EVALUATION OF FORAGE FEEDING STRATEGIE WITH OR WITHOUT METHIONINE HYDROXY ANALOG ON GROWING HEIFERS PERFORMANCE.

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SUMMARY

Twenty-four Holstein heifers with an average of age 9.28 ± 0.36 mo. and weight 194 ± 9.84 kg, were fed restricted intakes formulated to allow for 700 g/d (NRC. 1989). Diets were formulated to contain either 50: 50 (moderate forage) or 75: 25 (high forage) forage: concentrate ratio diets dry mater basis. Forage comprised of corn silage (CS) and constant amounts of Berseem hay (1.5 and 2 kg/ h/ d for moderate and high forage, respectively). Heifers were fed with or without Methionine Hydroxy Analog supplementation (MHA, 2.1 g / day/ 100 kg BW). Live body weight (LBW) was taken biweekly, while some body measurements and blood samples were taken monthly. Digestibility trial was performed at 370 kg BW, during the digestibility trial heifers were fed individually in tie-stall, rumen sample collected at the end of digestibility trial. We observed that, DM, OM, CP, and NFE digestibility were significantly ($P<0.05$) improved by reducing the forage portion of the diet, hoverer CF and EE digestibility had a significant ($P<0.05$) opposite direction. While, supplementation of MHA resulted in trends toward increased DM digestibility. Ruminal TVFA were significantly higher in moderate forage groups, however, ruminal PH was higher in high forage groups, while MHA trend to decreased TVFA only. Insignificant differences were observed for plasma protein and triglyceride, while significant ($P<0.05$) decreasing in plasma cholesterol was recorded for moderate forage without MHA treatment, and significant interaction between factors in plasma urea. ADG was not affected across all treatment rations (0.700 MF, 0.647 HF, 0.686 MFM, 0.658 HFM, SE ± 0.034 kg/d). Gain of heifers body measurements were not different among treatments. However, moderate forage groups had significantly ($P < 0.05$) better feed-conversion for DM and TDN. Also, no significant effect due to forage strategy or MHA addition was noted for reproduction parameters. Daily cost and total feed cost for high forage groups was significantly ($P < 0.05$) better than moderate forage groups. The recommendation of higher forage represents a viable alternative to traditional moderate forage heifer feeding strategy when economic conditions favor these systems.

Keywords: *Holstein heifers; forage; concentrate ratio; DL-Methionine; digestibility; growth performance, reproduction.*

INTRODUCTION

Producing high quality replacement heifers at minimum cost is one of the many challenges facing the dairy farm of the 21st century Heinrichs (1993), the most effective strategy to reduce rearing cost by fed heifers for accelerated growth rates prior to puberty and bred at an earlier age, Moallem *et al.* (2004), and Brown *et al.* (2005). Forages remain a vital part of the diet for dairy cattle to maintain rumen health, and in many cases, for reducing costs associated with feeding, Eastridge (2006). However, it is preferable to feed CS in combination with a legume crop to increase the concentration of these nutrients, Waldo *et al.* (1998).

Generally, growing cattle have relatively high metabolisable protein (MP) requirement for their rapid and efficient gains, the efficiency of MP used by ruminants highly depends on the profile of absorbable amino acids (AA), because the deficiency of a single AA can limit the use of other AAs that are in adequate supply, Cole and Van Lunen (1994); and Xue *et al.* (2011), Methionine and lysine are generally the first limiting AA for growing cattle and lactating dairy cows, Schwab *et al.* (2003), especially in corn

silage-based diets, Williams *et al.* (1999). Methionine hydroxy analog (MHA) is not an amino acid and it differs from methionine by having a hydroxyl group in place of the amine group. Therefore, ruminal degradation of MHA does not involve the deaminative enzymes that are responsible for the degradation of amino acids, Koenig *et al.* (2002). Notwithstanding, alfalfa and other forage legumes are high in protein but deficient in S-amino acids cysteine and methionine, Bagga *et al.* (2004).

