Iranian Journal of Applied Animal Science

Effect of Forage Feeding Level on Body Weight, Body Condition Score, Milk Production, and Milk Urea Nitrogen of Holstein Cows on an Organic Diet

Research Article

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Received on: 8 Apr 2014
Revised on: 21 Jul 2014
Accepted on: 31 Jul 2014
Online Published on: Dec 2019

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Online version is available on: www.ijas.ir

ABSTRACT

In the past decade, a global demand for products from organic agriculture has increased rapidly. Milk quality is of major interest to all parties. Therefore, the objective of this study was to compare cow performance and product quality on conventional and organic diets. 72 Holstein dairy cows were allotted to one of four diets: a conventional diet (CON40), an organic diet with a low amount of forage (ORG40), an organic diet with a moderate amount of forage (ORG60) and an organic diet with a high amount of forage (ORG80). Multiparous cows (2^{nd}, 3^{rd}, and 4^{th} parity) were randomly assigned to the treatments. Range forages were used as part of the diets, and cows were individually offered feed three times a day with refusals collected once a day. Daily dry matter intake (DMI) and milk yield (MY) were measured for 308 days. Somatic cell count (SCC), body weight (BW) and feed efficiency (FE) were determined at 28-day intervals. The DMI was different for cows that consumed the ORG80 (18.2 kg/d), ORG60 (19.1 kg/d), ORG40 (20.1 kg/d) and CON40 (20.5 kg/d) diets. BW was not affected by treatments, but differences in body condition score (BCS) ($P<0.05$) were observed. Although milk yield was higher in cows fed CON40, milk fat was higher ($P<0.05$) in cows fed organic diets. Lower FE, milk urea nitrogen (MUN) and blood urea nitrogen (BUN) were observed in cows fed organic diets ($P<0.05$).

KEY WORDS body condition, dairy Holstein, milk composition, organic diets.

INTRODUCTION

In recent years the market for organic products has grown considerably, along with the consumer's awareness of the production process. Therefore organic farming using domestic livestock has recently become widespread around the world (Lampkin, 2001). Clearly, crucial prerequisites in order to produce high quality milk are healthy cows fed with feed free from unusual materials. Organic farming defines clear rules for the feeding, health management and housing of animals (Padel *et al.* 2004).

With the transition from conventional to organic dairy farming, milk yield and its composition change drastically (Slots *et al.* 2009; Sundrum, 2001; Butler *et al.* 2011; Ellis *et al.* 2006; Collomb *et al.* 2008; Prandini *et al.* 2009). There is a growing body of research comparing organic and conventional farming systems. In a critical review, Sundrum (2001) demonstrated that the benefits of organic systems are more influenced by specific farm management policies than by the production system itself. Although organic systems may reduce milk yields and growth rates (Bergamo *et al.* 2003; Slots *et al.* 2009; Butler *et al.* 2011), organic production methods may improve animal health and welfare, human health, and improve the environment (Ellis *et al*. 2006; Bystrom *et al*. 2002; Hamilton *et al*. 2002; Slots *et al*. 2009; Prandini *et al*. 2009). Milk yield on organic dairy farms is lower than milk yield on conventional farms (Kristensen *et al*. 1998; Bystromet *et al*. 2002; Hamilton *et al*. 2002). The reasons for lower milk yield in organic dairy herds may be due to differences in genetics, management, feeding practices, and increased subclinical mastitis (Hovi *et al*. 2002). In addition to differences in feeding and milk yield, reproductive efficiencies may also be different in organic herds. Organic milk has been produced in rural areas of Iran for many years, and organic dairy products are available in villages and cities in special markets in Iran. However, the high demand for organic milk in recent years asks for production on a larger scale. No published studies have evaluated the effect of organic diets on the performance of dairy cows in Iran. Therefore, the objective of this study was to evaluate the use of organic forages in different levels of TMR diets and their effects on body weight, body condition score, milk production, and milk quality of Holstein dairy cows in Iran.

