Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 16, Issue, 09, pp.*30015-30019*, September, 2024
DOI: https://doi.org/10.24941/ijcr.47626.09.2024

ISSN: 0975-833X

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

META ANALYSIS OF NUTRIENT REQUIREMENTS OF INDIGENOUS AND CROSSBRED DAIRY COWS IN ETHIOPIA

Meseret Tsegaye[1], Adugna Tolera[2] and Ajebu Nurfeta[2]

Hawassa Agricultural Research Center, Sidama Agricultural Research Institute, Ethiopia

ARTICLE INFO

Article History:
Received 20th June, 2024
Received in revised form
19th July, 2024
Accepted 19th August, 2024
Published online 30th September, 2024

Key words:
Indigenous, Maintenance Energy, Meta-Analysis, Requirements, Crossbred.

***Corresponding author:**
Meseret Tsegaye

ABSTRACT

A meta-analysis of feeding trials was performed to determine the metabolizable energy (ME) and crude protein (CP) requirements for indigenous and crossbred dairy cows in Ethiopia. Data from 17 independently published articles on feeding trials conducted on lactating cows in various regions of Ethiopia were subjected to regression analysis. This analysis aimed to determine the ME and CP requirements for maintenance and milk production. A total of 62 observations and 212 dairy cows were used in the feeding trials. The study employed regression analysis to estimate the ME requirements for maintenance and milk production, while data management and analysis were performed using SPSS 26.0. A Pearson correlation analysis was conducted to assess the strength of the correlation between variables. The regression analysis revealed that the ME requirement for maintenance and milk production for indigenous cows was 357 KJ ME/kg $BW^{0.75}$, while it was 586 KJ ME/kg $BW^{0.75}$ for crossbred cows. The CP requirement for maintenance for indigenous cows was 2.94 g/kg $BW^{0.75}$, while it was 6.37 g/kg $BW^{0.75}$ for crossbred cows. The study found that the ME requirements exceeded the value of 335 MJ ME/kg $BW^{0.75}$ per day as recommended by the National Research Council. Therefore, the results highlight the need for nutrient requirement tables for livestock in Ethiopia to improve feed resource utilization and production.

Citation: Meseret Tsegaye, Adugna Tolera and Ajebu Nurfeta. 2024. "Meta Analysis of Nutrient Requirements of Indigenous and Crossbred Dairy Cows in Ethiopia.". *International Journal of Current Research*, 16, (09), 30015-30019.

INTRODUCTION

Dairying is a source of food and income for livestock keepers in Ethiopia. However, the animal's production and productivity are below the potential. The national average daily milk yield per cow was 1.48 liters for the indigenous breeds (CSA 2021). The low productivity of dairy cows is due to a lack of proper animal management, low genetic potential for milk production, poor feed quality, and imbalanced nutrition (Tolera, 2007). Thornton (2010) described the lack of information on the nutrient requirements of indigenous livestock breeds in sub–Saharan Africa as one of the challenges limiting ration formulation principles and accuracy in feeding practices to improve animal productivity and enhance the overall performance of the livestock sector. Furthermore, nutrient requirement tables are needed to fill the gap in the nutrient needs of the livestock. The National Research Council (NRC, 2001) is the most widely referenced nutrient requirement table for ration formulation purposes. However, it has also been developed for temperate livestock breeds. The nutrient requirement of tropical animals differs from those of temperate animals due to differences in genetic makeup, mature body size, growth rate, tropical feed quality, and climatic conditions as described by Paul et al. (2004) and Salah et al. (2014).

However, apart from our study in the temperate and some tropical countries (India and Tanzania), supplementation in feeding trials was on total digestible nutrients (TDN), ME, and digestible crude protein (DCP) for maintenance, milk production, and weight gain. Most available published studies on feeding trials of dairy cows in Ethiopia supplementation were crude protein (CP) and metabolizable energy (ME). Lactating dairy cows have a high metabolic process needed for milk production and require special nutrient supplements Indetie et al. (2009). Moreover, milk production potential and feed conversion efficiency were obtained through the inherent genetic capability of a particular category of animals, and it can be achieved through accurate evaluation of nutrient requirements Paul et al. (2004). Therefore, this meta-analysis study predicts the energy and protein requirements of Bos indicus and Bos taurus cross-bred dairy cows in different parts of Ethiopia.

