Acta Veterinaria (Beograd), Vol. 63, No. 2-3, 255-268, 2013.

DOI: 10.2298/AVB1303255N UDK 636.087+637.112:636.234:613.287.5+591.11

MONTHLY AND SEASONAL EVALUATION OF DIETARY NUTRIENTS AND THEIR RELATIONSHIPS WITH BLOOD AND MILK PARAMETERS IN LACTATING DAIRY COWS

NOZAD SH*, RAMIN AG*, MOGHADAM GH**, ASRI-REZAEI S*, KALANTARY LEILA*, BABAPOUR AZADEH*, RAMIN S*** and PHILLIPS CJC****

**Urmia University, Veterinary College, Urmia, Iran; **Tabriz University, Animal husbandary College, Tabriz, Iran; ***Tabriz University of Medical Sciences, Tabriz, Iran; ****The University of Queensland, School of Veterinary Science, Centre of Animal Welfare and Ethics, Australia*

(Received 10th October 2012)

Monthly and seasonal variations among dietary, blood and milk parameters and their interrelationships were investigated during the lactation period in Holstein dairy cows in order to determine reliable dietary indices that could be useful in the studies related to milk yield improvement. Samples were prepared monthly, up to 11 months of lactation and were analyzed by the current laboratory methods using appropriate kits. Mean monthly and seasonal comparison of the dietary, blood and milk values were different among sampling times (p<0.05). The overall mean for dietary energy (ME), crude fiber (CF), moisture, ash, phosphorus (DP), calcium (DCa), ether extract (EE) and crude protein (CP) were 1.38 Mcal/$_{KgDM}$, 20.4%, 42.8%, 5.5%, 0.34%, 0.76%, 2.39% and 10.2%, respectively. Correlations were found between dietary DP/Ca (r=-0.73), DP/EE (r=0.67), DP/ash (r=0.79), DP/moisture (r=0.84), DP/ME (r=0.60), Ca/ash (r=0.95), Ca/moisture (r=-0.64), and DCa/moisture (r=-0.93). Correlations among dietary, blood, and milk parameters revealed different relationships with the most important correlations between DP and blood parameters, and CP with blood and milk parameters. Among blood parameters glucose, BHB, SK, AST, GGT, neutrophils and lymphocytes. Milk parameters: Mg, Ca, and lactose showed the strongest relationships with dietary parameters. In conclusion, the dietary, blood and milk values were different during the lactation months and seasons. Dietary CP, Ca and DP could be applied as relevant indices in studies related to milk production improvement in dairy herds.

Key words: blood, cow, dietary, Holstein, milk parameters, monthly, seasonal

INTRODUCTION

Food and its carbohydrate and protein compounds are considered as the most important sources of energy and protein to sustain life, growth, production and reproduction performances. Dietary carbohydrates in ruminants are converted to free fatty acids and blood glucose, and proteins to amino acids and urea. Blood urea and glucose are used for milk protein and lactose production.

The ruminant dietary requirements for energy and protein vary based on the physical and physiological activities, reproduction status, parturition, and lactation stage. Energy and protein requirements are from 2.4 MJ/ kg/DM and from 13 to 15% of the diet, respectively (Naylor and Ralston, 1991). The normal value for milk lactose is 4.8% and for urea is from 15 to 40 mg/dL (Nbibualonji *et al*., 1998; Gfrorer and Koch, 1985). Various factors influence these parameters including the energy balance of the ration with or without concentrate (Cannas *et al*., 1998), protein ratio and its relation to dietary energy (Bed *et al*., 1997), breeding procedure (Casamassima *et al*., 2001), lactation (Bed *et al*., 1997), estrus cycle, pregnancy and parturition (Pulina *et al*., 1996) and weight loss (Kecec, 2003).

Based on literature data, milk urea increases when the energy ration is decreased (Cannas *et al*., 1998). Milk lactose increases by increasing the protein to energy ratio (Bed *et al*., 1997). Livestock bred on lush pasture showed less blood urea and glucose than those limited to closed hand feeding (Casamassima *et al*., 2001). Bed *et al*. (1997) mentioned no changes in milk urea during the lactation period while Nozad *et al*. (2011) reported variations in milk urea during the daily and weekly yield. Authors also reported different relationships between dietary parameters with blood and milk indices including positive relationships between milk and blood urea (Ramin *et al*., 2010), milk urea and crude protein (Cannas *et al*., 1998) and negative correlations between milk urea and dietary energy (Cannas *et al*., 1998). No relationship was found between blood and milk parameters with diet crude fiber, ether extract, calcium, phosphorus and ash.