MATERIALS AND METHODS

Animals, diets and experimental design

The study was conducted at Valfajr Agricultural Research Center farm, located in the central Alborz range lands of Kojour region of Mazandaran Province, Iran, from January 2012 to December 2012. All activities were performed under the guidelines approved by the Standard Committee of the Ministry of Agriculture and Veterinary Organization of Iran. Of 72 selected Holstein dairy cows for this study the average (Mean±SD) initial BW was 495.5 ± 39.6 kg, and the previous year's daily MY was 27.5 ± 1.1 kg/d. Cows were individually tied on stands at all times except when being milked in the milking parlor. A completely randomized block design with four treatments was used. Cows were randomly distributed into groups, and blocked by average BW, MY and parity (second, third or fourth calving). The four treatments during the study were: a conventional diet (CON40), an organic diet with a low amount of forage (ORG40), an organic diet with a moderate amount of forage (ORG60) and an organic diet with a high amount of forage (ORG80). Daily amounts of total mixed ration (TMR) were offered at morning (05:00), mid-day (13:00) and evening (21:00). Non-consumed feed was collected and subtracted from the provided amount of feed. Cows were milked at 04:00, 12:00 and 20:00, and had *ad libitum* access to fresh water. The ingredients and chemical composition of diets are shown in Table 1.

The rangeland forages in spring and summer contained *Hordeum bulbosum* (30%), *Festuca pratensis* (32%), *Dorema ammoniacum* (25%) and other species (13%). The rangeland forages in autumn and winter contained *Hordeum bolbosum* (35%), *Lolium perenne* (27%), *Prangos ferulacea* (22%), *Poa pratensis* (10%) and other species (6%). The rangeland forages were harvested at 50-day and 90-day intervals from the paddocks, respectively. Forages used in TMR diets were harvested and sun cured daily for 6-8 hours prior to being fed to cows. The extra forages of the field at each harvesting interval were dried and properly stored for the cold season.

Range management

The rangeland area was 20 ha of grassland from the Kojour region of Mazandaran province, Iran. A further ten ha of agricultural land was used for the production of conventional feed. To harvest the rangeland, a paddock was divided into four sections and forage was harvested every 50 or 90 days. The range areas were not irrigated and the yearly average rainfall amounted to about 790 mm with 15.7 ˚C average yearly temperature. The soil structures were classified as loam and/or sandy loam, with a neutral pH (6.83-7.19) and 2.99%-4.75% organic matter. During each harvest, botanical characterisation was performed using the method of Braun-Blanquet (1964), and the percentage of each species in the samples were recorded. Pasture samples were collected at the same time and used for chemical analysis.

Data collection

Forages and other feeds were evaluated according to the association of official analytical chemists (AOAC, 1991) method. Samples of sun-dried forages were packaged and sent to the laboratory for analysis of dry matter (DM), crude protein (CP), crude fiber (CF), ether extract (EE), Ash and neutral detergent fiber (NDF) measurements. The BW of cows was recorded at 28-day intervals prior to the morning feed. Cows were weighed when leaving the milking parlor using a digital scale.

A scale of 1 to 9 for body condition score (BCS) was estimated for cows by the same person throughout the experiment. The scoring scale ranged from 1 for very thin to 9 for very fat (ICAR, 2007).

The BCS values were recorded five times which included the dry period (pre-calving), post-calving, and the early, mid and late-lactation. Data for daily dry matter intake (DMI) was recorded from the beginning to the end of the experiment. With data spanning 308 days, each cow had DMI records for 11 periods (days 1-28, 29-56, 57-84 etc.). MY for each period was recorded as the average milk produced in each day of the 28-day period.