MATERIALS AND METHODS

Review data collection: A meta-analysis was conducted by collecting data from various scientific publications that contain information on indigenous and cross-bred dairy cows in Ethiopia.

The keywords used in the search included feed intake, dairy, crossbred, indigenous, energy and protein requirement, tropical dairy cows, feed supplementation, and nutrient requirements. The data collated in this study include author, year of publication and duration of the study, Ethiopia, energy intake, dry matter intake, milk yield and milk composition (fat, lactose, TS, SNF, and protein), live weight, treatment numbers, feed composition (DM, CP, ME, NDF, and ADF), a measure of the variance of responses (SE or SD), and P values. A total of 37 papers were collected. However, data from 20 studies were subsequently excluded because the information in these reports was incomplete concerning one or more of the essential variables, such as body weight, milk yield, milk fat percentage, live body weight, and nutrient intake. Finally, data from studies (Kitaw et al 2010; Abebe 2019; Diribe et al 2016; Gobena and Hundie 2020; Feyisa et al 2015; Hussien et al 2013; Tekeba 2012; Tekeba et al 2014; Ftiwi 2015; Bekele 2020; Mediksa, 2021; Teshome, 2023; Derso,2009; Abebaye,2020; Duressa,2016; Kebede,2009; Kehaliew,2010) in Ethiopia, from 17 independent publication and 62 different observations and 212 experimental cows (148 indigenous cows and 64 crossbred) were considered.

The study animal breeds, authors and treatment diets: The reviewed papers for Fogera breed dairy cows were evaluated by the authorsHussien et al (2013); Tekeba et al (2014); Ftiwi (2015); Gulilat and Walelign, (2017); and Derso, (2009); Kebede, et al. (2009) and the study was conducted at Bahir Dar University, Humera district, and Andassa Agricultural Research Center. Horro breeds were evaluated by authors Kumsa et al., (2016); and Gobena and Hundie (2020), and the research was conducted at HorroGuduru Agricultural Research Center and Nekemt University. The Boran Holstein Friesian crosses breds were evaluated by authors Feyissa et al. (2015); Kitaw et al. (2010); Abebe et al. (2019); Bekele (2020); Tekeba (2012); Kehaliew et al., (2010); Mediksa et al, (2021); Jersey breeds by Teshome et al. (2017; Abebaye H, (2020) and the study was conducted at Adaberga Agricultural Research center and Holeta Agricultural Research center.

The experimental designs were randomized complete block design, a single Latin square design, and a double Latin square design. The study dairy cows were fed on roughage sources native grass hay, Rhodes grass hay, urea-treated wheat straw, sorghum stover, Elephant grass, sugarcane top, and pea bran straw. The supplemental treatment diet sources were noug seed cake, cotton seed cake, oat grain, maize grain, wheat bran, wheat middling, mixed concentrates, fish meal, breweries spent dried grain, maize bran, premix, mineral, and common salt. Data was analyzed on nutrient intake (CP and ME), milk yield, milk composition and body weight changes of the experimental dairy cows.

Prediction of nutrient requirements of dairy cows: The Pearson correlation coefficient predicts the crude protein intake (CPI) that was significantly correlated with fat-corrected milk (FCM) (r^2=0.84; p<0.001) and milk yield (r^2=0.85; p<0.001). In addition, there was a significant relationship between nutrient intake and metabolizable energy intake, CPI, and fat-corrected milk. The collected data was subjected to regression analysis to develop nutrient requirements of indigenous and cross-bred dairy cows in Ethiopia (Paper III, Table 1).

