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Effect of maturity, silage and hay of various feeds on lactating cows feed intake and productivity; A meta-analysis

Abstract

Objective: This meta-analysis was done with the aim of cultivating farmers decision in feeding their dairy cows for substituting several silage types, hay and maturity-based comparison feeds to improve dairy cows' performance.

Methods: The data that have booked in data sheet from previous published researches was based on the measurement of inclusion criteria with its relevancy for the research objective. A database includes 71 papers that were published among the interval of 1984-2020 years. In the current meta-analysis, the comparison treatments were differing in feed types but similar for all other parameters.

Result: On the current meta-analysis there were six sub-grouped various silage and hay comparison feed types. The comparison of alfalfa hay maturity shows no significantly difference in all cows measuring parameters of DMI, milk yield and milk composition. The reason probably due to small data set used for analysis. Similarly, for the comparisons' alfalfa silage with corn silage and silage with hay didn't show any significance difference. On the other hand, the comparisons of early cut silage with late cut silage, sorghum with corn silage, and grass silage with legume silage; early cut silage, corn silage and legume silage were significantly higher from their comparison diet at least in milk yield. However, for feed efficiency from all over the comparisons, the effect of silage maturity was only significantly differed over late cut silage.

Conclusion: based on the results shown on the collective meta experimental data, in the comparison of early cut silage with late cut silage; early cut silage gives higher MY and converts feed more efficiently to production than late cut silage but for others paired comparisons feed efficiency was not significantly differed. Therefore, except silage maturity, most comparison feed types were recommended to be replaceable with further studying forages cost-effectiveness and their accessibility.

Keywords: lactating cows, forage, performance, feed efficiency

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Abbreviations: ADF, Acid Detergent Fiber; ADL, Acid Detergent Lignin; AI, Artificial Insemination; AS- Alfalfa Silage; CI, Calving Interval; CON, Control; CP, Crude Protein either Feed or Milk; CS, Corn Silage; DMI, dry matter intake; DMY, Daily Milk Yield; FCA, First Calving Age; GS, Grass Silage; Kg, Kilogram; Kg/d, Kilogram per day; L, liter; LS, Legume Silage; MY, Milk Yield; NDF, Neutral Detergent Fiber; TRT, Treatment; SPSS, Statistical Package for Social Science; SS, Sorghum Silage; TMY, Total Milk Yield; Vs, versus

Introduction

Feed and feeding are prerequisite necessities in dairy farming. For their nutrition, as dairy cattle are social animals that operate in herd structure the owner needed to energetically deliberate, understand and realize their comfort in following dairy cattle responses to various types of feeds by watching how their productivity have gone.[1] In preparation of diet, amount of moisture-corrected nutrient primary estimated to feed lactating cows is a dry matter intake**.** In fact, the compulsory of dry matter intake is most importantly to prevent either under feeding or overfeeding; to meet the nutrient needs of dairy cows appropriately for increasing productivity and to decrease healthy problem of productive cows. In dairy farm feeding appropriate nutrient for need of lactating cows is obligatory as under feeding restrict production and damage cow's health. Whereas, overfeeding wastes feed and also affects the environment through excessive excretion of nutrients. Based on these reasons' preparation of dray matter intake is very crucial to be economical by increasing the productivity of dairy cows with appropriate feeding.[2] The way forward to solve feed intake variation between lactating cows is grouping cows based on their nutrient requirement.[2] The amount of feed intake in comparison between individual and group; individually fed cows eat less hay than group this was probably because of augmented nerviness of cows.[1] Similarly, grouping cows eat more feed than separate feeding because competition for feed whether a cow is hungry or not, group feeding stimulates others to eat.[3]

In dairy farming **body condition score** of cows' background is a factor for milk composition; in which thin group cows displayed Strictly lower fat and makes total solids lower.[4] On the other hand, the content of forage cell wall determines cow's voluntary intake, feeds with high cell-wall content had lower voluntary intake than low cell-wall content and also quantity of digestible energy inclined voluntary intake.[5] A cattle wants a manager to not eat in a smooth surface in natural grazing position.[2] The advantage of eat with head down is to eliminate feed waste related with elevated bunks in feed tossing and saliva formation of cows eat with their head down produces 17% more saliva than that of cows eat in horizontal position.[1] Furthermore,

temperature affect feed intake and production of lactating cows; these decreases on the increment of ambient temperature in which the thermal neutral zone of dairy cattle is between 5 to 20 ^{0}c. The dairy cattle water consumption increases up to temperature reading of 35 °C, but because of idleness of feed intake when temperature increase further water consumption declines. Correspondingly, coldness affect feed intake in which cows to resist the cold stress they increases feed intake, thermal insulation and basal metabolic intensity, reticulo-rumen motility and passage rate but, the extremeness of cold didn't increase feed intake rather cows become negative energy balance.[2]

Research question: For people of Africa feed self-sufficiency and poverty alleviation dairy production is one of the vital rural development sector; still the potential remains underexploited.[6] African dairy stacked by many difficulties such as; breed, feed resources and low adoption of improved technologies; most importantly feed availability was a great influence for the sector.[7,8] Feed shortage was extremely critical[9] due to this reason most farmers fed lactating cows only maintenance needs.[10] The knowledge gap of farmers to formulate feed technologies makes feed costly to get and this gap enforces farmers to feed cows low quality feeds like unimproved straw and hay.[11,12] In dairy farm for the success of farm owner farmer's milk and feed price are the basics that has placed primarily for the decision of tomorrow environment. If price is well to continue their farm farmers hopefully facilitate their activity rather, no question to stop their farm completely.[13] The terrible of insufficient quality and quantity of feeds was most importantly due to over grazing, Shortage of land, variability of weather and population augmentation.[13-15] The absence of more feed processing companies makes dairy sector more complex especially in dry season feed depreciates in quality and rises in cost. This serious shortage ended up to closing the farm by decreasing milk yield, increasing mortality rate of young calf, lengthen parturition interval and retarded growth rate.[10,14]

The purposes of meta-analysis: In making more measurable discussion, experience and share more accurate and advanced knowledge for synthesizing strong phenomenon in a specified research problem with multi-quantitative data meta-analysis has chosen to do so. Based on farmers collective consequences that have stated before in the research question the meta-research has tried to show feed options as a solution for available feed constraints with collective effort of meta-data. Moreover, this meta-analysis has taken as an encouragement for farmers in attempting to deduce the consequence of switching those comparison feeds in a dairy production.