In spite of different reports indicating the normal values of dietary nutrients necessary for production, there seems to be no documented information available to show the possible roles and relationships between dietary nutrients with milk and blood parameters, and whether or not dietary components play a role as an index in dairy cow production. The understanding, detection and presentation of such relevant correlations is a preliminary essential for complementary studies resulting in the prediction of appropriate milk production on the basis of dietary nutrients. The aims were: 1) determination of the monthly and seasonal dietary components, milk and blood parameters in Holstein dairy cows, 2) presentation of the interrelationships between and within dietary, blood and milk parameters, and 3) determination of the most important dietary indices in relation to milk and blood parameters which could be useful in predicting the optimal production in ruminants.

MATERIALS AND METHODS

Seventy eight Holstein dairy cows were selected in an industrial dairy herd located in east Azarbyjan. The amount of 50 gr diet, 5 mL jugular vein blood and 10 mL milk were sampled monthly from calving day up to the end of lactation. The study was carried out over a period of 11 months starting from March to

December 2011 with an overall total of 858 blood and milk samples. During sampling, cows' ID, daily milk records and reproduction data were collected for future complementary studies. Cows were fed on total mix ration (TMR) containing lucerne, concentrate, pulp, and corn silage three times per day. Cows were bred under industrial dairy management. Blood and milk samples were placed in the refrigerator until the appropriate analyses were run for each sample. Experimental cows were all in good health throughout the experiment.

Dietary components included metabolisable energy (ME), crude protein (CP), ether extract (EE), crude fiber (CF), calcium (DCa), phosphorus (DP), magnesium (DMg), and sodium. Potassium, moisture and ash were assessed based on standard units with current laboratory methods. Two mL blood samples was mixed with EDTA for hematological tests and the remainder was used for biochemical and enzyme analysis. Milk samples were first skimmed, and then milk serum was separated after casein precipitation by HCl 0.1 N. The values of blood and milk parameters were determined by using spectrophotometry commercial kits, SPSS statistical program, student t-test and ANOVA were used for the monthly and seasonal comparison of the means. Correlation coefficient was used to determine the relationships among dietary, blood and milk parameters.

RESULTS

The monthly analysis of dietary components during the lactation period is shown in Table 1. The highest and lowest values were in December and October, respectively. The range for ME, CF, moisture, ash, DP, Ca, EE, and CP was 1.3-1.6 $Mcal/_{KgDM}$, 18.8-24.1%, 37.9-46.3%, 3.4-5.9%, 0.2-0.55%, 0.6-0.95%, 2.1-2.85%, and 9-11.2%, respectively. The overall means were 1.38 $Mcal/_{KgDM}$, 20.4%, 42.8%, 5.5%, 0.34%, 0.76%, 2.39% and 10.2%, respectively. The highest seasonal values for EE and moisture were in spring, CP in summer, ME in autumn and DCa, DP, CF and ash were in winter (Table 6). The lowest values for CP and CF were in spring, DCa, DP, ME and for ash were in summer, EE and moisture were in autumn. Mean monthly and seasonal comparison of the dietary components were significantly different during the lactation period ($p<0.05$).

Tables 2 to 5 show the mean monthly values for blood and milk parameters during the lactation period. Mean monthly values (ANOVA) for all parameters were significantly different during the lactation period ($p<0.05$). The highest values were observed in July for RBC, Hb, Ca, K, Na, AST, ALP, PCV, and March for WCC, P, ALT, December for glucose, protein and GGT, respectively. The lowest were in December for BUN, cholesterol, BHB, Ca, K, Cl, AST, and November for Hb, RBC, Tgs, and GGT. Milk parameters varied during the lactation period as well. The maximum seasonal values for RBC, BUN and macro-minerals were in spring, protein and cholesterol in summer, and PCV, Hb, WCC and GGT in autumn and glucose, creatinine, Tgs and BHB, AST, ALP in winter. The lowest values for PCV, glucose, creatinine and P were in spring, Hb, WCC, Tgs, BHB, Ca, Na, K in summer; RBC, urea, Mg, Cl, glucose, creatinine and P, AST, ALT and ALP in

Table1. Mean monthly values of dietary components during the lactation period in dairy cows (n=78)

Parameters	Energy[1]	Fiber[2]	Moisture[2]	Ash[2]	Phosphorus[2]	Calcium[2]	Fat[2]	Protein[2]
March	1245	20.2	46.3	5.3	0.3	0.65	2.35	9.5
April	1487	19.5	41.4	3.4	0.28	0.75	2.7	10.1
May	1345	19.2	44.7	5.7	0.33	0.8	2.55	10.4
June	1262	20.9	45.1	5.2	0.25	0.7	2.2	10.7
July	1414	18.8	42.7	5.9	0.4	0.9	2.2	11.2
August	1340	21.1	43.9	5.1	0.2	0.6	2.85	9.8
September	1535	20.8	37.9	5.6	0.4	0.8	2.1	9
October	1368	19.6	43.8	5.2	0.35	0.65	2.25	10.8
November	1429	20.1	41.2	5.6	0.4	0.85	2.1	10.5
December	1479	24.1	37.7	5.8	0.55	0.95	2.15	10.4
January	1300	20	45.6	5.5	0.29	0.75	2.85	9.8
Overall	1382	20.4	42.8	5.6	0.34	0.76	2.39	10.2

[1] =Mcal/$_{KgDM}$; [2] = %

autumn and protein, cholesterol and GGT in winter (Tables 7 and 8). For milk parameters the highest were in summer and the lowest in autumn (Table 9).