Table 1 Ingredients and chemical composition of the experimental diets

Item	Treatment			
	CON40	ORG40	ORG60	ORG80
Ingredient, % of DM				
Barley straw	3.00	3.00	1.00	1.00
Rangeland forage	8.00	8.00	18.0	27.0
Alfalfa hay	9.00	9.00	12.0	21.0
Corn silage %40 grain	11.0	11.0	20.0	22.0
Wheat bran	9.00	9.00	9.00	9.00
Barley grain	20.0	20.0	14.9	8.00
Corn grain	17.2	17.2	8.00	2.00
Canola	19.6	19.7	16.0	8.90
Carbonate calcium	1.42	1.35	0.35	0.35
DCP	0.45	0.43	0.25	0.25
Limestone	0.91	0.89	0.25	0.25
Mineral-vitamin mix[1]	0.42	0.43	0.25	0.25
Chemical composition, % of DM[2]				
Total digestible nutrients	66.0	64.0	61.0	58.0
Crude protein	17.3	16.1	15.2	14.5
Neutral detergent fiber	35.8	37.8	42.9	48.9
Non fiber carbohydrate	38.0	36.0	31.0	29.0
Calcium	1.22	1.17	1.15	0.97
Phosphorus	0.60	0.56	0.57	0.50
ME, Mcal/kg of DM	2.41	2.32	2.29	2.25

[1] Mineral composition (g/kg): Ca: 180; P: 60; Mg: 50; Na: 50; Cu: 1.3; Zn: 6.0; Mn: 3.5; I: 0.06; Co: 0.032; Se: 0.02; vitamin composition (IU/kg): vitamin A: 600000; vitamin D_3: 120000 and vitamin E: 1300.
[2] Data were measured using AOAC (1991) method, otherwise extracted from the nutrient requirements of dairy cattle (NRC, 2001).
CON40: conventional diet; ORG40: organic diet with low forage; ORG60: organic diet with medium forage and ORG80: organic diet with high forage.

The fat and protein contents and the density of milk were measured once a week and SCC was analysed each month. The fat content of milk was measured using the Smart-Trac rapid fat analyzer (CEM, Matthews, NC.). The Lacti-Check ultrasound milk analyzer (P and P International Ltd., Hopkinton, MA) was used to measure the protein contents, while SCC was determined with a Fossomatic 90 (Foss electric). For the milk urea nitrogen (MUN) measurement, samples were collected every 28 days. A concentration of MUN was determined in all trials using the same diacetyl monoxime colorimetric assay adapted to a continuous flow analyzer (Technicon, 1977). Feed efficiency (FE) was estimated by dividing energy-corrected milk (ECM), {ECM (kg)= [0.327 × (milk kg)] + [12.96 × (fat kg)] + [7.2 × (protein kg)]} by daily DMI. For BUN, blood samples (20 mL) were collected from the tail vein at 28-day farm visits using evacuated tubes containing ethylenediaminetetraacetic acid (EDTA) at a level of 1.8 g/L of blood. Samples were kept on ice for 15 min after collection and then centrifuged at 1000 × g for 20 min. Plasma was harvested and stored frozen in plastic tubes at −20 ˚C until further analysis. The plasma urea concentration was determined using the method of Chaney and Marbach (1962).

Statistical analyses

For statistical analysis the dependent variables were BW, BCS, MY, milk components as fat or protein percent, DMI, FE, MUN and BUN, the fixed effects were dietary treatment, parity and 28-day period nested within dietary treatment. The MIXED linear model procedure of SAS (SAS, 2004) was used, in which cow was the random variable and sample sequence was the repeated measure. The autoregressive covariance [AR (1)] structure was used because it resulted in the lowest Akaike's information criterion (Littell *et al.* 1998). The GLM PROC model was also used when necessary. Results are presented as least square means and statistical differences were considered significant at $P < 0.05$. Trends towards significance were considered at $0.05 \leq P < 0.10$.

RESULTS AND DISCUSSION

Body weight and body condition score

The change of BW over time during the study is shown in Figure 1. There were no statistically significant differences for BW between treatment groups. However, the CON40 cows lost slightly more BW than the organic cows during mid-lactation. Pre-calving BCS were not different between treatment groups (Table 2). However, significant differences were observed between treatments after calving (P<0.05), and early (P<0.001) and mid-lactation (P<0.01). Although BW change in CON40 cows was greater than in organic cows, results showed that organic diets with high forage levels can improve body condition.