The objective of this experiment was to evaluate performance of growing heifers fed moderate or high forage diets for equal BWG and supplemented by MHA. The hypothesis is that MHA will be utilized with improved efficiency when provided as a component of a high forage diet compared with a traditional diet.

MATERIALS AND METHODS

Animals and treatments:

This study was carried out at El-Karada experimental station, Kafr El-Sheikh, animal production research institute, agriculture research center, Egypt.

Twenty four Holstein heifers (9.28 ± 0.36 mo and 194 ± 9.84 kg initial age and BW, respectively) were randomly assigned into four groups of six according to forage levels (50% or 75% forage from DMI, moderate or high forage, respectively), and to supplementation of MHA (0 or 2.1 g / day/ 100 kg BW). Heifers were fed their nutritional requirements (DM, TDN and CP) at a level formulated to allow for 700 g/d according to NRC (1989) recommendations. Forage contained of corn silage (CS), and constant amount of berseem hay (BH) 1.5 or 2 kg/ heifer/ d for moderate or high forage groups, respectively. Chemical composition of feedstuffs is shown in Table 1. MHA, The dry Ca salt form of DL-Methionine hydroxy analog calcium, raw material of Alimet® (Novus International, Inc. St. Louis, MO, USA), MHA supplements were mixed with CFM prior to feeding. Heifers were housed in a free-stall barn and group-fed for moderate or high forage, water and trace mineralized salt bricks were available to heifers at all times.

Table (1): Chemical composition of feed stuffs.

Feedstuffs	DM%	Chemical composition on DM basis, %					
		OM	CP	CF	EE	NFE	Ash
CFM*	91.39	91.90	15.73	9.33	2.76	64.08	8.10
Corn silage	25.05	91.00	7.47	29.57	2.79	51.17	9.00
Berseem hay	90.47	87.65	13.56	29.94	1.77	42.38	12.35

**CFM: Consisted of 30% corn, 31% wheat bran, 35% undecorticated cotton seed meal, 1% molasses, 2% limestone, and 1% sodium chloride.*

Measurements and sample analysis

Throughout 278 day, body weight was recorded biweekly in the morning before feeding, while body measure and blood sample were taken once monthly approximately 3 h after starting of feeding. Body measure parameters included body length (from point of the shoulder to center of pin bone), Heart girth, Height at withers and Height at hip. Some reproductive parameters were studying their correlation with age and body weight. Heifers were checked once daily for detection estrus to insemination by artificially inseminated (AI), and pregnancy diagnose was detected by rectal palpation after 60 days from the last inseminations.

Whole blood samples were collected from each calf by jugular venipuncture into plasma vacuum tubes with EDTA added (ethylenediaminetetra-acetic acid dipotassium salt), blood plasma was recovered by centrifugation (15 min at 3,000 × g) and stored frozen at −20°C in clean and dried tube for later analysis. Plasma total protein and albumin were measured according to Falkner and Meites (1982) and Tietz (1987), respectively, whereas plasma globulin was calculated by difference. Triglyceride and cholesterol were determined according to Young (1995), and Urea was determined according to Patton and Crouch (1977).

During digestibility trial heifers were fed individually in tie-stall at 370 kg average BW, by a grab sample method [acid insoluble ash (AIA, Silica) as internal marker] was applied for determination the nutrients digestibility, Thonney *et al.* (1980). All samples were analyzed according to AOAC (2000). Rumen liquor samples were collected from three heifers per treatment at the last day of the digestibility trial, by a rubber stomach tube. Samples were directly strained through gauze, rumen liquor samples were

stored in glass bottles (25 ml) with few drops of toluene; and formalin to kill microorganisms and paraffin oil to cover the surface and stored at a deep freeze (-20°C) till it was analyzed. Rumen PH was determining immediately by using digital pH meter, while Total volatile fatty acids (TVFA) were determined by steam distillation according to Warner (1964).