The aim of meta-analysis was to evaluate effects of substituting various feeds for familiarizing farmers productivity-based decision on cows fed either silage or hay; legume or grass silage; early or late harvest; corn or sorghum silage; corn or alfalfa silage as a daily diet. **The main objective** of this meta-analysis was to compare and examine effect of maturity, silage and hay of various feeds on feed intake and milk productivity of lactating cows. **The hypothesis** was replacement of dairy cow's diet based on maturity, hay and silage of various feeds have a significant effect on feed intake and milk productivity.

Material and methods

Database establishment

The data that have terminated in datasheet was searched in "google scholar" with keywords of: "lactating cows", "milk production", "forage maturity" and "silage" and "hay" or **reference** method from other collected researches. The resulting papers that have used for this meta-analysis were checked on references. The meta-analysis aims to quantify and investigate effect of harvesting time, silage and hay of various feed types on lactating cow's DMI, milk yield and composition. On this regard **71** papers were marked and take part for analysis based on their relevancy for the comparison of present study. The meta multiple researches that have been analyzed were published for the last 1984-2020 years.

The inclusion criteria for experiments of meta-analysis were: papers that have at least one comparison feeds in the research, clearly stated DMI and milk productivity (MY and composition), similar status of lactating cows with only differ in feed types so that; breed-based comparisons, conference abstracts and quantitative survey reports were not included. The researches that have conducted with two strong significant trail experiments in one research paper and that fulfill the inclusion criteria each trail have included as one research. Generally, the researches that have used control measures of lactating cows other than feed difference were referred as an excluded paper.

This meta-analysis containing six pair set of feed comparisons. Dairy cows fed either control or treatment. The feed categories are maturity of alfalfa hay, maturity of silage, sorghum & corn silage, corn & alfalfa silage, grass & legume silage and lastly silage & hay comparisons based on cows DMI and productivity performance. Furthermore, the meta was designed for encouragement of farmers in attempting to deduce the consequence of switching off low productive feeds on lactating cows.

Statistics

In this meta-analysis the assembled data of various studies reported DMI, MY, milk fat content and protein content as comparison with different feed types. The analysis was done for the purpose of comparing two feed types for their response on lactating cows' productivity. Almost all previous studies of each comparison were mandated to compare with full productivity parameters of lactating cows within the research criteria. Other feed or milk quality determinant traits like feed digestibility, NDF or ADF content were examined only as a systematic review without any statistical analysis. The average value of each treatment was calculated before statistical analysis. Statistical analysis was performed by using SPSS version 22. So that the researcher used the software by following appropriate procedures.

Table 1 The overview of the experiments used for meta-analysis of forage comparisons

Experiments	Comparison feed types					
	maturity of silage	Maturity of Alfalfa hay	Corn and alfalfa silage	Sorghum and corn silage	Hay and silage	Grass and legume silage
NICHOLS et al. [1998]				X		
Lusk et al.[45]				X		
Oliver et al.[49]				X		
Colombini et al.[47]				X		

Table Continued...

Experiments	Comparison feed types					
	maturity of silage	Maturity of Alfalfa hay	Corn and alfalfa silage	Sorghum and corn silage	Hay and silage	Grass and legume silage
Dann et al.[41]				X		
M. Cattani et al.[48]				X		
Colombini et al.[47]				X		
H. M. Dann et al.[41]				X		
S. Colombini, et al.[47]				X		
R. J. GRANT et al.[3]				X		
Nelson & Satter[18]	X	X				
Nelson & Satter [19]	X					
Nelson & Satter [18]	X	X			X	
Nelson & Satter [19]	X	X			X	
Nelson & Satter [19]	X	X			X	
Hoffman et al.,[22]	X					
Hoffman et al.,[22]	X					
Rinne et al.,[27]	X					
Oshita et al.,	X					
A.Vanhatalo[28]	X					
Hatew et al.,[24]	X					
Alstrup et al.,[29]	X					
Alstrup et al.,[29]	X					
Cabezas-Garcia et al.,[25]	X					
Cabezas-Garcia et al.,[26]	X					
KAISER & COMBS[16]		X				
R.E.Redmann,[21]		X				
Colburn et al.,[20]		X				
Broderick,[32]			X			
Broderick, [37]			X			
Haddad et al.,[40]			X			
Onetti et al.,[69]			X			
Ruppert et al.,[34]			X			
Onetti et al.,[69]			X			
Wattiaux & Karg,[38]			X			
Brito & Broderick,[32]			X			
Kowsar et al.,[39]			X			
Yan et al.,[35]			X			
Gislon et al.,[31]			X			
Broderick,[32]					X	
Broderick,[37]					X	
Coulon,[56]					X	
Beauchemin et al.,[51]					X	
Eun et al.,[52]					X	

Table Continued...