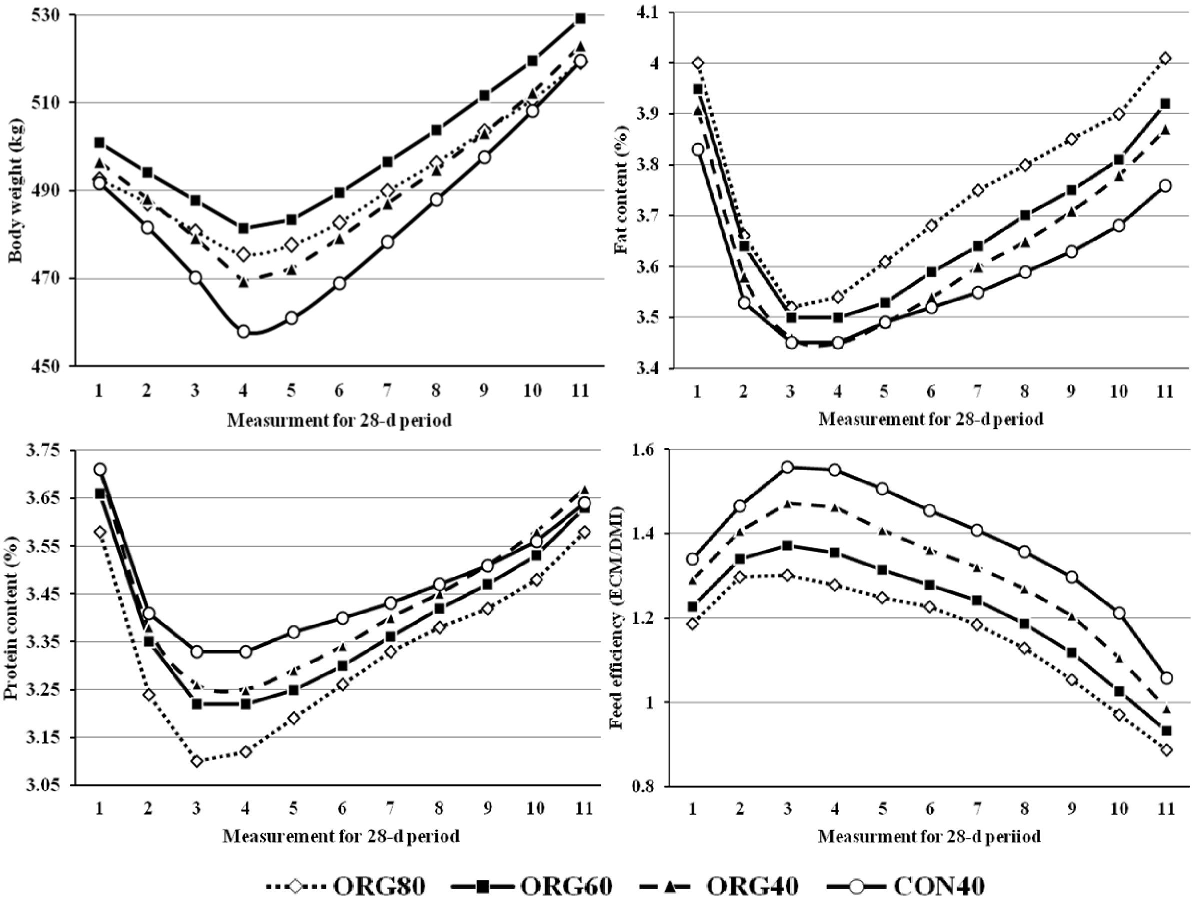

Figure 1 Time courses of body weight, fat content, protein content and feed efficiency in an ORG80: organic diet with high forage, ORG60: organic diet with medium forage; ORG60: organic diet with low forage and CON40: conventional diet, during the observation periods
Means of body weight were not statisticaly defferent among treatments for all periods (P=0.10), but the characteristics of fat content, protein content and feed efficiency were significantly diferent (P<0.05) detect among treatments for all periods
Overall standard error of the means (SEM) for body weight= 8.5; milk fat percentage= 0.004; milk protein percentage= 0.008 and feed efficiency= 0.008