Statistical analyses:

The studies were 2 × 2 factorial arrangements in a completely randomized design. All data ANOVA and regression analyses were done using the GLM procedure of SAS (1998), variables with a single measurement described by the following model:

$Y_{ijk} = \mu + T_i + M_j + (T \times M)_{ij} + e_{ijk}$

While, variables with repeated measures were analyzed according to the following model:

$Y_{ijk} = \mu + T_i + Mj + (Ti \times Mj) + ank\ (T_i \times M_j) + time_l + T_i \times time_l + M_j \times time_l + T_i \times M_j \times time_l + e_{ijk}$.
Where, Y_{ijk} = the observation, μ = overall mean, T_i = the effect of forage ratio, M_j = the effect of MHA, $(T_i \times M_j)$ = the effect of interaction, $an_k\ (T_i \times M_j)$ = random effect of heifers, $time_l$ = the effect of sampling time, e_{ijk}= experimental error.

RESULTS AND DISCUSSION

Apparent digestibility coefficients, nutritive values, rumen parameters:

Apparent digestibility coefficients, Nutritive values and rumen parameters of dietary components are shown in Table (2). Most of nutrients digestibility coefficients were significantly improved in moderate forage groups, with the exception of CF digestibility. Comparable observations have been demonstrated increased digestibility coefficients of DM, OM, CP, EE and energy Reynolds *et al.* (1991) DM, OM, CP and starch Moorby *et al.* (2006); DM, OM and CP Zanton and Heinrichs (2009, a) and DM and OM Lascano and Heinrichs (2011) as the percent concentrate increased in the diet of growing heifers. Presumably because moderate forage diets are composed of ingredients that are more readily fermentable than those of high forage diets, while the increase in CF digestibility by increased the forage level was consistent with the results reported by Moody *et al.* (2007) and Zanton and Heinrichs (2009 a, b), but not in others Cowsert and Montgomery (1968); Reynolds *et al.* (1991). However, the increase in CF digestibility in this study probably because high forage groups had higher CF intake, as well as CS had a higher fiber degradation rate compared with hay Waldo *et al.* (1997); Murphy *et al.* (2000). Thus, it was concluded that, effects of altering the forage: concentrate ratio in apparent digestion of diets depend on type, combinations and quality plus to proportion of forage included in the diets. TDN, ME, DCP and CP: ME ratio for moderate forage diets were significantly higher than high forage diets. Increased ratios of TDN and ME ratios in moderate forage groups were harmony reflected from increase digestibly of DM, OM, CP and NFE. In the same way, increased ratios of DCP ratio in moderate forage were agreement with increased intake and digestibly of CP with moderate forage. Accordingly, CP: ME ratio significant increased in moderate forage heifers mainly because increased DCP ratio in these groups. However CP:ME ratio in high forage diets (Table 2) was more compatible with the calculated CP: ME recommendations by NRC (2001) for large breed (non-bred) dairy heifers at 400 kg of LBW is 49 g/ Mcal for gains of 700 g/d, respectively.

Supplementation with MHA did not show a significant effect in digestibly and nutritive values. However, Digestibility of DM and CP Hoover *et al.* (1999) and ADF Noftsger *et al.* (2003) have been increased by MHA supplementation. Moreover, protein supplementation for cattle consuming forages with more than 7% CP appears to have limited benefits as recommended by Mathis *et al.* (2000) and Munn *et al.* (2003).

The mean of TVFA's and pH in the rumen fluid are showed in Table (2). High forage groups had a higher ruminal pH compared with moderate forage groups; contrarily the total volatile fatty acids were significantly higher in moderate forage groups. The decreased of ruminal pH in moderate forage groups may be related to increased DMI Zanton and Heinrichs (2008) or due to decreased CF intake, Beauchemin and Yang (2005) and Agle *et al.* (2011). Also, high forage diets produce acids only slowly and stimulate release of large amounts of saliva as they stimulate mastication, thus rumen pH tends to be higher on forage diets, NRC (2001). While the reduction in ruminal TVFA's by high forage diets was

consistent with the results reported by Murphy *et al.* (2000) and Moorby *et al.* (2006), but in other experiments TVFA's concentration were not affected by forage level Rotger *et al.* (2005) and Moody *et al.* (2007). Increasing TVFA's with moderate forage groups may be due to increased all nutrition substrate consumption with the exception of CF intake by moderate forage groups at the end of the trial, reflecting the greater consumption of fermentable substrate relative to end product utilization Zanton and Heinrichs (2008).