RESULTS

General information about the feeding trials: The mean ±SD deviation and range of body weight feed dry matter and nutrient intake, milk yield and milk fat content of indigenous and cross-bred dairy cow analyzed are presented in Table 1. The result on the meta-analysis was sufficient to pridict the result and was representative of the diversities observed in indigenous and cross-bred dairy cow feeding trials in Ethiopia. The average body weight of the experimental animals ranged from 200 to 322 kg for indigenous cows and 312 to 516 kg for cross-bred dairy cows. The average daily 4% fat-corrected milk yield ranged from 1.43 to 4.55 kg and 5.50 to 11.3 kg; mean Milk fat percentages ranged from 3.62- 5.05%; and 2.70-5.80 % for indigenous and cross-bred dairy cows, respectively. The dry matter intake ranged from 2.20-8.60 kg per day for indigenous and 7.32 to 15.7kg for cross-bred dairy cows. The crude protein intake ranged from 0.59 to 2.65 g per day for cross-bred and 0.10 to 1.10 g per day for indigenous cows.

Energy and protein requirements: The regression equations developed for the prediction of the ME and CP requirements were highly significant (p<0.01), as were the coefficients and R^2 values (Table 2). The regression constants and partial regression coefficients provided estimates of the nutrient requirements for maintenance and milk production. Thus, ME and CP requirements for maintenance were 589 KJ/kg $BW^{0.75}$ and 6390 KJ/kg FCM, respectively, and 6.39 g/kg BW $^{0.75}$ CP for maintenance and 72 g/kg fat-corrected milk. The prediction equation accounted for 62 % and 82% of the variation in observed ME and CP intake for crossbred dairy cows. 357 KJ/kg $BW^{0.75}$ and 4599 KJ/kg FCM, respectively, and 2.94 g/kg BW $^{0.75}$ CP for maintenance and 21 g/kg fat-corrected milk. The prediction equation accounted for 62.8 % and 39.4% of the variation in observed ME and CP intake for indigenous cows. **Table.2.** The regression equations of ME and CP requirements (Mean± SE) for maintenance (g or/kg W $^{0.75}$), FCM (b1, g or K/kg W $^{0.75}$) obtained from the present database for cross bred dairy cow.

DISCUSSION

Dry Matter Intake of Indigenous and Cross Bred Cows: The maximum daily dry matter intake (Table 1, Table 2) was observed 15.7 kg DM/day for cross-bred (50% indigenous Boran * 50% Holstein Frisian) dairy cows was similar to the value reported by Kelly et al (2021), but higher than the value (14 kg DM/day) reported by Paul et al. (2004). The value (7.32 kg DM/day) observed by Ftiwi (2015); Gulilat and Walelign, (2017) than the value (5.32 kg DM/day and 6.65 kg DM /day) observed by Paul et al. (2004). The variation in dry mater intake (DMI) from 17 kg DM/day to 9.56 kg DM/day for indigenous breeds may be due to differences in individual animals and feed quality. According to Thomas (2014), DMI is affected by both animal and feed factors, including body size, milk production, and stage of lactation or gestation. Daily crude protein intake was higher for cross-bred dairy cows but lower for indigenous (Boran, Horro, and Fogera) cows because indigenous cows are lower milk producers and have lower body weights. According to Diribe et al. (2016); Steinshamn (2010); and Husein et al. (2013), animals fed feed with better protein content could have a better intake than those fed grass alone.

Table.1. Mean values and variances of body weight feed dry matter and nutrient intake, milk yield and milk fat contentofindigenous and cross bred dairy cow

Variables	Mean	SD	Minimum	Maximum	N
Indigenous Cow					
LBW (kg)	256	33.7	200	322	31
CPI (g/d)	0.54	0.30	0.21	1.10	31
MEI (MJ/d)	73.9	25.3	15.8	98.6	31
DMI (kg/d)	5.40	1.56	2.20	8.60	31
DMY (kg/d)	2.70	0.45	1.37	4.40	31
Milk fat (%)	3.34	0.69	2.70	5.80	31
FCM (kg/d)	2.80	0.65	1.43	4.55	31
Cross bred dairy cow					
LBW (kg)	382	66.6	312	516	31
CPI (g/d)	1.49	0.49	0.59	2.65	31
MEI (MJ/d)	108.5	20.1	52.9	141	31
DMI (kg/d)	11.2	2.12	7.32	15.7	31
DMY (kg/d)	8.21	1.41	5.29	10.9	31
Milk fat (%)	4.43	0.34	3.62	5.05	31
FCM (kg/d)	11.6	1.21	5.50	11.3	31