Table2. Mean monthly values of hematological parameters during the lactation period in dairy cows (n=78)

Parameters	PCV%	Hb	RBC	WCC	neut	lymph	Mono	Eosin
March	31.9	10.7	5.29	9746	2914	6539	224	49
April	32.1	10.8	5.31	9407	2756	6416	160	66
May	30	10.1	4.9	7989	2477	5280	192	48
June	29	10.6	5.08	8917	3727	4904	125	169
July	32.3	11.2	5.66	8415	3492	4678	109	135
August	32.1	10	5.12	9405	2126	6828	433	28
September	32.1	10.8	5.32	8789	2241	6205	299	35
October	31.6	10.8	5.25	8606	2685	5746	112	60
Novem ber	29.5	9.9	4.9	8655	3808	5582	52	35
December	30	10	4.95	8638	3092	5441	61	43
January	32.1	11.3	5.28	9400	2726	6405	66	90
Overall	31	10.6	5.19	8919	2855	5824	170	71

$X10^3 l\mu =^2$; mg/dL=[1]

Table 3. Mean monthly values of biochemical parameters during the lactation period in dairy cows (n=78)

Parameters	BUN[1]	Ptn[2]	Glucose[1]	Creatinine[1]	Cholesterol[1]	Triglyceride[1]	BHB[3]
March	37.1	9.4	38.65	0.899	102.2	217.5	0.55
April	28.8	7	46.1	0.966	102/3	170/9	0.56
May	37.6	9.1	45.47	1.001	102.2	231.2	0.6
June	35.6	8.9	45.64	0.74	104.3	232.5	0.55
July	39.5	9.1	44.55	0.688	107.8	225.6	0.46
August	39.7	10.5	27.1	0.888	176.7	28.1	0.54
September	33.3	11.4	38.22	0.749	224.4	11.6	0.61
October	26.1	11.1	46.59	0.795	219.4	19.2	0.27
November	34.9	10.7	50.75	0.78	251.9	24	0.25
December	18.1	12.8	59.64	0.758	88.4	16.7	0.24
January	27.4	8.1	52.76	0.827	168.5	24.89	0.49
Overall	33.1	9.7	44.72	0.83	148.1	116.8	0.61

Mmol/L = [3]; g/dL = [2]; mg/dL=[1]

Table 4. Mean monthly values of minerals and enzymes during the lactation period in cows (n=78)

Parameters	Ca[2]	P[2]	Mg[2]	Na[2]	K[2]	Cl[2]	AST[1]	ALT[1]	ALP[1]	GGT[1]
March	20.70	2.71	0.82	134.8	4.94	102.2	102.5	38.3	123.4	16.8
April	2.48	2.17	1.03	142	4.48	102.3	112.4	33.5	158.2	15.1
May	2.32	1.65	0.99	125.8	4.50	102.2	130.5	31.4	164.3	16
June	2.80	1.50	0.98	170.5	6.10	104.3	120.4	33.6	154.8	19.8
July	2.85	1.33	1.19	173.9	6.10	107.8	127.6	32	160.4	20.3
August	2.06	1.53	1.13	144.3	5.10	109.7	88.2	32.1	75.4	21.7
September	2.22	1.26	0.95	107.7	4	94.1	117.6	32.2	93	23.4
October	2.03	1.60	1.20	116.4	4.60	101.9	121.6	25.3	86.2	15.6
November	2.07	1.57	1.06	121.5	4.60	114.6	94	28.3	90.3	14.6
December	2.96	1.50	0.94	115.8	3.70	92.8	86.3	26.3	83.2	25.7
January	2.70	2.02	0.98	140.2	5.11	100.1	93.1	29	70	22.2
Overall	2.35	1.73	1.22	137.2	4.90	103.2	109.1	31.4	116.7	19.2

Mmol/L = **2**; mg/dL = 1

Table 5. Mean monthly values of milk parameters during the lactation period in dairy cows (n=78)