Table (2): Effect of the experimental rations on apparent digestion coefficients and nutritive values % (DM basis).

Item	Treatment					*P*-value		
	MF	HF	MFM	HFM	SE±	Forage	MHA	*int.*
Digestibility coefficients %								
DM	65.95	64.71	66.04	65.38	0.22	0.0010	0.1122	NS
OM	65.66	64.75	65.52	65.30	0.36	0.1426	NS	NS
CP	57.06	50.76	58.80	50.82	0.83	< 0.0001	NS	NS
CF	51.12	60.66	51.24	60.62	1.16	< 0.0001	NS	NS
EE	80.59	82.67	81.00	81.71	0.61	0.0420	NS	NS
NFE	72.18	68.59	71.47	69.64	0.76	0.0040	NS	NS
Nutritive values, %								
TDN	62.97	61.98	62.88	62.43	0.32	0.0469	NS	NS
ME	2.28	2.24	2.27	2.26	0.01	0.0469	NS	NS
DCP	7.21	5.52	7.41	5.54	0.11	< 0.0001	NS	NS
CP:ME	55.52	48.50	55.44	48.28	0.28	< 0.0001	NS	NS
Rumen liquor parameters, mean of 0, 3, and 6 hours after beginning of feeding samples.								
pH	6.32	6.59	6.46	6.51	0.05	0.0076	NS	0.0488
TVFA's (mg/100ml)	9.45	7.23	8.60	6.84	0.43	0.0017	0.1858	NS

SE±: *Interaction standard error of the differences. int. : Forage × MHA*

Estimated: ME (Mcal/kg of DM) = TDN × 0.04409 × 0.82. CP: ME, g/ Mcal

Ruminal pH and TVFA's were not affected by MHA supplementation. Similar, Vázquez-Añón *et al.* (2001); Noftsger *et al.* (2005) reported that MHA addition did not affect ruminal pH or TVFA's. However, moderate forage groups were more sensitive to MHA supplied compared with high forage groups. Moreover, MF group had least pH and highest TVFA's compared with remnant groups.

Blood plasma parameters:

Effects of forage strategy and MHA addition on some blood plasma parameters of growing heifers are shown in Table (3). There were no significant differences between forage and MHA levels on overall mean of plasma total proteins, albumin, and globulin. Increasing energy and protein concentration in the diet increased total protein, and globulin but did not affect plasma albumin, Abeni *et al.* (2000). As well as, feeding heifers higher amounts of dietary CP resulted in linear increases in serum protein, and albumin, Hoffman *et al.* (2001) or energy intake Keady *et al.* (2001). While, MHA supplementation had no effect on total protein Sklan and Tinsky (1996). However, negligible differences on plasma proteins parameters in this study probably did not have a biological value, could be attributed to use same feed ingredient with almost isonitrogenous and isoenergetic intakes.

Plasma urea concentration didn't differ among treatments, Blood urea nitrogen in heifers seemed to be related to CP intake Lundquist *et al.* (1983), Hall *et al.* (1995), Hoffman *et al.* (2001) and Zanton and Heinrichs (2009, a), also be influenced by the energy availability of diet McShane *et al.* (1989), however Abeni *et al.* (2000) found the higher values of blood urea in accelerated diets than in moderate diets did not appear to be determined mainly by protein catabolism with energetic finality, but they appeared to be related more to CP: ME ratio. Whither, when N intake is similar Lobley *et al.* (1996) or equal Huntington *et al.* (1996), NH3 absorption is unaffected by forage level of the diet. Also, Bertics and Grummer (1999) and Rulquin *et al.* (2006) found that MHA supplementation did not affect blood urea. We found, there a significant interaction between forage level and MHA addition, whither HFM group had a higher plasma urea concentration, this may be related to increase NPN intake, thus CS and BH have higher amounts of NPN than die same feed when fresh because of the proteolysis that occurs during wilting and fermentation NRC (2001), In accordance with Misciattelli *et al.* (2003) who found that CS based rations

were characterized by higher urea level, or from decreased the energy intake, whither Schroeder *et al.* (2006) found that plasma urea N concentrations were decreased by both Met and energy supplementation.