Experiments	Comparison feed types					
	maturity of silage	Maturity of Alfalfa hay	Corn and alfalfa silage	Sorghum and corn silage	Hay and silage	Grass and legume silage
Rupert & Katie,[30]					X	
J.C.Plaizier,					X	
Gownipuram et al.,[54]					X	
Haselmann et al.,[58]					X	
Filleau et al.,[64]						X
Moorby, et al.,[68]						X
Vanhatalo,[28]						X
Moorby et al.,[63]						X
Linton & Allen,[70]						X
Cherney et al.,[67]						X
Al-Mabruk et al.,[62]						X
Evans, et al.,[66]						X
Fisher, et al.,[68]						X
Fisher, et al.,[68]						X
Broderick et al.,[32]						X
Hoffman et al.,[22]						X
Holden et al.,[5]						X
Weiss & Shockey,[65]						X
R. J. Dewhurst et al.,[66]						X
R. J. Dewhurst et al.,[66]						X
Total number of comparisons	15	7	11	10	12	16

Result and discussion

Result

Alfalfa hay maturity

Table 2 Effect alfalfa hay maturity on lactating cows DMI and performance

alfalfa hay early Vs. late cows' response	CON	TRT	Difference	SED	P-Value
n=7					
DMI (kg/d)	21.92	21.54	0.38	0.26	0.21
MY (kg/d)	31.64	32.3	-0.66	0.49	0.25
Fat content (%)	3.47	3.56	-0.09	0.05	0.17
Protein content (%)	2.98	2.93	0.05	0.02	0.08
Feed Efficiency	1.45	1.50	-0.05	0.02	0.10

DMI: Dry matter intake (kg/d), MY: Milk yield (kg/d)

CON (control): is early harvest from the comparison

TRT (Treatment): is late harvest treatment from the comparison

SED: Standard error of difference

Feed Efficiency = MY/DMI

The comparison of early and late harvest AH data set ended by considering each meta-data into account. The result shows DMI, MY and composition of early and late harvest AH was not significantly differed (Table 2). The reason probably availability of data that have used for comparison was with smaller observations. Furthermore; lactating cows that fed early harvest AH efficiently converts feed to milk in 0.45kg times greater portion of its dry matter intake. On the other hand, late harvest AH efficiently converts feed to milk 0.50 kg times greater portion of its dry matter intake. Feed efficiency between diets were not significantly differed (*P=0.1*).

Silage maturity

Table 3 Effect of silage maturity on lactating cows DMI and performance

silage maturity (early Vs. late) cows' response	CON	TRT	Difference	SED	P-Value
n=15					
DMI (kg/d)	20.92	20.73	0.19	0.32	0.56
MY (kg/d)	29.42	28.13	1.29	0.33	0.001
Fat content (%)	4.07	4.11	-0.04	0.04	0.42
Protein content (%)	3.33	3.32	0.01	0.02	0.90
Feed Efficiency	1.40	1.35	0.05	0.02	0.02

DMI: Dry matter intake (kg/d), MY: Milk yield (kg/d)

CON (control): is early harvest from the comparison.

TRT (Treatment): is late harvest from the comparison

SED: Standard error of difference.

Feed Efficiency = MY/DMI

The comparison of early and late cut of silage maturity shows that early cut silage was significantly higher on cow's milk yield and feed efficiency *(p=0.001, 0.02)* for MY and feed efficiency respectively (Table 3). On the other hand, maturity was not significantly differed for DMI and milk composition. Feed conversion efficiency of early cut silage converts feed to production 0.4 kg/day times greater portion of its dry matter intake whereas late cut converts 0.35kg/day times greater portion of its dry matter intake.

Corn and alfalfa silage

Table 4 Effect of Corn and Alfalfa silage on lactating cows DMI and performance

CS & AS cows' response	CON	TRT	Difference	SED	P-Value
n=11					
DMI (kg/d)	23.14	23.16	-0.02	0.66	0.98
MY (kg/d)	34.56	34.83	-0.27	0.60	0.67
Fat content (%)	3.56	3.67	-0.11	0.09	0.18
Protein content (%)	3.15	3.11	0.04	0.03	0.24
Feed Efficiency	1.48	1.50	-0.02	0.05	0.76

DMI: Dry matter intake (kg/d), MY: Milk yield (kg/d)

CON (control): which is corn silage (CS)

TRT (Treatment): which is alfalfa silage (AS)

SED: Standard error of difference.

Feed Efficiency = MY/DMI

The result of comparison CS and AS fed cows were observed with no significant difference on DMI, MY and composition (Table 4). Lactating cows that fed CS efficiently converts feed to milk in 0.48kg greater portion of its DMI and 0.50 kg greater for AS; but feed efficiency wasn't show any significant difference between the diet (*P=0.76*). Furthermore, numerically AS fed lactating cows were produce 0.27 kg more MY than corn diet and also fat content of AS fed cows gives 0.11 percentage more fat content than CS fed cows. Although there was a difference in cows' productivity and feed efficiency between the diet but it was not significantly differed.

Sorghum and corn silage

Table 5 Effect of Sorghum and Corn silage on lactating cows DMI and performance

SS Vs. CS cow's response	CON	TRT	Difference	SED	P-Value
n=11					
DMI (kg/d)	20.93	22.57	-1.64	0.67	0.04
MY (kg/d)	27.36	29.17	-1.81	0.64	0.02
Fat content (%)	3.69	3.66	0.03	0.13	0.83
Protein content (%)	3.17	3.20	-0.03	0.04	0.61
Feed Efficiency	1.29	1.27	0.02	0.04	0.65

DMI: Dry matter intake (kg/d), MY: Milk yield (kg/d)

CON (control): is SS (Sorghum silage)

TRT (Treatment): is CS (Corn silage)

SED: Standard error of difference

Feed Efficiency = MY/DMI

The Comparison of CS and SS of the collected data analyzed with contribution of each data set for the result. The result shows that there was a significant difference between the diet; in which CS fed cows has taken 1.64 kg/d more DMI and produces 1.81kg/d MY than SS *(P=0.04& 0.02)* (Table 5).

