RESEARCH ARTICLE Indian Journal of Animal Research, Volume 55 Issue 1: 60-65 (January 2021)

Effect of Different Energy Levels in Starter Ration Of Suckling Angus Calves on Blood Biochemical Parameters, Hormone Profile, Immune Response and Antioxidant Status

Chen Dong[1], Tang Jing[1], Shen Weijun[1], Wu Duanqin[2], Yan Jingcai[1], Li Fuqiang[3], Muhammad Aziz ur Rahman[4]

10.18805/ijar.B-1163

ABSTRACT

The objective of study was to evaluate the effects of energy level in starter ration on blood biochemical parameters, hormone profile, immune response and antioxidant status of calves. A total of eighteen angus calves were divided into three groups in such a way that each group had six calves. Three energy levels were {9 MJ/kg, low metabolizable energy (LME), 12.38 MJ/kg, medium metabolizable energy (MME) and 13.62 MJ/kg, high metabolizable energy (HME)} fed to experimental groups. Results showed that hemoglobin, red blood cells, hematocrit, thrombocytocrit and high-density lipoprotein was higher in HME diet ($P<0.05$). While, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, mean platelet volume and platelet distribution width was higher in MME diet as compared to HME diet ($P<0.05$). Results of immunity revealed that IgA content were lowest in calves fed LME diet ($P<0.05$). Calves received different energy level in the diet had no effect on IgG, IgM and C4 ($P>0.05$). However, the calves on LME starter diet represented higher blood complement C3 contents ($P<0.05$). It is concluded that blood metabolites were influenced by energy level in Angus calves.

Key words: Angus calves, Blood metabolites, Energy level, Hormone.

INTRODUCTION

In ruminant's production, feeding play an important role in growth both in preweaning and postweaning stage (Gayathri and Panda 2018). Preweaning claves receive nutrients from milk or milk replacer for growth in early days of life. However, solid feed like forages and concentrate are necessary for preweaning calves to develop rumen which ultimately enhance growth. Adequate amount of forage and starter diet fosters rumen volume and papillae development, favoring growth of pre-weaned calves. Sun *et al.* (2018) reported that starter feeding increased proliferation of rumen and enhanced rumen development in pre-weaned lambs. Composition of solid feed during preweaning stage could also affect rumen development, growth and behavior of animals (Suárez *et al.,* 2006; Khan *et al.,* 2008; Muhammad *et al.,* 2016; Aziz ur Rahman *et al.,* 2017; Rahman *et al.,* 2019). Khan *et al.* (2008) reported that rumen development is affected in calves fed pelleted calf starter containing 25% starch and based on wheat, oats, barley and corn. Suárez *et al.* (2006) fed young veal calves calf starter containing neutral detergent fiber, pectin, starch, or combinations and reported that differences in diet composition resulted in differences in rumen size and morphological development of rumen.

Based on review, it could be seen that solid feed type and composition is closely related with rumen development of young pre-weaned calves. However, most of the studies focused on solid feed type and composition effects on intake, rumen development and growth of pre-weaned calves but scientific literature regarding the effects of energy contents in solid feed of pre-weaned Angus on blood metabolites, hormonal profile, antioxidant status and immune response is limited. Therefore, this study was conducted to evaluate the effects of energy level in starter ration on hormone, blood metabolite levels and immune index of pre-weaning angus calves.

[1]College of Animal Science and Technology, Hunan Agricultural University, Changsha, 410130, China.
[2]Institute of Bast Fiber Crops, Chinese Academy of Agricultural Sciences, Changsha, 410205, China.
[3]Hunan Tianhua Industrial Co., Ltd., Loudi, Changsha, 417000, China.
[4]Institute of Animal and Dairy Science, University of Agriculture, Faisalabad, 35200, Pakistan.

Corresponding Author: Wu Duanqin, Institute of Bast Fiber Crops, Chinese Academy of Agricultural Sciences, Changsha, 410205, China. Email: wuduanqin@caas.cn

How to cite this article: Dong, C., Jing, T., Weijun, S., Duanqin, W., Jingcai, Y., Fuqiang, L. and Rahman, M.A. (2021). Effect of Different Energy Levels in Starter Ration Of Suckling Angus Calves on Blood Biochemical Parameters, Hormone Profile, Immune Response and Antioxidant Status. Indian Journal of Animal Research. 55(1): 60-65. DOI: 10.18805/ijar.B-1163.