Also, there was no significant difference in plasma triglyceride among treatments groups. These result, in agreement with Ramanzin *et al.* (1997) who found no effect of forage level on plasma triglyceride. Similarly, MHA supplementation did not change plasma triglyceride Sklan and Tinsky (1996). Plasma cholesterol increased in high forage and MHA group, this increased in plasma cholesterol reflects increased CF digestibility in high forage groups, also may be to changes in acetate: propionate ratio in rumen. Furthermore, plasma cholesterol decreased significantly with MF heifers, this drew attention to presumably that high forage and MHA have a similar effect on composition of rumen VFA by increase of ratio of ruminal acetate to propionate, of animals fed high forage Zanton and Heinrichs (2009, b), or with MHA supplementation Lundquist *et al.* (1983).

Table (3): Effect of forage level and MHA on some blood plasma parameters.

Item	Treatment					*P*-value		
	MF	HF	MFM	HFM	SE±	Forage	MHA	*int.*
Total Protein , g/dl	6.59	6.47	6.45	6.45	0.11	NS	NS	NS
Albumin, g/dl	3.18	3.38	3.32	3.31	0.09	NS	NS	NS
Globulin , g/dl	3.38	3.10	3.13	3.14	0.11	NS	NS	NS
Urea, mg/dl	25.46	23.49	23.89	28.08	1.14	NS	NS	0.0271
Triglyceride , mg/dl	19.03	16.98	17.48	16.94	1.27	NS	NS	NS
Cholesterol , mg/dl	71.14	85.21	84.36	85.28	3.03	0.0383	0.0592	0.0615

SE±*: Interaction NS = not significant and* ***int.*** *= interaction between factors.*

Growth performance and Feed conversion:

Growth performance (body weight and measurements) and feed conversion are shown in Table (4). There were no significant effects of forage strategy or MHA treatment on live body weight of all treatments, This result could be attributed to the total amount of TDN provided were similar among treatments, these result agree with those reported by, Rotger *et al.* (2005), Kononoff *et al.* (2006), and Zanton and Heinrichs (2007), when moderate forage diets are compared with high forage diets. Also, Hussein and Berger (1995) and Tripp *et al.* (1998) observed that Met supplementation did not result in increased ADG.

High forage groups needed more DM and TDN to produce one kg LBW compared with high forage groups, without significant effect for CP and DCP conversion, However, Zanton and Heinrichs (2008 - 2009b) noticed that several studies have shown that feeding higher concentrate rations in a restricted manner to growing dairy heifers from 4 to 22 mo of age leads to similar growth performance with respect to BW gains and structural growth, with greater feed conversion and utilization of ME compared with high forage based rations, due to reducing dietary digestibility by the inclusion of high fiber components, While, Kononoff *et al.* (2006) observed that feed conversion did not differ between rations of different forage level.

MHA supplementation did not have effects on feed conversion; Similarly, Hersom *et al.* (2009) did not found effects of MHA addition with beef calves consuming a forage-based diet on feed or TDN efficiency.

There were no statistically differences among forage strategy or MHA supplementation for most of body measures, this result could be attributed to fed for equal ADG between dietary groups, Carson *et al.* (2000) and Zanton and Heinrichs (2007), Also MHA supplementation did not show significant effects on body measurements this result agreement with Hersom *et al.* (2009). However, the gain of heart girth trend toward is higher in high forage groups.