Table 2 Estimation of body condition score of cows fed from organic and conventional diets in during lactation

Measurement for period	Treatment				SEM	P-values
	CON40	ORG40	ORG60	ORG80		
Beginning of dry cow	5.99	5.96	5.99	5.93	0.03	NS
Post calving	4.59[b]	4.60[b]	4.70[a]	4.68[a]	0.03	*
Early lactation	5.08[a]	4.99[b]	5.01[b]	4.90[c]	0.03	***
Mid lactation	5.53[a]	5.50[a]	5.38[b]	5.23[c]	0.03	**
Late lactation	5.71	5.54	5.54	5.48	0.03	†
Mean of periods	5.38[a]	5.32[b]	5.32[b]	5.24[c]	0.03	**

CON40: conventional diet; ORG40: organic diet with low forage; ORG60: organic diet with medium forage and ORG80: organic diet with high forage.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
† (P<0.10); * (P<0.05); ** (P<0.01) and *** (P<0.001).
NS: non significant.

Across all periods CON40 cows had greater (P<0.01) BCS than organic cows (5.38 for CON40, 5.32 for ORG60, and 5.24 for ORG80 cows). During late-lactation BCS was similar (P<0.10) for all treatment groups.

Milk yield and milk composition

Table 3 shows the means and standard error of means for milk yield for each 28-d period and across to the 308 days.

Figure 1 shows the change over time for fat and protein content. Milk yield (Table 3) was different among treatment groups, especially for the 3rd to 11th periods (P<0.001). Across the lactation period, cows fed the CON40 or ORG40 diets had greater (P<0.05) MY than cows fed the ORG60 or ORG80 diets (27.55 and 25.20 kg/d *vs*. 22.45 and 20.34 kg/d). Fat percentage was higher for cows fed the ORG80 diet compared to the other treatment groups.

Table 3 Estimation of milk yield (kg/day) of cows fed from organic and conventional diets in during lactation

Measurement for 28-d period	Treatment				SEM	P-values
	CON40	ORG40	ORG60	ORG80		
1	24.59[a]	23.33[a]	21.22[b]	19.67[c]	0.13	*
2	30.62[a]	28.87[b]	26.20[c]	24.46[d]	0.13	**
3	34.69[a]	32.11[b]	28.03[c]	25.13[d]	0.13	***
4	33.75[a]	31.29[b]	27.12[c]	24.10[d]	0.13	***
5	31.71[a]	28.85[b]	25.50[c]	22.82[d]	0.13	***
6	29.70[a]	27.07[b]	24.24[c]	21.91[d]	0.13	***
7	28.03[a]	25.52[b]	22.97[c]	20.61[d]	0.13	***
8	26.35[a]	23.85[b]	21.27[c]	18.97[d]	0.13	***
9	24.45[a]	21.72[b]	19.25[c]	17.01[d]	0.13	***
10	21.73[a]	18.86[b]	16.76[c]	14.97[d]	0.13	***
11	17.48[a]	15.77[b]	14.44[c]	13.02[d]	0.13	***
Mean of periods	27.55[a]	25.20[b]	22.45[c]	20.24[d]	0.09	**

CON40: conventional diet; ORG40: organic diet with low forage; ORG60: organic diet with medium forage and ORG80: organic diet with high forage.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
* (P<0.05); ** (P<0.01) and *** (P<0.001).

Across all periods, milk from cows fed the ORG80 or ORG60 diets contained more fat (P<0.05) than milk from cows fed the ORG40 or CON40 diets (3.76% and 3.68% vs. 3.64% and 3.59 %). Milk from cows fed the CON40 diet contained more protein (P<0.01) than milk from organic cows.