Months	Urea[1]	Protein[2]	lactose[2]	Ca[1]	P[1]	Mg[1]	Na[3]	K[3]
March	9.43	4.12	4.9	16.77	15.86	2.61	16.44	8.59
April	11.23	3.39	4.84	16.92	20.21	2.38	38.77	10.23
May	10.56	3.71	4.58	15.84	19.48	2.43	20.29	6.74
June	10.25	3.51	4.93	18.95	12.27	2.32	20.45	8.91
July	10.69	3.47	5.23	18.27	18.21	2.74	23.08	13.11
August	9.85	3.41	4.92	18.6	17.43	2.98	22.44	10.63
September	11.35	3.46	4.7	18.53	10.65	2.56	15.41	7.92
October	6.19	3.74	4.8	17.78	11.47	2.53	15.85	7.09
November	5.43	3.65	4.79	16.98	11.49	3.24	20/73	6.87
December	10.32	3.64	4.85	20.45	12.54	2.67	15.70	6.91
January	8	3.42	4.66	20.47	12.73	2.86	16.18	7.04
Overall	9.65	3.6o	4.86	17.97	15.22	2.63	21.06	8.83

mg/dL = 1; % = 2; Mmol/L = 3

Table 6. Mean seasonal values of dietary components during the lactation period in dairy cows (n=78)

Seasons	ME	CF	Moist	Ash	P	Ca	EE	CP
Spring	1359	19.6	44.1	5.4	0.31	0.73	2.5	10
Summer	1339	20.3	43.9	5.4	0.28	0.73	2.4	10.6
Autumn	1444	20.2	40.9	5.5	0.38	0.77	2.2	10.1
Winter	1390	22.1	41.6	5.6	0.42	0.85	2.5	10.1

Table 7. Seasonal mean values of blood parameters during the lactation period in dairy cows (n=78)

Parameters	PCV%	Hb	RBC	WCC	Neut	Lymph	Mono	Eosin
Spring	30.5	10.6	5.29	8899	3168	5411	214	116
Summer	31	10.5	5.15	8684	2640	5853	148	43
Autumn	31.2	10.7	5.14	9073	2893	6014	64	73
Winter	31.3	10.5	5.17	9048	2724	6080	199	54
	BUN[1]	Ptn[3]	Glucose[1]	Creatinine[1]	Cholesterol[1]	Tgs[1]	BHB[4]	
Spring	38.3	9.46	39.4	0.77	128.4	165.4	0.52	
Summer	31.6	11.1	45.2	0.77	232.3	18.3	0.38	
Autumn	23.7	9.96	55.5	0.8	136.6	21.6	0.46	
Winter	34.5	8.51	43.4	0.96	102.3	206.8	0.57	

Mmol/L = g/dL = [2]; $x10^3 l\mu$ = [2]; mg/dL = [1]

Table 8. Mean seasonal values of macro-minerals and enzymes during the lactation period in cows (n=78)

Parameters	Ca[2]	P[2]	Mg[2]	Na[2]	K[2]	Cl[2]	AST[1]	ALT[1]	ALP[1]	GGT[1]
Spring	2.58	1.45	1.06	163.3	5.75	107.2	112.7	32.6	131.7	20.6
Summer	2.11	1.51	1.07	115.2	4.38	103.7	110.6	28.6	90	18.5
Autumn	2.4	1.81	0.89	130.5	4.55	97.2	90.4	28	75.3	23.6
Winter	2.29	2.16	0.9	134.2	4.64	102.3	115	34.4	148.4	16

Mmol/L = [2]; mg/dL = [1]

Correlations among dietary, blood and milk parameters revealed different relationships with a correlation coefficient over 60% (Tables 10 and 11). Among these parameters dietary DCa and DP showed the strongest relationships with other nutrients. Different correlations were observed among nutrients and blood parameters including dietary DP with serum protein, glucose, BHB, dietary moisture/serum K (r=0.65), ME/serum K (r=0.61), CF/AST (r=-0.63), CF/GGT (r=0.72), CP/neutrophil (r=0.66), CP/lymphocyte (r=0.80), CP/milk Mg (r=0.62), DP/milk Ca (r=0.78), ash/milk Ca (r=0.76), EE/milk Ca (r=-0.65), EE/milk lactose (r=0.79). Dietary DP, DCa, CF and CP were the most outstanding parameters among the dietary components in cows.