**LBW= live body weight, CPI= crude protein intake, MEI= metabolizable energy intake, each observation is mean of observations on at least four cows. *(Kitaw et al 2010; Abebe 2019; Diribe et al 2016; Gobena and Hundie 2020; Feyisa et al 2015; Hussien et al 2013; Tekeba 2012; Tekeba et al 2014; Ftiwi 2015; Bekele 2020; Mediksa, 2021; Teshome, 2017; Derso,2009; Abebaye,2020; Gulilat and Walelign, 2017; Kebede,2009; Kehaliew,2010),17 independent publications across 62 observation and 212 cows (124 indigenous and 88 crossbred) are used for the study*

Table 2. The regression equations of ME and CP requirements (Mean± SE) for maintenance (g or/kg $W^{0.75}$), FCM (b1, g or K/kg $W^{0.75}$) obtained from the present database for cross bred dairy cow

Variables	Cross bred dairy cow		Indigenous cow	
	MEI	CPI	MEI	CPI
MBW kg	86.2±1.99	86.2±1.99	63.9 ± 25.3	63.9 ± 25.3
FCM kg	10.4± 0.56	10.4 ±0.56	4.40± 0.22	4.40± 1.20
DM intake g/d	11206 ±38	1490 ± 88.5	6401.3±388	519 ± 27.0
DM intake /kg MBW	131± 4.26	17.0 ± 0.70	100.6±6.03	8.20 ± 4.32
FCM per kg MBW g/d	0.131 ±0.01	0.131± 0.01	0.072±0.02	0.072±0.02
No of observations [a]	31	31	31	31
Predicted energy and protein requirement				
a (intercept)	586±31	6.37 ± 1.08	357± 75	2.94 ±8.01
b_1 (coefficient)	6402±108	0.72 ± 0.18	4598±216	0. 21± 0.45
R^2	62.8**	82.1**	62.8**	39.4
SE of estimate	12.7	0.22	0.22	0.22

a=Each observation is mean of observations on at least 4 animals. b Model: intake/MBW=a+b1(FCM/MBW) *(Kitaw et al 2010; Abebe 2019; Diribe et al 2016; Gobena and Hundie 2020; Feyisa et al 2015; Hussien et al 2013; Tekeba 2012; Tekeba et al 2014; Ftiwi 2015; Bekele 2020; Mediksa, 2021; Teshome, 2017; Derso,2009; Abebaye,2020; Gulilat and Walelign, 2017; Kebede,2009; Kehaliew,2010); LBW=live body weight, CPI=crude protein intake, MEI=metabolizable energy intake, FCM= Fat corrected milk.17 independent publications across 62 observation and 212 cows (124 indigenous and 88 crossbred) are used for the study*

Table 3. Correlations between nutrient intake, milk yield and milk composition

	MBW	DMI	MEI	CPI	FCM	MY kg	M_{fat}	$M_{protein}$
MBW	1							
DMI	0.35	1						
MEI	0.40^{*}	0.71^{**}	1					
CPI	0.85^{**}	0.55^{**}	0.62^{**}	1				
FCM	0.73^{**}	0.67^{**}	0.76^{**}	0.84^{**}	1			
MY kg	0.75^{**}	0.66^{**}	0.75^{**}	0.84^{**}	0.99^{**}	1		
M_{fat}	0-.20	0.42^{*}	0.37^{*}	0.03	0.19	0.14	1	
$M_{protein}$	0.18	0.41^{*}	0.30	0.12	-0.01	-0.03	0.28	1

(Kitaw et al 2010; Abebe 2019; Diribe et al 2016; Gobena and Hundie 2020; Feyisa et al 2015; Hussien et al 2013; Tekeba 2012; Tekeba et al 2014; Ftiwi 2015; Bekele 2020; Mediksa, 2021; Teshome, 2017; Derso,2009; Abebaye,2020; Gulilat and Walelign, 2017; Kebede,2009; Kehaliew,2010); MBW=Metabolic body weight, CPI=crude protein intake, MEI=metabolizable energy intake, FCM= Fat corrected milk.17 independent publications across 62 observation and 212 cows (124 indigenous and 88 crossbred) are used for the stu

The daily dry matter intake varied from 2% -2.8% of their body weight on a DM basis for indigenous and 2.8-3.2% for cross-bred dairy cows, which is in agreement with the studies by Steinshamn (2010) and Hussien et al. (2013).