Submitted: 14-06-2019 **Accepted:** 23-10-2019 **Online:** 03-12-2019

MATERIALS AND METHODS

The experiment was carried out in the Breeding Research Center of Hunan Tianhua Industrial Co., Ltd. (Loudi City,

Hunan Province, China). Animal Welfare and use Committee of Hunan Agricultural University approved all experimental procedure of current study.

Experimental design, animal management and diet

In this study, eighteen Angus calves of twenty days old with initial BW = 43.4±4.25 kg were selected. Animals were divided into 3 different experimental groups in such a way that each experimental group contained three replicates and each replicate had two calves. Dietary treatments were: Low metabolizable energy (LME) that was 11.19 MJ/kg; Medium metabolizable energy (MME) that was 12.38 MJ/kg and High metabolizable energy (HME) that was 13.62 MJ/kg. Proximate analysis of feed, orts and fecal samples were determined by the following the procedure of Association of Official Analytical Chemists (AOAC, 1990). Ankom Fibre Analyser (Ankom Technology, Fairport, NY) was used to determine the fractions of NDF and ADF. Metabolizable energy we calculated by using nutrient composition of ingredient. However, formula used was just contribution of specific ingredient percentage in the total ration and sum of all ingredients. The diets were not iso-nitrogenous and contained 23, 20 and 23 per cent CP respectively along with variation in energy level. The quality of fodder was determined as described in literature (Vasileva and Naydenova, 2017; Zulfiqar *et al.,* 2017). The duration of the experiment was 90 days. The composition of pelleted starter rations is shown in Table 1. Besides, pelleted starter ration, calves were offered whole oat hay *ad-libitum*. Milk was provided to each calf from their dams by suckling method at 07:00 and 18:00 every day. After milk feeding calves were separated from their dams. The starters and oat hay were offered at 08:00 and 15:30 and refusal of feed was ensured at 10%.

Blood sample collection and chemical analysis

Blood was collected from the Jugular vein of the each calf at the end of the experiment. Collected blood was in a 0.5 ml heparin sodium centrifuge tube and analyzed for red blood cells, white blood cells, hemoglobin, hematocrit, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, red cell distribution width, platelets, mean platelet volume, platelet distribution width and thrombocytocrit as described in the previous studies (Rezende *et al.,* 2014).

For blood plasma collection, blood samples were centrifuged at 3000 rpm/min for 10 min as described in previous studies (Xia *et al.,* 2018). The collected serum was dispensed into a 2 ml centrifuge tube and store at -20° for testing. The plasma biochemical indicators were determined using an automated biochemistry analyser (Hitachi 7020; Hitachi Co., Tokyo, Japan). Blood metabolites were determined in this study by using commercial test kits (Andygene, Beijing, China) following the procedure as described in literature (Sheikh *et al.,* 2019; Kumar *et al.,* 2018). The levels of immune indices, hormone and antioxidant index (SOD, GSH-PX, MDA concentrations) in plasma were also determined by using commercial test kits (Andygene, Beijing, China).

Table 1: Composition of experimental diets.

Items	Treatments		
	[2]LME	[3]MME	[4]HME
Ingredients			
Corn	5.00	30.60	46.50
Soybean meal	16.00	17.00	18.00
Wheat bran	59.00	29.90	9.00
Soybean protein concentrate	3.00	3.50	6.00
Cotton seed meal	7.00	8.00	7.00
Soya-bean oil	0.00	1.00	3.50
Premix	5.00	5.00	5.00
Molasses	5.00	5.00	5.00
Total	100	100	100
Nutrients			
Dry matter (%)	87.00	88.00	89.00
Crude protein (%)	23.17	20.77	23.02
Ether extract (%)	2.68	2.73	3.47
Neutral detergent fiber (%)	22.11	18.10	11.21
Acid detergent fiber (%)	10.40	8.41	7.35
Metabolizable energy (MJ/kg)	11.19	12.38	13.62

[1]One kilogram premix provided the following: VA 260 00000 IU, VD3 100 00000 IU, VE 70000 IU, Fe 8000 mg, Mn 6290 mg, Zn 816.3 mg, Cu 1200 mg, I 1200 mg, Se 600 mg, Co 200mg, Ca 150 g, P 30 g.