Moreover, milk composition (fat and protein content) of the diet was not significantly differed *(P=0.83, 0.61)* for fat and protein content respectively. In feed efficiency cows efficiently converts 0.27kg and 0.29kg of milk greater portion of its DMI for CS and SS respectively. However, feed efficiency between the diet was not significantly differed (*P=0.65*). Generally, result states although comparison fed cows show significant difference on milk yield and DMI but feed efficiency and milk composition were not significantly differed.

Silage and hay

Table 6 Effect of Silage and Hay on lactating Cows DMI and performance

AG Silage Vs. Hay Cows response	CON	TRT	Difference	SED	P-Value
n=12					
DMI (kg/d)	19.96	20.62	-0.66	0.41	0.13
MY (kg/d)	30.96	30.72	0.24	0.46	0.61
Fat content (%)	3.51	3.42	0.09	0.05	0.11
Protein content (%)	2.99	3.01	-0.02	0.02	0.34
Feed Efficiency	1.55	1.50	0.05	0.03	0.07

DMI: Dry matter intake (kg/d), MY: Milk yield (kg/d)

CON (control): Silage

TRT (Treatment): Hay

SED: Standard error of difference.

Feed Efficiency = MY/DMI

AG= alfalfa and grass (hay vs. Silage)

The result shows that silage and hay fed cows were not significantly differed on their DMI, milk yield and Composition. Although, milk yield of silage fed lactating cows was greater and DMI was greater for hay fed cows but it was not significantly deviated *(P=0.13, 0.61)* for DMI and milk yield respectively (Table 6). Particularly for milk composition fat content was greater on silage fed cows and protein was higher on hay fed cows but milk composition as general was not significantly differed. Furthermore, lactating cows that fed silage efficiently converts feed to milk in 0.55kg above its dry matter intake. Whereas in the cows feeding hay converts 0.50 kg greater above its dry matter intake feed efficiency was not significantly differed between the diet(*P=0.07*).

Legume and grass silage

Table 7 Effect of Grass and Legume silage on lactating Cows DMI and performance

Grass & Legume Silage Cows response	Control	Treatment	Difference	SED	P-Value
n=16					
DMI (kg/d)	17.66	19.5	-1.84	0.53	0.002
MY (kg/d)	26.93	28.75	-1.82	0.50	0.001
Fat content (%)	3.83	3.79	0.04	0.05	0.58
Protein content (%)	3.14	3.08	0.06	0.02	0.03
Feed Efficiency	1.57	1.53	0.04	0.04	0.4

DMI: Dry matter intake (kg/d), MY: Milk yield (kg/d)

CON (control): grass silage

TRT (Treatment): legume silage

SED: Standard error of difference

Feed Efficiency = MY/DMI

When we compare GS and LS DMI of LS was significantly higher in taking higher diet than GS. The present result shows that LS fed cows were observed with 1.84 kg more dry matter than GS *(P=0.002)* (Table 7). Similarly, milk yield and milk protein content also significantly differed which was 1.82 kg higher and 0.06 percentage lesser on LS fed cows over GS *(P= (0.001 & 0.03)* for milk yield and protein respectively. On the other hand, milk fat content of the diet was not significantly differed *(P=0.58)*.

Moreover; lactating cows that fed LS efficiently converts feed to milk 0.53kg times greater portion of its dry matter intake. On the other hand, the cows feeding GS converts feed to milk 0.57kg times greater portion of its dry matter intake. Generally, the result indicates even though milk yield, DMI and protein content shows significant difference between the diet but feed efficiency was not significantly differed (*P=0.4*).

Discussion and combined result

Table 8 Effect of Various feed types on lactating cows DMI and performance A combined table

Feed Comparisons	DMI (kg/d)		MY (kg/d)		Fat content (%)		Protein content (%)		Feed Efficiency (MY/DMI)	
	CON	TRT	CON	TRT	CON	TRT	CON	TRT	CON	TRT
Hay maturity (early vs. late)	21.92	21.54	31.64	32.3	3.47	3.56	2.98	2.93	1.45	1.50
Difference	0.38		-0.66		-0.09		0.05		-0.05	
P-value	0.211		0.253		0.17		0.08		0.098	
SED	0.255		0.494		0.051		0.021		0.023	
Silage maturity (early vs. late)	20.92	20.73	29.42	28.13	4.07	4.11	3.33	3.32	1.40	1.35
Difference	0.19		1.29		-0.04		0.01		0.05	
P-value	0.561		0.001		0.423		0.902		0.016	
SED	0.320		0.333		0.043		0.020		0.019	
Corn vs. Alfalfa silage	23.14	23.16	34.56	34.83	3.56	3.67	3.15	3.11	1.48	1.50
Difference	-0.02		-0.27		-0.11		0.04		-0.02	
P-value	0.979		0.670		0.188		0.240		0.756	
SED	0.659		0.600		0.090		0.034		0.046	
Sorghum vs. Corn silage	20.93	22.57	27.36	29.17	3.69	3.66	3.17	3.20	1.29	1.27
Difference	-1.64		-1.81		0.03		-0.03		0.02	
P-value	0.04		0.022		0.826		0.613		0.648	
SED	0.671		0.642		0.127		0.044		0.045	

Table Continued...