Table 4 shows that cows fed the CON40 diet had greater (P<0.05) SCC than cows fed the other diets at periods 3[th], 4[th], 5[th], 6[th] and 8[th] with a tendency for cows fed the CON40 diet to have higher (P<0.10) SCC than cows fed the organic diets for the period 2[nd] and 11[th].

Dry matter intake and feed efficiency

Table 5 show the DMI intake for treatment groups over the 308 days of lactation. For the mean of all periods, cows fed the CON40 or ORG40 diets had a greater (P<0.05) DMI than cows fed the ORG60 or ORG80 diets (20.54 and 20.06 kg/d vs. 19.14 and 18.18 kg/d). Changes in DMI (Table 5) and MY (Table 3) were similar from the beginning to the end of the experiment. Figure 1 shows the change in feed efficiency during the trial period. Across the periods, cows fed the CON40 or ORG40 diets had greater (P<0.01) FE than those fed the ORG60 or ORG80 diets (1.391 and 1.308 *vs.* 1.225 and 1.168). Cows fed the ORG80 and ORG60 diets were similar for FE. It may be difficult to determine how cows in different treatments partitioned consumed energy into alternative components of production (body maintenance, and growth or restoration of body reserves). However, it is possible to determine how treatment groups utilized energy from consumed feed to restore body reserves.

Milk urea nitrogen and blood urea nitrogen

Across the 308 days, CON40 cows had greater (P<0.01) MUN than ORG40, ORG60 and ORG80 cows (16.79, 15.51, 14.67 and 13.86 mg/dL; Table 6).

Similarly, CON40 cows had greater (P<0.01) BUN than ORG60, ORG40 and ORG80 cows (4.15, 3.96, 3.76 and 3.66 mmol/L; Table 7). Consequently, changes in MUN and BUN values were similar for organic cows and indicated higher quality milk production. Quite possibly milk from cows fed organic diets had reasonably higher quality milk due to lower urea contents.

In this study, no significant differences between conventional and organic diets regarding the time course of BW were found (Figure 1). Similar results are reported by Roesch *et al.* (2005) but their finding that BCS was not different between cows fed organic compared to conventional diets is in contrast to our results. Bystrom *et al.* (2002) found that cows fed organic diets weighed less at the end of lactation compared to cows fed conventional diets although BW and BCS change was greater for conventional cows compared to organic cows. Furthermore, Trachsel *et al.* (2000) reported lower changes in BCS in cows fed organic diets than in cows fed conventional diets.

Milk yield and milk composition

The milk yield and milk composition reported here are in agreement with the findings of Bergamo *et al.* (2003), Butler *et al.* (2011), Bystrom *et al.* (2002), Ellis *et al.* (2006), Hamilton *et al.* (2002), Prandini *et al.* (2009), Roesch *et al.* (2005) and Stiglbauer *et al.* (2013), all of whomreported that MY was greater for conventional cows than organic cows. Butler *et al.* (2011) and Roesch *et al.* (2005) reported that milk protein percentage was equal between groups, but a greater fat percentage was seen with organic feeding than with conventional feeding. Conversely, Reksen *et al.* (1999) reported that milk yield was not significantly different for cows fed organic or conventional diets. On the other hand, Rozzi *et al.* (2007) showed that, conventionally kept cows had greater milk, fat, and protein in milk than organically managed cows.

Table 4 Estimation of somatic cell count (10^3 cells/mL) of cows fed from organic and conventional diets in during lactation

Measurement for 28-d period	Treatment				SEM	P-values
	CON40	ORG40	ORG60	ORG80		
1	239.1	240.7	230.7	234.8	45.1	NS
2	241.4	237.2	232.1	235.4	45.1	†
3	247.8^{a}	238.0^{b}	238.0^{b}	242.9^{ab}	45.1	*
4	246.2^{a}	234.1^{b}	236.7^{b}	241.6^{ab}	45.1	*
5	237.6^{a}	233.4^{a}	223.4^{b}	217.7^{b}	45.1	*
6	234.9^{a}	220.1^{b}	220.1^{b}	213.5^{c}	45.1	**
7	227.3	221.9	223.8	220.7	45.1	NS
8	225.5^{ab}	230.3^{a}	220.6^{b}	219.9^{b}	45.1	*
9	227.3	227.2	221.1	223.2	45.1	NS
10	231.7	231.2	233.2	228.0	45.1	NS
11	233.8	232.0	232.5	225.5	45.1	†
Mean of periods	235.7	231.4	228.4	227.6	44.2	†