[2]LME= Low metabolizable energy calf starter.

[3]MME= Medium metabolizable energy calf starter.

[4]HME= High metabolizable energy calf starter.

Data processing and analysis

All collected data were analyzed by using SPSS 23.0 software. Mean values were compared using Tukey's test.

RESULTS AND DISCUSSION

Results of blood biochemical parameters are presented in Table 2. Result reveled that red blood cells, hemoglobin, hematocrit and thrombocytocrit was higher in HME diet ($P<0.05$). While, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, mean platelet volume and platelet distribution width was higher in MME diet as compared to HME diet ($P<0.05$).

Results of effect of different levels of energy in diet of suckling Angus calves on protein and fat metabolism are presented in Table 3. Highest HDL contents were observed in HME fed calves as compared to other dietary treatments ($P<0.05$). Lowest HDL contents were observed in LME fed calves as compared to other dietary treatments ($P<0.05$).

Table 2: Effects of different energy levels in starter ration of suckling Angus calves on blood biochemical parameters.

Items	[2]LME	[3]MME	[4]HME	SEM	*P*-value
White blood cells ($\times10^9\cdot L^{-1}$)	78.48	65.23	76.82	11.150	0.689
Red blood cells ($\times10^9\cdot L^{-1}$)	6.03^b	3.70^c	11.34^a	0.703	<0.001
Hemoglobin ($g\cdot L^{-1}$)	104.75^b	63.25^c	129.00^a	12.570	0.010
Hematocrit (%)	29.00^{ab}	17.6^b	38.38^a	3.790	0.007
Mean corpuscular volume (fL)	47.25^a	47.65^a	33.92^b	1.710	<0.001
Mean corpuscular hemoglobin (Pg)	17.20^a	17.03^a	11.35^b	0.499	<0.001
Mean corpuscular hemoglobinconcentration ($g\cdot L^{-1}$)	365.50^a	359.5^a	336.33^b	5.944	0.009
Red cell distribution width (%)	17.28	18.28	18.08	0.619	0.532
Platelet ($\times10^9\cdot L^{-1}$)	596.75	600.00	660.50	86.994	0.827
Mean platelet volume (fL)	5.38^a	5.50^a	4.78^b	0.187	0.033
Platelet distribution width	17.48^a	17.18^a	16.10^b	0.192	0.001
Thrombocytocrit (%)	0.03^b	0.05^b	0.32^a	0.106	<0.001

In the same row, values with no letter or the same letter superscripts mean no significant difference ($P>0.05$), while with different small letter superscripts mean significant difference ($P<0.05$).

[2]LME= Low metabolizable energy calf starter.

[3]MME= Medium metabolizable energy calf starter.

[4]HME= High metabolizable energy calf starter.

Table 3: Effects of different energy levels in starter ration of suckling Angus calves on protein and fat metabolism status.

Items	[2]LME	[3]MME	[4]HME	SEM	*P*-value
Protein metabolism status					
Total protein mg/mL	43.55	48.03	41.87	7.98	0.551
Albumin mg/mL	104.06	100.89	102.00	4.05	0.960
Globulin mg/mL	36.00	32.98	37.34	2.91	0.566
Cholestrolumol/L	1357.63	1423.83	1180.94	87.88	0.164
Urea nitrogenmmol/L	3.58^{ab}	4.05^a	3.18^b	0.197	0.022
Fat metabolism status					
Total glyceridesumol/L	241.06	225.03	246.89	23.20	0.791
High density lipoprotein mol/L	0.91^a	0.99^{ab}	1.15^a	0.065	0.049
Low density lipoprotein mol/L	1.35	1.29	1.43	0.098	0.626
Free fatty acidumol/L	320.81	337.71	390.00	23.13	0.122
Enzyme					
Lactate dehydrogenase ng/L	198.30	230.65	199.08	15.85	0.288
Alanine aminotransferasepg/ml	158.11	184.83	165.32	10.08	0.187
Aspartate aminotransferase ng/L	179.93	171.16	197.60	12.28	0.327

In the same row, values with no letter or the same letter superscripts mean no significant difference ($P>0.05$), while with different small letter superscripts mean significant difference ($P<0.05$).