Feed Comparisons	DMI (kg/d)		MY (kg/d)		Fat content (%)		Protein content (%)		Feed Efficiency (MY/DMI)	
	CON	TRT	CON	TRT	CON	TRT	CON	TRT	CON	TRT
Silage vs. Hay	19.96	20.616	30.96	30.72	3.51	3.42	2.99	3.01	1.55	1.50
Difference	-0.656		0.24		0.09		-0.02		0.05	
P-value	0.131		0.611		0.111		0.336		0.067	
SED	0.408		0.462		0.054		0.020		0.027	
Grass vs. Legume silage	17.66	19.5	26.93	28.75	3.83	3.79	3.14	3.08	1.57	1.53
Difference	-1.84		-1.82		0.04		0.06		0.04	
P-value	0.002		0.001		0.588		0.031		0.42	
SED	0.531		0.503		0.045		0.024		0.042	

DMI: Dry matter intake (kg/d), MY: Milk yield (kg/d)

CON (control): is the first treatment from the comparison listed in the table

TRT (Treatment): is the second treatment from the comparison listed in the table

SED: Standard error of difference

Feed Efficiency = MY/DMI

Discussion

Alfalfa hay maturity

The result shows that DMI, milk yield and milk composition of both early and late cut fed cows were not significantly differed. Similarly, the earlier findings also confirm that milk yield and milk composition of cows was not affected by maturity of AH.[16-19] Rationally the maturity of hay decreasing digestibility of dry matter in 0.4% per day[20] and this maturity of hay affect cows to take more time for ruminating, chewing and a greater volume of rumen contents which decreases dry matter intake[17,19] but it was not show any difference for dry matter intake for this meta result; probably the small data set used for analysis. On the other hand, matured AH contained slightly lower content of CP and greater NDF content this endorsed to a greater loss of leaves during harvest and low nutritional value[17,19] and the feeds with their protein content increasingly less would depress the ruminal microorganism synthesis of amino acid and protein; those all causes for continuously decrease rate of reticulorumen digesta and feed intake.[21]

Silage maturity

In comparing Silage maturity, the result shows that milk yield and feed efficiency were significantly higher on early cut fed cows (*P=0.001 &0.02*) for milk yield and feed efficiency respectively. Similarly, the previous finding confirm that late cut alfalfa silage fed cow's milk yield were less than early cut but for milk composition it was not significantly differed.[17,18,22] On the other hand, early cut corn and sorghum silage fed cows produce greater milk yield over late cut silage.[23,24] This different probably because of the diet crude protein was excellent quality on early cut and the increment of NDF, ADF and ADL content on late cut decreases nutrient content of diet.[17-19]

The result didn't show any significant difference on dry matter intake and milk composition. In contrast previous finding of grass-barley multi-cultivated late cut silage DMI was significantly higher than early cut. But milk yield and milk protein content were not influenced by maturity; milk fat content was higher on early harvest (P<0.05).[25,26] On the other hand, for feed efficiency the result shows that early cut silage fed cows more efficiently convert feeds to production over late cut silage *(p=0.016) (Table 8)* and the earlier authors Cabezas-Garcia et al.[25,26] also approve similarly, early cut silage fed cows more efficiently covert feed to production than late cut silage. Generally, the result with previous findings confirm that early cut silage had significant effect on milk yield and feed efficiency but milk composition and DMI was not significantly differed.[27-29] So that, with the significant result of feed conversion efficiency and milk yield; the result confirms and encourages farmers to switch off using late harvest silage for increasing dairy cows' productivity with efficient use of feed resources.

Corn and alfalfa silage

The result of CS and AS comparison fed cows were not display any significant difference on DMI, milk yield and milk composition. similarly, previous findings confirm that CS and AS diet was not significantly varied on cows DMI, milk yield and fat composition.[30,31] Although crude protein content of alfalfa silage diet was higher but total dry matter digestibility was not differed among diets this may be a reason that diets not differed in cow's productivity. On the other hand, earlier finding showed that replacement DMI of AS with CS significantly decreases (p<0.01).[32] The reason of increment of DMI of AS probably due to its higher NDF digestibility.[33-35] The depression of CS DMI related with the enclosure of high moisture content in the diet.[36] Milk yield was higher on AS over CS *(P=0.02)*.[32,35] In contrary, milk yield was higher on CS than AS.[37-39] The result generally confirms; even though there was a difference between diets for cows DMI, milk yield and composition but it was not significantly observed. Feed efficiency was not affected by forage types so feeding of these both comparison diets didn't affect cows feed intake and milk productivity.

Sorghum and corn silage

When we compare SS and CS-based diets the result shows that DMI of SS was significantly lower than CS (*P=0.04).* Similarly, the previous authors also confirm that, in the replacement of CS by SS percentage increment of SS significantly decreases DMI.[40-42] This increment was probably the particle size of SS.[42] The less digestibility of SS over CS was also other possible reason for decrement of DMI.[43] Other previous authors stated in different way, there was a stable similar association of DMI between CS and SS fed lactating cows.[44-46] On the result milk yield of CS fed cows display significantly higher milk yield over SS fed cows (*P=0.02)* and this earlier authors observed similarly.[40,47-49] On the other hand, similar with the result previous findings deep-rooted the non-significancy of milk

composition between the diet.[41,45,47-50] Conclusively, on the result there was a significant difference of milk yield and feed intake between CS and SS diet fed cows but feed efficiency between the diet was not significantly differed. So that the present result confirms that replacing CS with SS didn't affect productivity and the previous findings also strongly confirm for the replacement of these diets.[41,50]

Silage and hay

For silage and hay fed cows comparison their DMI, MY and milk composition were not significantly varied. The earlier authors similarly stated that Silage and hay based prepared forage of gama grass, cowpea and alfalfa was observed with no significance difference on lactating cows DMI, MY and composition.[30,51-54] On the other hand, DMI and MY of Silage was higher than hay the reason probably silage diet digestibility was higher than hay as hay had higher NDF content and less digestible due to its leaf loss during hay making.[18,19,55-57]

Feed efficiency of lactating cows was lower on hay fed cows than silage which means silage fed cows were efficiently convert feed to production but not significantly differed.[51,54,58] In combining with the collective data set the present meta-analysis confirms that feed efficiency was not significantly differed. Some feed technologies like processed (Cubed and chopped forages) of both hay and silage can be used as an alternative feed for replacement diet. Although processing of hay or silage shows similar results in which it decreases DMI and MY with less chewing time. Processed forages has insufficient effective fiber so that minimum amount of unprocessed hay or silage should be included as forage particle length is critical to maintain ruminal function.[51] Most importantly DMI decreases when NDF content of diets exceeded 25%.[59]