CON40: conventional diet; ORG40: organic diet with low forage; ORG60: organic diet with medium forage and ORG80: organic diet with high forage.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
† (P<0.10); * (P<0.05); ** (P<0.01) and *** (P<0.001).
NS: non significant.

Table 5 Estimation of dry matter intake (kg/day) of cows fed from organic and conventional diets in during lactation

Measurement for 28-d period	Treatment				SEM	P-values
	CON40	ORG40	ORG60	ORG80		
1	19.97^{a}	19.85^{a}	19.05^{b}	18.27^{c}	0.15	*
2	21.50^{a}	21.24^{a}	20.34^{b}	19.52^{c}	0.15	**
3	22.57^{a}	22.01^{a}	20.67^{b}	19.45^{c}	0.15	**
4	22.07^{a}	21.57^{a}	20.26^{b}	19.05^{b}	0.15	***
5	21.48^{a}	20.85^{a}	19.78^{b}	18.72^{c}	0.15	*
6	20.97^{a}	20.42^{a}	19.51^{b}	18.57^{b}	0.15	**
7	20.60^{a}	20.08^{ab}	19.25^{b}	18.30^{c}	0.15	*
8	20.22^{a}	19.69^{b}	18.83^{c}	17.87^{d}	0.15	**
9	19.75^{a}	19.14^{ab}	18.29^{bc}	17.31^{c}	0.15	**
10	19.02^{a}	18.33^{ab}	17.58^{bc}	16.73^{c}	0.15	***
11	17.77^{a}	17.46^{ab}	16.96^{bc}	16.22^{c}	0.15	**
Mean of periods	20.54^{a}	20.06^{ab}	19.14^{bc}	18.18^{d}	0.11	*

CON40: conventional diet; ORG40: organic diet with low forage; ORG60: organic diet with medium forage and ORG80: organic diet with high forage.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
* (P<0.05); ** (P<0.01) and *** (P<0.001).

Table 6 Estimation of milk urea nitrogen (mg/dL) of cows fed from organic and conventional diets in during lactation

Measurement for 28-d period	Treatment				SEM	P-values
	CON40	ORG40	ORG60	ORG80		
1	11.96^{a}	11.42^{b}	11.03^{b}	10.65^{c}	0.12	*
2	18.07^{a}	17.19^{b}	15.66^{c}	14.16^{d}	0.12	**
3	24.16^{a}	21.74^{b}	19.98^{c}	18.21^{d}	0.12	***
4	28.34^{a}	25.77^{b}	24.55^{c}	23.40^{d}	0.12	***
5	24.06^{a}	21.75^{b}	21.19^{b}	20.67^{c}	0.12	***
6	20.26^{a}	18.48^{b}	17.77^{c}	17.16^{c}	0.12	***
7	16.61^{a}	15.57^{b}	14.84^{c}	14.19^{c}	0.12	**
8	13.80^{a}	12.98^{b}	12.30^{b}	11.65^{c}	0.12	**
9	11.19^{a}	10.42^{a}	9.81^{b}	9.22^{b}	0.12	*
10	9.07^{a}	8.45^{b}	7.89^{c}	7.25^{c}	0.12	**
11	7.16^{a}	6.84^{ab}	6.39^{b}	5.91^{b}	0.12	*
Mean of periods	16.79^{a}	15.51^{b}	14.67^{c}	13.86^{c}	0.06	**

CON40: conventional diet; ORG40: organic diet with low forage; ORG60: organic diet with medium forage and ORG80: organic diet with high forage.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
* (P<0.05); ** (P<0.01) and *** (P<0.001).