[2]LME= Low metabolizable energy calf starter.

[3]MME= Medium metabolizable energy calf starter.

[4]HME= High metabolizable energy calf starter.

Table 4: Effects of different energy levels in starter ration of suckling Angus calves on immune response.

Items	[2]LME	[3]MME	[4]HME	SEM	*P*-value
IgA ug/ml	19.72[b]	22.12[a]	21.13[ab]	0.587	0.038
IgG mg/ml	19.02	21.58	22.33	1.96	0.475
IgM mg/ml	2.67	2.97	2.77	0.23	0.661
C3 mg/ml	1.04[a]	0.84[b]	0.98[ab]	0.055	0.049
C4 mg/ml	0.31	0.27	0.27	0.022	0.424

In the same row, values with no letter or the same letter superscripts mean no significant difference (P>0.05), while with different small letter superscripts mean significant difference (P<0.05).

[2]LME= Low metabolizable energy calf starter.

[3]MME= Medium metabolizable energy calf starter.

[4]HME= High metabolizable energy calf starter.

Table 5: Effects of different energy levels in starter ration of suckling Angus calves on hormone profile and antioxidant status.

Items	[2]LME	[3]MME	[4]HME	SEM	*P*-value
Growth hormone ug/L	5.26	5.41	5.32	0.52	0.979
Leptin ug/L	3.39	3.22	3.18	0.246	0.819
InsulinmIU/L	23.57	27.24	29.85	2.76	0.300
[1]IGF ug/L	22.40	20.10	20.92	1.38	0.505
T-SOD Pg/ml	256.46	283.70	274.44	16.78	0.521
GSH-Px mol/L	66.84	64.30	75.10	4.87	0.291
MDA umol/L	7.72	6.70	6.36	0.61	0.293

In the same row, values with no letter or the same letter superscripts mean no significant difference (P>0.05), while with different small letter superscripts mean significant difference (P<0.05).

[1]IGF= Insulin like growth factor.

[2]LME= Low metabolizable energy calf starter.

[3]MME= Medium metabolizable energy calf starter.

[4]HME= High metabolizable energy calf starter.

Results of effect of different levels of energy in diet of suckling Angus claves on immunity parameter are presented in Table 4. Result of current study revealed that IgA content were lowest in calves fed starter ration of LME as compared to calves received calf starter with MME and HME diet (P<0.05). Calf received different energy level in the diet had no effect on IgG, IgM and C4 (P>0.05). The calves on LME starter diet represented higher compliment C3 contents as compared to calves on MME starter diet (P<0.05).

Effect of different energy level in starter ration of calves on hormone level and antioxidant index is presented in Table 5. Results of present study showed that hormone level and antioxidant index were similar in all calves received LME, MME and HME starter diet (P>0.05).

A close relationship exists between diet nutritional factors, hormones and blood metabolites in pre-weaned calves (Fernández *et al.,* 2012). Klinkon and Ježek, (2012) studied the effect of milk feeding in calves without any solid feed on hemoglobin, red blood cells and hematocrit and reported that the veal calves fed predominantly with milk, the values hemoglobin, red blood cells and hematocrit decreased and calves become anemic. Based on findings of previous studies and current study, one could just guess that change in nutritional content of feed especially energy level in the feed of preweaning growing Angus calve influence the hemoglobin, red blood cells and hematocrit.