Legume and grass silage

The comparison of legume silage fed cows displays significantly higher milk yield and DMI over grass silage; whereas for milk composition protein content was significantly higher for grass-based diet but no significance difference was observed on fat content. Correspondingly, earlier authors approves that both alfalfa and Red clover legume silage was significantly higher on DMI and milk yield over grass silage.[5,22,60-64] The reason probably legume silage was more digestible than grass silage.[63]

On the other hand, the previous findings displays with no significant difference between Red clover legume silage and grass silage in both milk yield and Composition[65,66] and also this authors[5,58] states Similarly, in that milk composition of alfalfa silage and grass silage was not significantly differed. We Usually think that grass silage fed cows results in lower milk yield and DMI than legume silage; but orchard grass silage and alfalfa silage fed cows didn't show any significance difference in both milk yield and DMI. The reason was probably harvesting time of grass Silage.[28,67]

According to Moorby et al.[68] feed efficiency was higher for normal grass silage over Red clover legume silage, and authors Broderick et al.[60] and Fisher, et al.[61] states similarly, for Ryegrass silage feed efficiency was higher than alfalfa legume silage. Generally, although legume silage was observed high significant difference on milk yield and DMI over grass-based fed diet but feed efficiency was not significantly differed. So that the present result concludes grass silage can be replaced by legume silage with better forage management.

Conclusion

This meta-analysis was analyzed six sub-grouped dairy feed comparisons in the aim of determining effects of various feed on lactating cows feed intake and productivity. For maturity-based comparisons feeding either early or late alfalfa hay has no effect on DMI and milk productivity of lactating cows. Alfalfa hay maturity didn't show any significant difference on feed intake and lactating cows' productivity as a whole. The comparisons of cows fed corn silage over sorghum silage; legume silage over grass silage show a high significant difference for both DMI and milk yield but feed efficiency was not significantly differed with in these comparison feed types. On the other hand, silage maturity shows high significant variation for early cut silage over late cut on milk yield and feed efficiency. Whereas alfalfa versus corn; grass versus hay-based comparisons didn't show any significant different for cows' feed intake and productivity.

Generally, for almost all comparisons feeding either comparison feeds didn't affect feed intake and cow's productivity except silage maturity; for silage maturity this meta-analysis confirms that to increase lactating cow's productivity farmers highly encouraged to switch off using late harvest silage as early cut silage more efficiently converts feed to production than late cut silage and also results significantly higher milk yield but for others feed efficiency was not significantly differed.

Conflict of interest

The authors have not declared any conflict of interests.

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References

1. Albright JL. Nutrition, feeding, and calves Feeding Behavior of Dairy Cattle. *J Dairy Sci*. 1993;38:485–498.
2. NRC. Nutrient Requirements of Dairy Cattle Seventh. 2001.
3. Grant RJ, Albright JL. Effect of Animal Grouping on Feeding Behavior and Intake of Dairy Cattle. *Journal of Dairy Science.* 2001;84:E156–E163.
4. Holter JB, Slotnick MJ, Hayes HH, et al. Effect of Prepartum Dietary Energy on Condition Score, Postpartum Energy, Nitrogen Partitions, and Lactation Production Responses 1. *J Dairy Sci.* 1990;8:3502–3511.
5. Holden LA, Glenn BP, Erdman RA, et al. Effects of Alfalfa and Orchardgrass on Digestion by Dairy Cows. *Journal of Dairy Science.* 2020;77(9):2580–2594.
6. Bingi S, Tondel F. Recent developments in the dairy sector in Eastern Africa: Towards a regional policy framework for value chain development. *ECDPM.* 2015;78:19.
7. Seifu E, Reiner D. Analysis of the dairy value chain: Challenges and opportunities for dairy development in Dire Dawa, Eastern Ethiopia. *International Journal of Agricultural Policy and Research.* 2014;2(6):224–233.
8. Mihret T, Mitku Fentahun, Guadu T. Dairy Farming and its Economic Importance in Ethiopia: A Review. *World Journal of Dairy & Food Sciences.* 2017.
9. Eticha BD. Productive and reproductive performance and management practices of crossbred dairy cows at Jimma, ethiopia. *International journal of current research.* 2012.
10. Sraïri MT. Dairy Development in Morocco. In Dairy Development in Morocco. 2011.

11. Kuma Berhanu. Market Access and Value Chain Analysis of Dairy Industry in Ethiopia (Issue February). 2012.

12. Mitiku E, Mekdes S, Yesihak YM. Milk production, marketing practices and qualities along milk supply chains of Haramaya District, Ethiopia. *African Journal of Agricultural Research.* 2019;14(35):1990–2005.

13. Negash D. Evaluation of Commercial Animal Feed Quality and Manufacturing Status in Ethiopia. *Acta Scientifci Nutritional Health.* 2020;4(2):1–13.

14. Kuma Birhanu. Market Access and Value Chain Analysis of Dairy Industry in Ethiopia : The Case of Wolaita Zone (Issue February). 2012.

15. Alemu MM. Urban and Peri-Urban Dairy Cattle Production in Ethiopia : a Review. *Online Journal of Animal and Feed Research*. 2019;9(4):173–177.

16. Kaiser RM, Combs DK. Utilization of Three Maturities of Alfalfa by Dairy C o w s Fed Rations that Contain Similar C o n c e n t r a t i o n s of Fiber. *Journal of Dairy Science.* 1998;72(9):2301–2307.

17. Nelson WF, Satter LD. Effect of Stage of Maturity and Method of Preservation of Alfalfa on Production by Lactating Dairy Cows. *Journal of Dairy Science.* 1990;73(7):1800–1811.

18. Nelson WF, Satter LD. Impact of Alfalfa Maturity and Preservation Method on Milk Production by Cows in Early Lactation. *Journal of Dairy Science.* 1992a75(6):1562–1570.