Table 9. Mean seasonal values of milk parameters during the lactation period in dairy cows (n=78)

Parameters	Urea	Protein	Lactose	Calcium	Phosphorus	Magnesium	Sodium	Potas-sium
Spring	10.68	0.53	4.81	17.24	17.33	2.38	26.67	8.66
Summer	10.62	0.45	4.95	18.46	15.51	2.77	20.39	10.6
Autumn	7.16	0.68	4.78	18.32	11.88	2.77	17.21	6.98
Winter	6.97	0.89	4.9	17.96	14.85	2.69	16.36	8.09

Mmol/L = ^{2}; mg/dL = ^{1}

Table10. The relationships among dietary parameters during the lactation period in dairy cows (n=78)

Parameters	P	Ash	Moisture	ME
Fat	-0.67*			
Calcium	0.84**	0.95**	-0.64*	
Phosphore		0.79**	-0.73*	-0.60*
Moisture				-0.93**

p<0.01 = **; p<0.05 = *

Table11. Relationship between diet and blood parameters in dairy Holstein cows during 338 days of lactation

Parameters	ME	Ca	P	Moist	Fiber	CP	Ash	EE
Glucose		0.67*						
Protein			0.64*					
Glucose			0.65*					
BHB			-0.64*					
AST					-0.63*			
GGT					0.72*			
Neutrophil						0.66*		
Lymphocyte						-0.80**	-0.61*	
BK	-0.61*			0.65*				
Leukocyte						0.62*		

cont. Table 11.

Parameters	ME	Ca	P	Moist	Fiber	CP	Ash	EE
MMg						0.68**		
MCa			0.78**				0.76**	-0.65**
Lactose								0.79**

p<0.01 = **; p<0.05 = *

DISCUSSION

The intake of carbohydrates, proteins and minerals from the diet in order to provide energy, amino acids and electrolytes is essential (Naylor and Ralston, 1991). Blood glucose and urea are considered the final products of dietary protein and glucose and the bulk of milk lactose and minerals originate from blood glucose and electrolytes, therefore, blood components and milk yield can be directly influenced by variations in energy and protein ration. Determination of these parameters can lead to clarification of clinical efficiencies in improving the ruminants' production. In addition, there are many other parameters in the diet, blood and milk which show less important roles than others, but care must be taken regarding their probable roles in production performance, particularly their relationships with each other; thus it is necessary to consider all parameters under investigation.

The estimated ME in this study was less than that recommended for dairy cows i.e up to 3 $Mcal/_{kg/DM}$ (Hof *et al*., 1997). Energy requirements vary on the basis of age, gender, breed, growth, production and reproduction stages and for this study they were 1.25 to 1.54 $Mcal/_{kg/DM}$ during the lactation period. The reason could be related to the consumption of different types of feed with various nutrients such as forage, silage, concentrate, and lucerne durin different seasons of the year. The role of dietary energy in the quality and quantity of milk production has already been studied. Increased dietary energy results in the reduction in fat content and milk volume but improves milk protein (Depeters and Cant, 1992). Poor nutrition causes low milk yield up to 31% while increases milk fat to 9.6% (Agus and Bocquier, 1995). High quality concentrate influences the milk composition and production, whereas over-nutrition reduces the milk protein and fat content (Naylor and Ralston, 1991).

The requirements for dietary protein depend on the age, gender, breed, growth and reproduction phase and vary from 14 to 18%. In this study it was estimated at 10.2%, which was less than recommended for the lactating period (Ramin *et al*., 2010) and was considered unsuccessful in the nutrition program. The protein component is mainly located in the lucerne and concentrates. The range for dietary protein in this study was from 9 to 11.2% and indicates low protein content in the feed and probably 12% protein in concentrate, which results in partial hypo-proteinemia. Cows in this study were fed TMR having fairly poor energy and protein. The role of dietary protein on the blood and milk protein has already been investigated. Increase in CP results in high milk yield, low milk protein without changes in milk fat (Bocquier and Caja, 1998). Authors demonstrated that negative energy balance and poor nutrition has not affected milk protein (Agus and Bocquier, 1995). The side effects of low dietary protein include wasting, edema, low growth rate and animal production.

Monthly and seasonal values of blood parameters were within the reference ranges (Radostits *et al*., 2010) and the presence of small variations during this study could be related to the differences in obtaining the amounts of diet, individual metabolism among cows, and finally, digestion and absorption differences in feed consumption (Cozzi *et al*., 2011; Villa *et al*., 2011). Among the parameters under investigation, urea, glucose and BHB are indicative of the protein and energy balance in the body, creatinine is an index of health status. Protein and triglycerides show the body energy resources and haemathological parameters indicate the situation of anemia and possible diseases. Blood minerals present the ability of animals for milk production, and blood enzymes reflect the liver activity in animals. Investigation of the overall parameters in the study of animal health improves the quality of milk production, as well. Variations in these indices during parturition, lactation, season and different feedstuffs are considered as physiological effects (Cozzi *et al*., 2011), whereas following milk fever (Ismail *et al*., 2011), ketosis (Sahinduran *et al*., 2010), fat cow syndrome (Sakhaee *et al*., 2011) and LDA (Mokhber Dezfouli *et al*., 2011) are considered as disease condition.