Reproductive performance

Age and weight at first detected estrus, first AI (artificial insemination), and conception are shown in Table (5). No significant effect due to forage strategy or MHA addition was noted for reproduction parameters. However, Zanton and Heinrichs *et al.* (2007) observed that heifers receiving moderate forage were younger and lighter at puberty than were those fed high forage for equal ADG, although these results were not significant. However, most studies found that dairy heifers attained puberty at a constant

BW and body composition independent of dietary manipulation, but other observed that the reduction in age at puberty was accompanied by a lighter BW at puberty in heifers fed the high concentrate diet Gasser *et al.* (2006). Also, RPMet supplementation was not affected age at puberty Tripp *et al.* (1998) who concluded that heifers with no supplemental Met may have received an adequate profile of AA at the duodenum to allow for normal growth and onset of puberty from the diet. Possible explanations for did not detected any treatment effects on reproduction performance may be attributed to the wide variation within groups in age and BW in most reproduction parameters.

Table (4): Effect of forage level and MHA on growth performance and feed conversion.

Item	Treatment					*P*-value		
	MF	HF	MFM	HFM	SE±	Forage	MHA	*int.*
Initial LBW, kg	186.3	203.3	195.5	190.5	9.8	NS	NS	NS
Final LBW, kg	380.8	383.2	386.2	373.3	16.4	NS	NS	NS
ADG kg/day	0.700	0.647	0.686	0.658	0.034	NS	NS	NS
Feed conversion kg /one kg gain								
DM	10.13	11.85	10.56	11.44	0.47	0.0117	NS	NS
TDN	6.11	6.94	6.42	6.76	0.28	0.0480	NS	NS
CP	1.315	1.329	1.370	1.283	0.055	NS	NS	NS
DCP	0.670	0.697	0.672	0.719	0.029	NS	NS	NS
Heart girth, cm								
Initial	132.7	137.0	133.8	134.5	3.0	NS	NS	NS
Final	170.8	170.7	170.2	168.5	3.3	NS	NS	NS
ADG cm/day	0.147	0.130	0.140	0.131	0.007	0.0610	NS	NS
Withers height, cm								
Initial	106.7	108.3	106.8	106.5	1.4	NS	NS	NS
Final	126.2	126.5	124.8	124.0	1.3	NS	0.1445	NS
ADG cm/day	0.075	0.070	0.069	0.068	0.004	NS	NS	NS
Hip height, cm								
Initial	112.3	111.7	111.7	110.8	1.5	NS	NS	NS
Final	130.8	130.3	131.5	130.3	1.3	NS	NS	NS
ADG cm/day	0.071	0.072	0.077	0.075	0.004	NS	NS	NS

***SE±**: Interaction NS = not significant and **int.** = interaction between factors.*

Table (5): Effect of the experimental rations on some reproductive parameters.

Item	Treatment					*P*-value		
	MF	HF	MFM	HFM	SE±	Forage	MHA	*int.*
At first detected estrus:								
Age, mo	12.03	11.95	12.14	11.78	0.61	NS	NS	NS
BW, kg	243.17	254.02	258.05	243.76	10.96	NS	NS	NS
At first AI:								
Age, mo	15.88	16.31	15.83	16.28	0.43	NS	NS	NS
BW, kg	333.71	338.99	334.27	333.78	6.32	NS	NS	NS
At conception:								
Age, mo	16.62	16.69	16.75	17.14	0.73	NS	NS	NS
BW, kg	349.05	348.49	351.05	347.58	12.49	NS	NS	NS
N. of service	1.60	1.40	1.80	1.80	0.42	NS	NS	NS

***SE±:** Interaction standard error of the differences. int. : Forage × MHA*

Economic efficiency:

Feed cost is shown in Table (6). The prices used to compare costs in this experiment were specific to the situation, they demonstrate that high forage diets have the potential to significantly reduce

of total and daily feed cost during experimental periods, also gain feed cost were trend to have more cost effective in high forage groups, while MHA supplementation was not economically inefficient.

Table (6): Effect of forage level and MHA on feed cost until 330 kg LBW.