19. Nelson WF, Satter LD. Impact of Stage of Maturity and Method of Preservation of Alfalfa on Digestion in Lactating Dairy Cows. *Journal of Dairy Science.* 1992b;75(6):1571–1580.

20. Colburn MW, Evans JL, Ramage CH. Apparent and True Digestibility of Forage Nutrients by Ruminant Animals. *Journal of Dairy Science.* 1986;51(9):1450–1457.

21. RE Redmann. Chemical factors and their relation to feed intake regulation in ruminants: a reyiev. *Canadian Journal of Soil Science.* 1972;58:119–124.

22. Hoffman PC, Combs DK, Casler MD. Performance of Lactating Dairy Cows Fed Alfalfa Silage or Perennial Ryegrass Silage. *Journal of Dairy Science.* 1998;81(1):162–168.

23. Thomas JW, Brown LD, Emery RS, et al. Comparisons Between Alfalfa Silage and Hay. *Journal of Dairy Science.* 1969;52(2):195–204.

24. Hatew B, Bannink A, van Laar H, et al. Increasing harvest maturity of whole-plant corn silage reduces methane emission of lactating dairy cows. *Journal of Dairy Science.* 2016;99(1):354–368.

25. Cabezas-Garcia EH, Krizsan SJ, Shingfield KJ, et al. Effects of replacement of late-harvested grass silage and barley with early-harvested silage on milk production and methane emissions. *Journal of Dairy Science.* 2017; 100(7):5228–5240.

26. Cabezas-Garcia EH, Krizsan SJ, Shingfield KJ, et al. Effects of replacement of late-harvested grass silage and barley with early-harvested silage on ruminal digestion efficiency in lactating dairy cows. *Journal of Dairy Science.* 2018; 101(2):1177–1189.

27. Rinne M, Huhtanen P, Jaakkola S. Digestive processes of dairy cows fed silages harvested at four stages of grass maturity. *Journal of Animal Science.* 2002;80(7):1986–1998.

28. Vanhatalo. Effects of feeding grass or red clover Silage cut at two maturity Stages in Dairy Cows. 1. Nitrogen motabolism and Supply of amino acids. *J Dairy Sci*. 2009.

29. Alstrup L, Søegaard K, Weisbjerg MR. Effects of maturity and harvest season of grass-clover silage and of forage-to-concentrate ratio on milk production of dairy cows. *Journal of Dairy Science.* 2016;99(1):328–340.

30. Rupert M, Katie R. Reproduced with permission of the copyright owner. Further reproduction prohibited without. *Journal of Allergy and Clinical Immunology.* 2003;130(2):556.

31. Gislon G, Colombini S, Borreani G, et al. Milk production, methane emissions, nitrogen, and energy balance of cows fed diets based on different forage systems. *Journal of Dairy Science.* 2020;103(9):8048–8061.

32. Brito AF, Broderick GA. Effect of varying dietary ratios of alfalfa silage to corn silage on production and nitrogen utilization in lactating dairy cows. *Journal of Dairy Science*. 2006; 89(10):3924–3938.

33. Onetti SG, Shaver RD, McGuire MA, et al. Effect of supplemental tallow on performance of dairy cows fed diets with different corn silage:alfalfa silage ratios. *Journal of Dairy Science.* 2002;85(3):632–641.

34. Ruppert LD, Drackley JK, Bremmer DR, et al. Effects of tallow in diets based on corn silage or alfalfa silage on digestion and nutrient use by lactating dairy cows. *Journal of Dairy Science.* 2003;86(2):593–609.

35. Yan R, Han JG, Zhang X, et al. Effects of different corn silage: Alfalfa silage ratios and full fat extruded soybeans on milk composition, conjugated linoleic acids content in milk fat and performance of dairy cows. *African Journal of Biotechnology.* 2010;9(33):5465–5474.

36. Bal MA, Coors JG, Shaver RD. Impact of the Maturity of Corn for Use as Silage in the Diets of Dairy Cows on Intake, Digestion, and Milk Production. *Journal of Dairy Science*. 1997;80(10):2497–2503.

37. Broderick, Glen A. Alfalfa Silage or Hay Versus Corn Silage as the Sole Forage for Lactating Dairy Cows. *Journal of Dairy Science*. 1985;68(12):3262–3271.

38. Wattiaux MA, Karg KL. Protein level for alfalfa and corn silage-based diets: I. Lactational response and milk urea nitrogen. *Journal of Dairy Science.* 2004;87(10):3480–3491.

39. Kowsar R, Ghorbani GR, Alikhani M, et al. Corn silage partially replacing short alfalfa hay to optimize forage use in total mixed rations for lactating cows. *Journal of Dairy Science.* 2008;91(12):4755–4764.

40. Haddad SG, Moore KJ, Pedersen JF. Brown Midrib Sorghum Silage for Midlactation Dairy Cows 1. *J Dairy Sci.* 1995;16:1970–1980.

41. Dann HM, Grant RJ, Cotanch KW, et al. Comparison of Brown Midrib Sorghum-Sudangrass with Corn Silage on Lactational Performance and Nutrient Digestibility in Holstein Dairy Cows. Journal of Dairy Science. 2008;91(2):663–672.

42. Colombini S, Galassi G, Crovetto GM, et al. Milk production, nitrogen balance, and fiber digestibility prediction of corn, whole plant grain sorghum, and forage sorghum silages in the dairy cow. *Journal of Dairy Science.* 2012;95(8):4457–4467.

43. Bakici Y, Demirel M. Determination of qualities of corn, sorghum, sudangrass and sorghum x sudangrass hybrid silages. *Journal of Applied Animal Researc*h. 2004;26(1):45–48.

44. Bernard JK, Tao S. Short communication: Production response of lactating dairy cows to brachytic forage sorghum silage compared with corn silage from first or second harvest. Journal of Dairy Science. 2015;98(12):8994–9000.

