogianni, Aphrodite I., Marios Moschovas, Foteini Chrysanthakopoulou, Thomai Lazou, Georgios Theodorou, Ioannis Politis, Ioannis Bossis, and Athanasios I. Gelasakis. 2022a. “The Effects of Replacing Soybean Meal with Rapeseed Meal, Cottonseed Cake, and Fava Beans on the Milk Yield and Quality Traits in Milking Ewes.” *Animals 2022, Vol. 12, Page 274* 12(3):274. doi: 10.3390/ANI12030274.

Kalogianni, Aphrodite I., Marios Moschovas, Foteini Chrysanthakopoulou, Thomai Lazou, Georgios Theodorou, Ioannis Politis, Ioannis Bossis, and Athanasios I. Gelasakis. 2022b. “The Effects of Replacing Soybean Meal with Rapeseed Meal, Cottonseed Cake, and Fava Beans on the Milk Yield and Quality Traits in Milking Ewes.” *Animals 2022, Vol. 12, Page 274* 12(3):274. doi: 10.3390/ANI12030274.

Klir, Z., J. M. Castro-Montoya, J. Novoselec, J. Molkentin, M. Domacinovic, B. Mioc, U. Dickhoefer, and Z. Antunovic. 2017. "Influence of Pumpkin Seed Cake and Extruded Linseed on Milk Production and Milk Fatty Acid Profile in Alpine Goats." *Animal* 11(10):1772–78. doi: 10.1017/S175173111700060X.

Meissner, H. 1997. "Recent Research on Forage Utilization by Ruminant Livestock in South Africa." *Animal Feed Science and Technology* 69(1–3).

Morales, E. Ramos, E. Molina Alcaide, and M. R. Sanz Sampelayo. 2008. "Milk Production of Dairy Goats Fed Diets with Different Legume Seeds: Effects of Amino Acid Composition of the Rumen Undegradable Protein Fraction." *Journal of the Science of Food and Agriculture* 88(13):2340–49. doi: 10.1002/JSFA.3355.

Murad, H. A., and H. H. Azzaz. 2010. "Cellulase and Dairy Animal Feeding." *Biotechnology* 9(3):238–56. doi: 10.3923/biotech.2010.238.256.

Nega, Tekeba. 2018. "Review on Nutritional Limitations and Opportunities of Using Rapeseed Meal and Other Rape Seed by - Products in Animal Feeding." *Journal of Nutritional Health & Food Engineering* 8(1). doi: 10.15406/jnhfe.2018.08.00254.

Nudda, A., G. Battacone, M. G. Usai, S. Fancellu, and G. Pulina. 2006. "Supplementation with Extruded Linseed Cake Affects Concentrations of Conjugated Linoleic Acid and Vaccenic Acid in Goat Milk." *Journal of Dairy Science* 89(1):277–82. doi: 10.3168/jds.s0022-0302(06)72092-6.

Osti, Netra P. 2019. *ACTA SCIENTIFIC AGRICULTURE (ISSN: 2581-365X) Animal Feed Resources and Their Management in Nepal*.

Pokharel, Raj Kumar, Robin Houston, Philip Harvey, Ramu Bishwakarma, Jagannath Adhikari, Kiran Dev Pant, and Ritu Gartoulla. 2009. *Nepal Nutrition Assessment and Gap Analysis Final Report Nutrition Assessment Team 1 1*.

Sanz Sampelayo, M. R., M. L. Pérez, F. Gil Extremera, J. J. Boza, and J. Boza. 1999. "Use of Different Dietary Protein Sources for Lactating Goats: Milk Production and Composition as Functions of Protein Degradability and Amino Acid Composition." *Journal of Dairy Science* 82(3):555–65. doi: 10.3168/JDS.S0022-0302(99)75267-7.

Schingoethe, D. J., C. L. Beardsley, and L. D. Muller. 1974. "Evaluation of Commercial Rapeseed Meal and Bronowski Variety Rapeseed Meal in Calf Rations." *The Journal of Nutrition* 104(5):558–62. doi: 10.1093/JN/104.5.558.

Sharma, Banshi. 2015. "Present Status and Future Strategy of Forage Development in Nepal." *Journal of Agriculture and Environment* 16:170–79. doi: 10.3126/AEJ.V16I0.19850.

Swati, Sneha Sehwag, and Madhusweta Das. 2015. "A Brief Overview: Present Status on Utilization of Mustard Oil and Cake." *IJTK Vol.14(2) [April 2015]* 14(2):244–50.

York, Luke. n.d. *Characterisation of the Livestock Production System and the Potential of Feed-Based Interventions in the Municipality of Ratnanagar and Gitanagar in the Chitwan District of Southern Nepal, September 2010*.