Energy requirement for maintenance and milk yield: The regression equations developed for the prediction of ME and CP requirements were highly significant as were the coefficients and R^2 values (Table 2). The nutrient requirement for lactating dairy cows depends on the amount of milk produced during peak lactation and milk composition (NRC 2001).

Cows that produce higher amounts of milk with higher fat and protein contents have higher energy and protein requirements than those with low milk composition. Reports on the nutrient requirements of Ethiopian milking cows are limited. Our review result showed that the values (6402 kJ/kg FCM, 586 KJ ME/kg MBW) for milk production and maintenance, respectively, were higher than the values reported by Paul et al., (2004) for Indian crossbred cattle with the requirement of 5,023 KJ/kg FCM for milk production and 598 KJ/kg MBW during the mid-stage lactation. Patle and Mudgal (1976) reported that during the early stage of lactation Indian cattle require 546.6 KJ ME/kg MBWfor maintenance and 4,746 KJ for 1 kg FCM production. Our review estimates for maintenance and milk production were slightly higher than the report by Patle and Mudgal (1976). Methodological differences may be a critical source of this variation. The current review result (586 KJ ME/kgBW$^{0.75}$ per day) for metabolizable energy for maintenance (MEm) for cross-bred dairy cows is lower than the value 7(14 KJ/kg BW $^{0.75)}$ and 685 KJ/kg BW $^{0.75}$) observed by Morris et al (2021); for maintenance energy requirements and efficiency of metabolizable energy utilization for dry and lactating Jersey cows. It is alsolower than the values (631 KJ ME/kgBW$^{0.75}$, 596 KJ ME/kg BW$^{0.75}$, 554 KJ ME/kg BW $^{0.75}$ per day) reported by Salah et al (2014), Cabezas et al (2021) and Kelly et al. (2021), respetivly. This variation may be due to differences in the nutrient requirements of the animals, depending on their genotype, body weight, location, and dietary situation (Paul et al. 2004). Our current review results can be used as a reference for feeding indigenous and crossbred dairy cows in Ethiopia.

Protein requirement for maintenance and milk yield: This meta-analysis revealed that protein requirements based on the metabolizable protein for maintenance level of crude protein intake (6.37 g/kg BW. day$^{0.75}$) for cross-bred cattle (Paper 3) is similar to the value (6.27 g/kg BW $^{0.75}$) reported by Paul et al. (2014). However, the crude protein (CP) intake for the indigenous breed (paper 3) was lower than the value (4.35 g/kg BW$^{0.75}$) meta-analysis reported for warm climates cattle (Salah et al 2014). Veras et al (2008) obtained a value of 4.03 g/kg BW $^{0.75}$ for MP maintenance, which was lower than the CP values adopted by NRC (2000) for cross-bred dairy cows (4.43g/kg BW0.75). Cattle typically require crude protein in the range of 7–14% of their daily dry matter intake, but this may vary depending on the animal production, growth and body weight. Dry cows have lower requirements, while pregnant and lactating cows, especially dairy cattle, require more (NRC, 2001). Differences in MP requirements are due to feed quality and animal production, and diets composed of poor-quality roughage are likely to have low N retention and high protein requirements (Salah et al., 2014).