45. Lusk JW, Karau PK, Balogu DO, et al. Brown Midrib Sorghum or Corn Silage for Milk Production. *Journal of Dairy Science.* 1984;67(8);1739–1744.

46. Salamone CS. Effect of Replacing Corn silage and Alfalfa hay with master Graze Silage on dairy Cows performance. *International Journal of Dairy Science.* 2013.

47. Colombini, Stefania, Rapetti L, et al. Brown midrib forage sorghum silage for the dairy cow : nutritive value and comparison with corn silage in the diet. *Italian Journal of Animal Science.* 2010.

48. Cattani M, Guzzo N, Mantovani R, et al. Effects of total replacement of corn silage with sorghum silage on milk yield , composition , and quality. *Journal of Animal Science and Biotechnology*. 2017.

49. Oliver AL, Grant RJ, Pedersen JF, et al. Comparison of Brown Midrib and Forage Sorghum with Conventional Sorghum and Corn Silage in Diets of Lactating Dairy Cows*. *Journal of Dairy Science.* 2004;87(3):637–644.

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50. Li SS, Zhang JJ, Bai YF, et al. Sorghum silage substituted for corn silage in diets for dairy cows : Effects on feed intake, milk yield and quality, and serum metabolites. *Applied Animal Science.* 2020.

51. Beauchemin KA, Rode LM, Eliason MV. Nutrition, feeding , and calves chewing Activities and Milk Production of Dairy Cows Fed Alfalfa as Hay , Silage , or Dried Cubes of Hay or Silage. *Journal of Dairy Science*. 1997;80(2):324–333.

52. Eun J, Fellner V, Burns JC. Gamagrass Evaluated E astern as Hay or Silage for Lactating Dairy Cows. *Professional Animal Scientist.* 2003;7446.

53. JC Plaizier. Replacing Chopped Alfalfa Hay with Alfalfa Silage in Barley Grain and Alfalfa-Based Total Mixed Rations for Lactating Dairy Cows. *J Dairy Sci.* 2004.

54. Gownipuram R, Mendoza M, Solano N, et al. Effects of feeding tropical forage legumes on nutrients digestibility , nitrogen partitioning and performance of crossbred milking cows E ff ects of feeding tropical forage legumes on nutrients digestibility, nitrogen partitioning and performance of cros. *Animal Feed Science and Technology.* 2020;247:32–40.

55. Broderick, Glen A. Performance of lactating Dairy Cows Fed Either Alfalfa Silage or Alfalfa Hay as the sole Forage. *Journal of Dairy Science*. 1995;78(2):320–329.

56. Coulon JB. Effect of forage conservation (hay or silage) on chemical composition of milk. *Ann Zootech.* 1977;33.

57. Lehmann JO. Production of hay milk Farmer's motivation, cow performance and farm economy. 2012.

58. Haselmann A, Wenter M, Fuerst-waltl B, et al. Comparing the e ff ects of silage and hay from similar parent grass forages on organic dairy cows ' feeding behavior , feed intake and performance. *Animal Feed Science and Technology.* 2020;267:114560.

59. Allen MS. Effects of Diet on Short-Term Regulation of Feed Intake by Lactating Dairy Cattle. *J Dairy Sci.* 2000;1598–1624.

60. Broderick GA, Koegel RG, Walgenbach RP, et al. Ryegrass or alfalfa silage as the dietary forage for lactating dairy cows. *Journal of Dairy Science.* 2002; 85(7):1894–1901.

61. Dewhurst RJ, Fisher WJ, Tweed JK. Comparison of grass and legume silages for milk production. 1. Production responses with different levels of concentrate. *Journal of Dairy Science.* 2003;86(8):2598–2611.

62. Al-Mabruk RM, Beck NFG, Dewhurst RJ. Effects of silage species and supplemental vitamin E on the oxidative stability of milk. *Journal of Dairy Science*. 2004; 87(2):406–412.

63. Moorby JM, Lee MRF, Davies DR, et al. Assessment of dietary ratios of red clover and grass silages on milk production and milk quality in dairy cows. *Journal of Dairy Science.* 2009;92(3):1148–1160.

64. Halmemies-Beauchet-Filleau A, Vanhatalo A, Toivonen V, et al. Effect of replacing grass silage with red clover silage on nutrient digestion, nitrogen metabolism, and milk fat composition in lactating cows fed diets containing a 60:40 forage-to-concentrate ratio. *Journal of Dairy Science.* 2004;97(6):3761–3776.

65. Weiss WP, Shockey WL. Value of Orchardgrass and Alfalfa Silages Fed with Varying Amounts of Concentrates to Dairy Cows. *Journal of Dairy Science.* 1991;74(6):1933–1943.

66. Dewhurst RJ, Evans RT, Scollan ND, et al. Comparison of grass and legume silages for milk production. 2. In vivo and in sacco evaluations of rumen function. *Journal of Dairy Science.* 2003;86(8):2612–2621.

67. Cherney DJR, Cherney JH, Chase LE. Lactation performance of Holstein cows fed fescue, orchardgrass, or alfalfa silage. *Journal of Dairy Science*. 2004;87(7):2268–2276.

68. J MMoorby, PH Robinson, WJ Fisher. Compariosn of Red Clover and Ryegrass Silage for Dry Cows and Influence on Subsequent Lactation Performance. *J Dairy Sci.* 2008;51(3):49–51.

69. Onetti SG, Reynal SM, Grummer RR. Effect of alfalfa forage preservation method and particle length on performance of dairy cows fed corn silage-based diets and tallow. *Journal of Dairy Science.* 2004;87(3):652–664.

70. Voelker Linton JA, Allen MS. Nutrient demand interacts with forage family to affect intake and digestion responses in dairy cows. *Journal of Dairy Science.* 2008;91(7):2694–2701.