Blood urea, glucose and protein as the protein and energy sources in animals are considered to be more important than others (Gupta *et al*., 2011). The range for blood glucose is mentioned as 45-55 mg/dL (Radostits *et al*., 2010), which supports the results of this study. Reduction in glucose concentration is common in ketosis (Sahinduran *et al*., 2010), but hyperglycemia is not usual in ruminants. Glucose plays the main role in milk lactose yield and is influenced by diet, normal physiological activity and reproduction. Glucose reduction during lactation is probably related to milk lactose production, thus its administration compensates the glucose disturbances, but does not influence milk yield, so milk fat will be reduced (Radostits *et al*., 2010). Blood urea is mentioned as 25.2 mg/dL (Zadnik *et al*., 1993) and for this study it was high, around 33.1 and ranged from 18.1 to 39.7 mg/dL. Urea is the result of protein metabolism and is detectable in blood, milk, saliva and sweat. It is influenced by many factors (Radostits *et al*., 2010) such as pregnancy and lactation (Nbibualonji *et al*., 1998). Urea increases in during the lactation period, as observed in this study. Abnormal changes in blood urea were recorded following diarrhea, nephritis, pregnancy toxemia and acidosis (Igbokwe, 1993; Radostits *et al*., 2010).

Mean milk urea in this study was 9.65 mg/dl, protein 3.6% and lactose 4.86%. The normal reported values were 10-48 mg/dL (Hof *et al*., 1997), 4% (Naylor and Ralston, 1991) and 4%, respectively (Ramin *et al*., 2010), which was low for milk urea, protein and high for lactose. Variations in milk parameters depend on nutrition, milk yield and reproduction stages. Low amount of milk urea in this study is an advantage due to the low percent of dietary protein. Urea changes follow pregnancy and lactation (Arunvipas *et al*., 2007), season (Kitaeg *et al*., 2009), quality and quantity of milk yield. Low milk protein is related to dietary protein imbalance which is directly related to the consumed concentrate as recommended up to 16% in lactating cows. Variation in milk lactose is very small (Bed *et al*., 1997), but can be influenced by milk production and ratio of protein to energy, as well (Pulina *et al*., 1996).

The means for milk Ca, P, Mg were 7, 9 and 1.5 times higher than in the blood. This was less than what was reported by other authors (Ramin *et al*., 2010), thus these values are not stable in milk and can be influenced by nutrition, breed, lactation period, milk protein and urea and milk yield (Closa *et al*., 2003). In addition, variations in these minerals depend on citrate, casein and Mg level in the milk. The role of milk minerals is limited to growth and bone formation; high amount of milk minerals is an advantage which is observed in early and late lactation (Kupczynski *et al*., 2011). Means for milk sodium and potassium were 21.2 and 8.8 mmol/L, respectively, which differed from others studies (Ramin *et al*., 2010). This means that the concentrations are not stable in milk, however, the exact roles of these minerals in milk are as yet unclear.

The most important relationships among dietary nutrients were between DP and DCa with other nutrients. Dietary DP revealed positive relations with DCa, energy and ash and negative correlations with EE and moisture, thus by reducing the dietary EE and moisture the macro-minerals mainly, DCa and DP will be improved. Correlations between dietary nutrient with blood and milk parameters were largely related to dietary DP and CP. Dietary DP revealed strong and reasonable relationships with blood protein, glucose, BHB and milk Ca, while CP revealed correlations with leukocytes, neutrophils, lymphocytes and milk Mg. Other nutrients which showed a few relationships with blood and milk parameters were CF, ash and EE. No previous studies have been done on extended parameters. The outcome of this study results in a better definition for milk production assessment. The lack of relationships among dietary nutrients with blood and milk urea and protein which is mentioned by Cannas *et al*. (1998) and Ramin *et al*. (2010) poses the question of whether or not milk urea and protein are useful in the determination of dietary status in ruminants, although reliable reports persist regarding the usefulness of blood and milk urea and protein in the prediction of milk production and reproduction performances (Nourozi *et al*., 2010).

In conclusion, monthly and seasonal values of dietary, milk and blood parameters during the lactation period were varied under the normal range. Dietary DP and DCa showed numerous relationships with other nutrients. Among correlations, the dietary parameters with blood and milk parameters, DP and CP were the most suitable. The predominant blood parameters were protein, glucose, BHB, leukocytes and in the milk were Ca and Mg. Therefore, dietary DP, DCa and CP could be useful indices in the complementary studies related to the assessment of nutrition, milk production and reproduction performances.