CONCLUSION

The meta-analysis result revealed that the ME (metabolizable energy) requirements for the maintenance of indigenous and crossbred dairy cows in Ethiopia: were 357 and 586 KJ ME/kg BW$^{0.75}$, and 4598 and 6402 KJ ME/kg FCM for indigenous and crossbred dairy cows. The crude protein (CP) requirement was 2.94 g/kg BW$^{0.75}$ for indigenous cows and 6.39 g/kg BW$^{0.75}$ for crossbred dairy cows. The measured maintenance energy requirement for indigenous cows exceeded the National Research Council's (NRC) recommended value of 335 MJ ME/kg BW$^{0.75}$ per day by 6.57%. To enhance feed resource utilization and production in Ethiopia and sub-Saharan Africa, nutrient requirement tables for livestock are decisive**.**

ACKNOWLEDGEMENTS

This work was funded in whole or part by the United States Agency for International Development (USAID) Bureau for Food Security under Agreement # AID-OAA-L-15-00003 as part of Feed the Future Innovation Lab for Livestock Systems and EQUIP.

The authors acknowledge Southern Agricultural Research Institute and Hawassa university for giving them a chance first-rate work.

Disclaimer: This work is funded in whole or part by the United States Agency for International Development (USAID) Bureau for Food Security under Agreement # AID-OAA-L-15-00003 as part of Feed the Future Innovation Lab for Livestock Systems. Additional funding was received from Bill & Melinda Gates Foundation. Any opinions, findings, conclusions, or recommendations expressed here are those of the authors alone.

Conflict of interest: The authors declare that there is no conflict of interest.

REFERENCES

Abeba K 2019 Dairy production systems characterization in urban and peri urban areas of central Oromia, Ethiopia, and effects of concentrate supplementation on productive and reproductive performances of crossbred dairy cows, Dissertation Ref. No. 041/04/2019

Abebaye, H. 2020. Assessment of feed resources, feeding systems, conservation practices of maize stover in west Shewa zone and evaluation of green maize stover silage for feeding lactating jersey cows. Dissertation Ref. No: 056/06/

Bekele W 2020 Dairy feed resources and mineral assessment in selected districts of east Shoa zone. Dissertation Ref. No. 053/06/2020

Chabra S 2006 Studies on mineral imbalances in dairy animals with special references to copper, manganese and iodine status in Punjab. ‟ Ph.D. dissertation. Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India.

CSA 2021 Agricultural sample survey. Federal Democratic Republic of Ethiopia Central Statistical Agency. Private Peasant Holdings. Statistical Bulletin 570, Addis Ababa, Ethiopia,

Derso ,T. 2009. On-farm Evaluation of Urea Treated Rice Straw and Rice Bran Supplementation on Feed Intake, Milk Yield and Composition of Fogera Cows, North Western Ethiopia

Feyissa F, Kitaw G and Assefa G 2015 Nutritional Qualities of Agro-Industrial By-Products and Local Supplementary Feeds for Dairy Cattle Feeding. Ethiopian Journal of Agricultural Sciences. 26(1): 13-26

Ftiwi M 2015 Production system and phenotypic characterization of Begait cattle, and effects of supplementation with concentrate feeds on milk yield and composition of Begait cows in Humera ranch, western Tigray, Ethiopia. Dissertation Ref. No. 0013/06/2015

Gobena G and Hundie D 2020 Effects of Concentrate Level on Lactation Performance of Horro Cows Fed Rhodes Grass Hay (RGH) as a Basal Diet at Guduru Animal Production and Research Center, Western Ethiopia. Ethiop. J. Agric. Sci. 30(3) 1-13

Gulilat and Walelign,2017. Evaluation of milk production performance of lactating Fogera cows fed with urea and effective micro-organisms treated rice straw as basal diet. Journal of Agricultural Research and Development Vol. 7(2). pp. 0111-0119, April, 2017

Hussien R Tegegne F Yilma Z Mekuriaw Z 2013 Feed Intake Milk Yield and Milk Composition of Fogera Cows Supplemented with Different Feeds. 3(2): 41-45.

Indetie D 2009 Effects of nutritional supplementation and genotype on milk production and fertility of lactating dairy cattle under tropical conditions.P.2930.International Symposium on Sustainable Improvement of Animal Production and Health.Vienna, Australia.