No effect of dietary treatments on white blood cells indicate that all diets respond similar and had no stress on claves. In the current study, the observed number of platelets in calves was in range of 596-660 x 10^9/L in different dietary regimes. The number of platelets was in range as described by previous study (Knowles *et al.,* 2000). The decrease in mean corpuscular volume in HME diet of calves was associated with higher number of red blood cells and hemoglobin. Our findings were also in consistent with the findings of previous researcher (Egli and Blum, 1998; Knowles *et al.,* 2000). The decrease meancorpuscular hemoglobin concentration and increase in thrombocytocrit in calves fed HME could be explained by the mechanism of body to increase the red blood cells number to maintain a normal hemoglobin concentration. Lower hemoglobin concentration in MME fed animals could also be explained by lower CP concentration of diet. As the composition of MME diet shows less CP contents (20.77%) as compare to LME (23.17%) and HME and Rotimi *et al.* (2018) reported that hemoglobin concentration reduced by the low protein diet.

In current study total serum total protein, albumin, globulin, total glycerides, low density lipoprotein and free

fatty acid was not affected by dietary treatment. Our findings were similar with the findings of Quigley *et al.* (2006) who reported increase in nutrient in calf's daily intake had no effect on serum total protein, albumin, globulin, total glycerides, low density lipoprotein and free fatty acid. However, the higher blood urea nitrogen in MME diet as compare to HME diet could be explained by the previous study of Dominic *et al.* (2014) who reported that increasing energy level in the diet decreases the concentration of blood urea nitrogen. If this is the case, blood urea nitrogen should be less in calves fed MME diet as compare to LME diet calves. This could also be explained by the study of Dominic *et al.* (2014) who reported that increasing the level of CP in the diet of animals results in higher blood urea nitrogen. In current study, the CP concentration of MME diet was 20% while the LME diet had 23.17% protein that could be reason of higher blood urea nitrogen concentration of LME diet. The activity of lactate dehydrogenase in calves were similar among the dietary treatments. Our findings were similar with the findings of Egli and Blum (1998) who reported that lactate dehydrogenase remains same in calves on different dietary regimes. Similar, concentration of aspartate aminotransferase was indication that heart, skeletal muscle and liver cells undergoes similar changes with dietary treatments in calves.

Similar response of hormone and antioxidant in current study due to various dietary treatments explored that during weaning, change in energy level in the diet of calves had no influence on growth hormone, growth and antioxidant activity. It could further explain, change in energy level might have no effect on rumen development, nutrient absorption and hence growth of calves.

CONCLUSION

The results from our study confirm that red blood cells, hemoglobin, hematocrit, mean corpuscular volume, mean corpuscular hemoglobin, mean platelet volume, platelet distribution width, thrombocytocrit, high density lipoprotein and blood urea nitrogen was influenced by change in energy level in young suckling Angus calves. However, protein and fat metabolism were not influenced by different energy level except urea nitrogen and high-density lipoprotein. Furthermore, different dietary energy levels did not influence the hormonal profile and antioxidant status of young suckling Angus calves.

ACKNOWLEDGEMENT

This work was funded by 'National Key Research and Development Program of China (2017YFD0502005)' and 'The Key Research and Development Project of Hunan Province, China" (No.2 017NK1020) and 'Hunan Modern Agricultural Technology System of Herbivora' and'Hunan Co-Innovation Center of Animal Production Safety'.

REFERENCES

Aziz-ur-Rahman, M., Chuanqi, X., Huawei, S. and Binghai, C., (2017). Effects of hay grass level and its physical form (full length vs. chopped) on standing time, drinking time and social behavior of calves. J. Vet. Behav. 21: 7-12.

Dominic, G., Allyb, K., Muralic, P. and Anild, K.S. (2014). Effect of energy supplementation on the milk urea nitrogen and blood urea nitrogen level in cross bred cows in early lactation. Live. Res. Int. 2: 68-71

Egli, C. and Blum, J., (1998). Clinical, Haematological, Metabolic and endocrine traits during the first three months of life of suckling simmentaler calves held in a cow-calf operation 1. J. Vet. Med. Ser. 45: 99-118.

Fernández, H., Busso, C.A., Laborde, H.E., Torrea, M., Fernández, L., López, G., Delucchi, F. and García, B. (2012). Growth, blood metabolites and hormones in calves fed diets with different amounts of energy and protein during the pre- or post-weaning periods. Afric. J. Agr. Res. 25: 3739-3746.