Item	Treatment					*P*-value		
	MF	HF	MFM	HFM	SE±	Forage	MHA	*int.*
Daily cost/ h/ d, LE.	10.24	9.09	10.60	9.11	0.28	0.0001	NS	NS
Cost/ one kg gain, LE.	14.67	14.32	15.51	14.01	0.60	0.1388	NS	NS
Total cost/ head, LE.	2846.7	2528.3	2947.8	2532.0	76.8	0.0001	NS	NS

SE± Interaction standard error of the differences, NS = not significant and int. = interaction between factors.
The price of one kg of CFM. CS. BH. and MHA were 1.75, 0.25, 0.75, and 20 L.E., respectively

CONCLUSION

Heifers fed diets containing different forage levels for equal ADG and MHA supplementation, provided insufficient statistical evidence to affect most growth characteristics or reproduction parameters. We could not supported MHA supplementation, but forage and feedstuff used in this experiment may have attenuated the expectation of a response to supplemental MHA, or this could be attributed to insufficiency amount of MHA supplementation. Nonetheless, it is possible to use two experimental forage strategies without negative effects on general performance of the treated heifer to obtained equal BWG. The recommendation of higher forage represents a viable alternative to traditional moderate forage heifer feeding strategy when economic conditions favor these systems.

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تقييم نظم تغذية المالئ مع أو بدون اضافة الميثيونين هيدروكسي أنالوج على أداء العجلات النامية.

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اربعة وعشرون عجلة متوسط عمرها 9.28 شهر ووزنها 194 كجم تم تغذيتها تغذية مقننة طبقا لمقررات NRC لإعطاء معدل نمو يومى 0.700 كجم/ يوم. وكان نظام تغذية تتكون من 50 أو 75 % مالئ على اساس المادة الجافة المأكولة للمعتدل و المرتفع، على الترتيب. المالئ اشتمل على سيلاج الذرة وكمية ثابتة من دريس البرسيم (1.5 أو 2 كجم/ رأس/ يوم للمعتدل و المرتفع، على الترتيب)، مع او بدون إضافة الميثيونين هيدروكسي أنالوج (2.1جم/ يوم/ 100كجم وزن حي). تم وزن العجلات مرة كل أسبوعين، بينما تم اخذ مقاييس الجسم وعينات الدم مرة كل شهر. أجريت تجربة هضم عند متوسط وزن 370كجم، تم خلالها تغذية العجلات تغذية فردية طبقا لوزنها، وفى نهاية تجربة الهضم تم أخذ عينات سائل الكرش. لوحظ ارتفاع معنوي لمعدل هضم المادة الجافة والمادة العضوية والبروتين الخام والمستخرج الخالي من النيتروجين في المجموعات معتدلة المالئ، بينما كان معدل هضم الالياف والمستخلص الإيثيلى مرتفع معنويا مع زيادة نسبة الألياف. في حين أن، اضافة الميثيونين لم تؤثر على معدلات الهضم معنويا. مجموع الأحماض الدهنية الطيارة بالكرش أرتفع معنويا في المجموعات معتدلة المالئ، و انخفضت الحموضة عند التغذية مرتفعة المالئ، بينما إضافة الميثيونين اتجهت الى خفض الأحماض الدهنية الطيارة. لم تظهر فروق معنوية على مقاييس الدم فيما عدا انخفاض معنوي في كوليسترول الدم للعجلات المغذاة على مالئ معتدل بدون ميثيونين، ووجود تداخل معنوي بين المعاملات على يوريا الدم. لم يتأثر معدل النمو اليومي أو مقاييس الجسم بالمعاملات. اظهرت المجموعات معتدلة المالئ تحسن معنوي في معامل تحويل المادة الجافة ومجموع المركبات الغذائية المهضومة. لم تظهر اى تأثير معنوى للمعاملات على الأداء التناسلى. كانت المجموعات مرتفعة المالئ أفضل معنوياً من حيث تكلفة التغذية اليومية والكلية. يمكن التوصية باستبدال التغذية التقليدية معتدلة المالئ بالمرتفعة المالئ فى تغذية العجلات عندما تكون الظروف الاقتصادية لصالح هذه النظم.