Address for correspondence:
Ramin AG
Veterinary College, Urmia University
Urmia, Iran

REFERENCES

1. *Agus A, Bocquier F*, 1995, Contribution of body reserves to milk production in under nutrition ewes. IV sgmposium International sur la wutrition des Herbivores, clermont-september 1995, *Annal Zootechn*, 44, 320.
2. *Arunvipas P, Vanleeuwen JA, Dohoo IR, Leger ER, Keefe GP, Burton AS et al.*, Lissemore KD, 2007, Milk urea-nitrogen negatively affected first service breeding success in commercial dairy cows in Prince Edward Island, *Can Pre Vet Med*, 82, 42-50.
3. *Bed S, Ikodemusz E, Gunndel K, Nagy Z,* 1997, Relation of plasma concentration of urea, glucose and total protein to Milk levels of urea, loctose and protein of grazing ewes during lactation, *Arch Tierz Dummerstorf,* 40, 265-75.
4. *Bocquier F, Caja G*, 1998, Effects of nutrition on ewes' milk quality, Comparative FAO network on sheep and goats, Nutrition sub-network, 3-5 Sept., Grignon, France.
5. *Cannas A, Pes A, Mancuso R, Vodret B, Nudda A*, 1998, Effect of dietary energy and protein concentration on the concentration of milk urea nitrogen in dairy ewes*, J Dairy Sci*, 81, 499-508.
6. *Casamassima D, Sevi A, Patazzo M, Ramacciato R, Colella GE, Bellitti A,* 2001, Effects of two different housing system on behavior, physiology and milk yield of comisana ewes, *Dipart Sci Anim*, 41, 151-61.
7. *Closa SJ, de Landeta MC, Andérica D, Pighín A, Cufré JA,* 2003. Mineral nutrient content in cow milk and dairy products in Argentina, *Arch Latinoam Nutr,* 53, 320-4.
8. *Cozzi G, Ravarotto Lb, Gottardo F, Stefani AL, Contiero B, Moro Lb et al.*, 2011, Reference values for blood parameters in Holstein dairy cows: Effects of parity, stage of lactation, and season of production, *J Dairy Sci*, 94, 3895-901.
9. *Depeters EJ, Cant JP*, 1992. Nutritional factors influencing the nitrogen composition milk, *J Dairy Sci,* 75, 2043-70.
10. *Gfrorer F, Koch G*, 1985. Determination of the urea content of milk in general practice, *Tieraztl prax*, 13, 559-63.
11. *Gupta GN, Himani, Saini M, Prakash V,* 2011, In vitro study of propylene glycol on bovine blood biochemical parameters, *Global Veterinaria*, 7, 66-71.
12. *Hof G, Vervoorn MD, Lenaers PJ, Tamminga S,* 1997, Milk urea nitrogen as a tool to monitor the protein nutrition of dairy cow, *J Dairy Sci*, 80, 3333-40.
13. *Igbokwe IO,* 1993, Haemoconcentration in yankasa sheep exposed to prolonged water deprivation, *Small Rum Res*, 12, 99-105.
14. *Ismail ZAB, Alzghoul MDB, Eljarah A,* 2011. Hematology, plasma biochemistry, and urinary excretion of glucose and minerals in dairy cows affected with parturient paresis, *Com Clin Pathol,* 20, 631-4.
15. *Kecec T*, 2003. Effect of low birthweight on serum thyroid hormones, glucose, urea and blood pH in newborne lambs, *Turk J Vet Anim Sci*, 27, 395-9.
16. *Kitaeg N, KiHyun K, InSik N, Abanto OD, Seonggu H,* 2009. Seasonal and regional effects on milk composition of dairy cows in South Korea, *J Anim Sci Tech*, 51, 537-42.
17. *Kupczyñski R, Adamski M, Falta D, Chládek G, Kruszyñsk W*, 2011, The influence of condition on the metabolic profile of Czech Fleckvieh cows in the perinatal period, *Arch Tierzucht,* 54, 456-67.
18. *Mokhber Dezfouli M, Eftekhari Z, Sadeghian S, Bahounar A, Jeloudari M,* 2011, Evaluation of hematological and biochemical profiles in dairy cows with left displacement of the abomasum, *Com Clin Pathol*, 20, 234-41.
19. *Naylor JM, Ralston SL,* 1991, *Large Animal Clinical Nutrition*, Mosby Year Book, Inc., Missouri, USA, 6-21.
20. *Nbibualonji BB, Rodrigues MN, Dehareng D, Godeau JM,* 1998, Effects of late pregnancy and early lactation on renal urea handling in Corriedale ewes, *J Agri Sci*, 130, 213-6.
21. *Nourozi M, Moussavi AH, Abazari M, Zadeh MR*, 2010, Milk Urea Nitrogen and fertility in dairy farms, *J Anim Vet Adv*, 9, 1519-25.
22. *Nozad Sh, Ramin AG, Moghadam, Gh, Asri-Rezaie S, Babapour A*, 2011, Diurnal variations in milk urea, protein and lactose concentrations in Holstein dairy cows, *Acta Vet,* 60: 145-53.