Gayathri, S.L. and Panda, N., (2018). Chelated minerals and its effect on animal production. A. rev. Agric. Rev. 39: 314-320.

Khan, M., Lee, H., Lee, W., Kim, H., Kim, S., Ki, K., Park, S., Baek, K., Ha, J. and Choi, Y., (2008). Starch source evaluation in calf starter: II. Ruminal parameters, rumen development, nutrient digestibilities and nitrogen utilization in Holstein calves. J. Dairy Sci. 91: 1140-1149.

Klinkon, M. and Ježek, J., (2012). Values of blood variables in calves. A Bird's-Eye View of Veterinary Medicine. Intech Open.

Knowles, T., Edwards, J., Bazeley, K., Brown, S., Butterworth, A. and Warriss, P., (2000). Changes in the blood biochemical and haematological profile of neonatal calves with age. Vet. Rec. 147: 593-598.

Kumar, D., Kumar, S., Gera, S. and Yadav, J., (2018). Comparative assessment of biochemical parameters of Hariana, Hardhenu and Sahiwal breeds. Indian J. Anim. Res. 52: 1565-1568.

Muhammad, A.U., Xia, C.Q. and Cao, B.H., (2016). Dietary forage concentration and particle size affect sorting, feeding behaviour, intake and growth of Chinese holstein male calves. J. Anim. Physiol. Anim. Nutr. 100: 217-223.

Quigley, J., Wolfe, T. and Elsasser, T., (2006). Effects of additional milk replacer feeding on calf health, growth and selected blood metabolites in calves. J. Dairy Sci. 89: 207-216.

Rahman, M.A., Qi, X.C. and Binghai, C., (2019). Nutrient intake, feeding patterns and abnormal behavior of growing bulls fed different concentrate levels and a single fiber source (corn stover silage). J. Vet. Behav., https://doi.org/10.1016/j.jveb.2019.03.003.

Rezende, S.M., Lijfering, W.M., Rosendaal, F.R. and Cannegieter, S.C., (2014). Hematologic variables and venous thrombosis: red cell distribution width and blood monocyte count are associated with an increased risk. Haematologica. 99: 194-200.

Rotimi, O.A., Rotimi, S.O., Oluwafemi, F., Ademuyiwa, O. and Balogun, E.A. (2018). Oxidative stress in extrahepatic tissues of rats co-exposed to aflatoxin B1 and low protein diet. Toxic. Resea. 3: 211.

Sheikh, G.G., Masood, D., Ganai, A.M., Afzal, S.Y. and Ahmad, H.A., (2019). Effect of probiotics mix supplementation on haemato-biochemical parameters and bacterial faecal shedding in Corriedale lambs fed paddy straw based complete feed. Indian J. Anim. Res. 53: 1049-1053.

Suárez, B., Van-Reenen, C., Gerrits, W., Stockhofe, N., Van-Vuuren, A. and Dijkstra, J., (2006). Effects of supplementing

concentrates differing in carbohydrate composition in veal calf diets: II. Rumen development. J. Dairy Sci. 89: 4376-4386.

Sun, D., Mao, S., Zhu, W. and Liu, J., (2018). Effect of starter diet supplementation on rumen epithelial morphology and expression of genes involved in cell proliferation and metabolism in pre-weaned lambs. Anim. 12: 2274-2283.

Vasileva, V. and Naydenova, Y., (2017). Nutritive value of forage biomass from mixtures of alfalfa with cocksfoot and tall fescue. J. Glob. Innov. Agric. Soc. Sci. 5: 121-129.

Xia, C., Aziz Ur Rahman, M., Yang, H., Shao, T., Qiu, Q., Su, H. and Cao, B., (2018). Effect of increased dietary crude protein levels on production performance, nitrogen utilisation, blood metabolites and ruminal fermentation of Holstein bulls. Asian-Australas. J. Anim. Sci. 31: 1643.

Zulfiqar, U., Ishfaq, M., Yasin, M.U., Ali, N., Ahmad, M., Ullah, A. and Hameed, W., (2017). Performance of maize yield and quality under different irrigation regimes and nitrogen levels. J. Glob. Innov. Agric. Soc. Sci. 5: 159-164.