Müller and Sauerwein (2010) reported that SCC was not significantly different between organic and conventional feeding. In contrast, Hovi and Roderick (2000) reported that average individual cow SCC was significantly higher in organic herds (135000 cells/mL) than in conventional herds (84000 cells/mL), most likely resulting from higher subclinical mastitis levels in organic herds (individual cow SCC>200000 cells/ml in 34% of all measurements).

Table 7 Estimation of blood urea nitrogen (mmol/L) of cows fed from organic and conventional diets in during lactation

Measurement for 28-d period	Treatment				SEM	P-values
	CON40	ORG40	ORG60	ORG80		
1	3.98[a]	3.80[a]	3.62[b]	3.55[b]	0.02	**
2	4.51[a]	4.29[ab]	4.13[bc]	4.05[c]	0.02	**
3	5.08[a]	4.83[b]	4.66[bc]	4.55[c]	0.02	**
4	5.56[a]	5.28[b]	5.13[b]	5.08[b]	0.02	***
5	5.35[a]	5.05[b]	4.85[bc]	4.80[c]	0.02	***
6	4.82[a]	4.62[a]	4.35[b]	4.29[b]	0.02	**
7	4.26[a]	4.10[a]	3.87[b]	3.73[b]	0.02	**
8	3.73[a]	3.61[a]	3.38[b]	3.25[b]	0.02	*
9	3.19[a]	3.06[a]	2.86[b]	2.71[b]	0.02	**
10	2.75[a]	2.64[a]	2.42[b]	2.26[c]	0.02	*
11	2.38[a]	2.28[a]	2.08[b]	1.97[b]	0.02	*
Mean of periods	4.15[a]	3.96[a]	3.76[b]	3.66[b]	0.01	*

CON40: conventional diet; ORG40: organic diet with low forage; ORG60: organic diet with medium forage and ORG80: organic diet with high forage.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
* (P<0.05); ** (P<0.01) and *** (P<0.001).

Dry matter intake and feed efficiency

Our observation of relatively low DMI in cows fed the ORG80, ORG60 and ORG40 diets (18.8, 19.14 and 20.06 kg/d) compared to those fed the conventional diet (20.54 kg/d) is in line with many reports (Bystrom *et al.* 2002; Prandini *et al.* 2009; Butler *et al.* 2011; Stiglbauer *et al.* 2013). However, organic cows in the current study consumed more forage than conventional cows, while conventional cows consumed more concentrates than organic cows. In contrast to our study, Bystrom *et al.* (2002) found that feed efficiency was not different between animals fed conventional versus organic diets. In contrast, Reksen *et al.* (1999) reported that feed efficiency was greater for cows fed organic diets compared to conventional diets, due to the higher forage consumption of organic cows compared to conventional cows.

Milk urea nitrogen and blood urea nitrogen

MUN and BUN of cows were significantly different between the diets. This finding is in agreement with the works of Busato *et al.* (2000) and Bystrom *et al.* (2002) who found that high forage diets compared to high concentrate diets appear to decrease MUN levels. Our study provides support to other studies that the participating systems adequately reflect the performance level for the two management systems and are not due to biased selection of systems.

CONCLUSION

This study showed that BW of dairy cows was not different for cows fed CON40 or an organic diet. The changes of body condition score of cows during the study indicates that rumen dimensions, body fat or muscle might be different between the diet groups. Further studies are necessary to test this hypothesis. Gradual replacement of concentrate with forage showed the highest DMI, MY and SCC. Feed efficiency was the greatest for CON40 cows compared to organic cows; however, ORG60 and ORG40 cows were similar for feed efficiency. Furthermore, the results indicate that the maximum BUN and MUN in the conventional diet can be effective in reducing milk quality.

ACKNOWLEDGEMENT

We gratefully thank the team at the experimental dairy farm at the Valfajr Agricultural Research Center (Cooperative company Kojour of Mazandaran) for financial support. Moreover, Tehran University and University of Minnesota is grateful for the support of research. We also thank Behin Lorkalantari for their assistance in data collection and the care of animals.

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