Kebede, A. 2009. Characterization of Milk Production Systems, Marketing and On- Farm Evaluation of the Effect of Feed Supplementation on Milk Yield and Milk Composition of Cows at Bure District, Ethiopia. Https://www.researchgate.net/

Kehaliew A, Assefa G, Fekadu D, Kitaw G and Dejene M 2010. Milk Yield and Quality of Crossbred Dairy Cows Fed with Different Levels of Vetch (Vicia dasycarpa) Hay and Concentrate on a Basal Diet of Fresh Cut Napier Grass (Penissetium purpureum. Ethiop. J. Agric. Sci.

Kelly L Bougouin A and Kebreab E 2021 Maintenance energy requirement and efficiency of utilization of metabolizable energy for milk production of Bos taurus * Bos indicus crossbred tropical dairy cows: a meta-analysis. Animal Production Science, 2021, 61, 1338–1347. https://doi.org/10.1071/AN20470

Kitaw G, Melaku S and Seifu E 2010 Replacement of Concentrate Mix With Vetch (Vicia dasycarpa) Hay on Feed Intake, Digestibility, Milk Yield and Composition of Lactating Crossbred Dairy Cows Fed UreaMolasses Treated Wheat Straw. East African Journal of Sciences, V olume 4 (1) 11-19

Kumsa D, Eshetu M and Diba D 2016 Feed Intake, Milk Yield and Composition, and Profitability of Horro Cows Fed Rhodes Grass Hay Supplemented with Ficus sur (Cv. Forssk) Fruits. https://www.ajol.info/index.php/star/article/view/170063

Meads N Tahmasbi R and Jantasila N 2021 The nutritional evaluation of forage-based mixed rations in New Zealand using an in vitro gas production technique. Journal of Applied Animal Nutrition, 9(2)

Mediksa T, Bekele D, Marsha T and Abera H. 2021. Evaluation of Formulated Concentrate Feeds on Feed Intake and Milk Yield of Lactating Upgraded Dairy Cows at Nekemte and Ijaji Towns. American Journal of Applied Scientific Research 2021; 7(2): 22-28

NRC 2001 Nutrient Requirements of Dairy Cattle. 1989. 6th revised edition. Washington D.C: National Academy Press;

Paul S S, Mandal A B, Mandal G P, Kannan A and Pathak N. N 2004 Deriving Nutrient Requirements of Lactating Indian Cattle under Tropical Condition Using Performance and Intake Data Emanated from Feeding Trials Conducted in Different Research Institutes. Asian-Aust. Journal of Animal science; Vol 17, No. 6: 769-776

Salah N Sauvant D and Archimède H 2014 'Nutritional requirements of sheep, goats and cattle in warm climates: A meta-analysis', Animal, 8(9), pp. 1439–1447. Available at: https://doi.org/10.1017/S1751731114001153.

SteinshamnHavard 2010 Effect of forage legumes on feed intake, milk production and milk quality – a review. Animal Science Papers and Reports. 28(3): 195-206

Tekeba E M, Wurzinger L Baldinger and W J Zollitsch 2014 "Effects of Dietary Supplementation with Urea Molasses Multi-Nutrient Block on Performance of Mid Lactating Local Ethiopian and Crossbred Dairy Cows." Livestock Research for Rural Development 25 (6):

Tekeba E 2012 Effects of dietary supplementation with Urea Molasses Multi-Nutrient Block in local Ethiopian and crossbred dairy cows in North-western Ethiopia.September 2012 Vienna, Austria.https://www.researchgate.net/publication/286811685

Teshome D, Fita L, Feyissa F, Kitaw G and Wondatir Z. 2017. Effect of Total Mixed Ration on Dry Matter Intake, Milk Yield and Composition of Early Lactating Jersey Cows. Journal of Biology, Agriculture and Healthcare www.iiste.org ISSN 2224-3208.

Tolera A 2007 Feed Resources for Producing Export Quality Meat and Livestock in Ethiopia Examples from Selected Woredas in Oromia and SNNP Regional States; Ethiopia Sanitary and Phyto-sanitary Standards and Livestock and Meat Marketing Program (SPS-LMM), Addis Ababa, Ethiopia, 77 pp

Thornton P 2010 Livestock production: recent trends, future prospects. Philosophical Transactions of the Royal Society.365: 2853–2867.

https://doi.org/10.1098/rstb.2010.0134

****