23. *Pulina G, Beneini R, Rassu SPG,* 1996. Relation between birth weight of lamb milk production in ewes, Stocarstvo, 50, 199-203.
24. *Radostits OM, Blood DC, Henderson JA,* 2010, *Veterinary Medicine*, 8th Ed., Bailliere & Tindall Publication, Ltd., London, 1450-2.
25. *Ramin AG, Aghazadeh A, Karamian T, Ramin S*, 2010, Correlations of Dietary Crud Protein and Gross Energy on Blood Glucose and Urea, Milk Urea and Lactose Concentrations in Lactating Ewes, *Acta Vet Brno*, 28, 49-57.
26. *Sahinduran S, Sezer K, Buyukoglu T, Albay MK, Karakurum MC,* 2010. Evaluation of some haematological and biochemical parameters before and after treatment in cows with ketosis and comparison of different treatment methods, *J Anim Vet Adv*, 9, 266-71.
27. *Sakhaee E, Kheirandish R, Jafari H, Yaghoubi MA*, 2011. Fatty liver syndrome in dairy herds in southeast Iran, *Com Clinic Pathol,* 20, 75-8.
28. *Van Hulzen KJ, Sprong RC, van der Meer R, van Arendonk JA,* 2009, Genetic and nongenetic variation in concentration of selenium, calcium, potassium, zinc, magnesium, and phosphorus in milk of Dutch Holstein-Friesian cows, *J Dairy Sci,* 92, 5754-9.
29. *Villa NA, Osorio JM, Escobar D, Ceballos A,* 2011, Biochemical indicators of energy balance around calving in pasture-based brahman cows in the tropic of Colombia, *Ciencias Veterinarias de la Universidad del Zulia,* 21, 353-9.
30. *Zadnik T, Pengov A, Mijovic A, Lipuzic E, Pogacnik M*, 1993. Somatic cell count and ewe milk composition, Prvi Slovenski Veterinarski Kongres, 18-20.

MESEČNA I SEZONSKA ANALIZA SASTOJAKA HRANIVA I NJIHOVI ODNOSI SA VREDNOSTIMA NEKIH PARAMETARA KRVI I MLEKA MLEČNIH KRAVA

NOZAD SH, RAMIN AG, MOGHADAM GH, ASRI-REZAEI S, KALANTARY LEILA, BABAPOUR AZADEH, RAMIN S i PHILLIPS CJC

SADRŽAJ

U ovoj studiji su izneti rezultati dobijeni ispitivanjem mesečnih i sezonskih varijacija u sastavu hraniva i njihovih odnosa sa vrednostima nekih parametara krvi i mleka kod mlečnih krava Holštajn rase. Studija je sprovedena sa ciljem da se utvrdi koji parametri kvaliteta hraniva mogu biti od koristi za poboljšanje mlečnosti. Uzorci su prikupljani jednom mesečno tokom laktacije od 11 meseci i analizirani odgovarajućim komercijalnim testovima. Srednje vrednosti su smatrane statistički različitim za $P<0,05$. Srednja vrednost metaboličke energije (ME), procenat sirovih vlakana (CF), vlage, pepela, fosfora (DP), kalcijuma (DCa), etarskog ekstrakta (EE) i sirovih proteina (CP) su bile 1.38 $Mcal/_{KgDM}$, 20,4%, 42,8%, 5,5%, 0,34%, 0,76%, 2,39% i 10,2% respektivno. Korelacije su dokazane u sledećim slučajevima: DP/DCa (r=-0,73), DP/EE (r=0,67), DP/pepeo (r=0,79), DP/vlaga (r=0,84), DP/ME (r=0,60), Ca/pepeo (r=0,95), Ca/vlaga (r=0,64) i DCa/vlaga (r=0,93). Korelacije između parametara kvaliteta hraniva, krvi i mleka ukazivale su na različite odnose ali su najznačajnije korelacije utvrđene izmedju DP i parametara krvi i CP i parametara krvi i mleka. Od ispitivanih parametara krvi, koncentracija glukoze, BHB, SK, aktivnost AST i GGT i broj neutrofilnih granulocita i limfocita su bili u najvećoj zavisnosti od kvaliteta hraniva. Od ispitavanih parame-

tara u mleku, to su bili koncentracija Mg, Ca i laktoze. Može se zaključiti da su ispitivani parametri imali sezonske i mesečne varijacije. Od parametara hraniva, DCa i DP i Ca i P iz seruma i mleka su bili najpouzdaniji u poređenju sa ostalim parametrima i mogu se koristiti u studijama koje imaju za cilj povećanje mlečnosti.