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Feeding strategies and management of feed resources in cattle farms in the province of Khenchela, Algeria

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Abstract

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Controlling cow nutrition is a key factor in improving milk production. This is why evaluating the quality of rations given on farms can contribute subsequently to correcting any deficiencies. In this context, our study aimed to investigate the diets, followed by cattle breeders in two municipalities of the Khenchela region, Montbeliard breeds having a weight of 557.23±40.37 for Farm (B) and 588.10 ± 26.04 kg Farm (A), and to appreciate the rations distributed by the breeders comparatively with the real needs of each breed. We performed chemical composition analyzes contained in the dry matter of available feeds at farm level, in addition to the description of feeding practices used in dairy cow management. The results obtained showed that the nutritional value of the raw materials used proved to be of paramount importance for their better valorization. The performances recorded on milk production were 25.40 ± 2.36 L.day^{-1} for Farm (A) and 18.30 ± 2.12L.day^{-1} for Farm (B), knowing that the feeding of dairy cows was essentially based on concentrate, with insufficient quantities of fodder and energy and nitrogen wastes. It has been found that rationing problems still remain as a major constraint for livestock production in semi-arid regions. The success of any breeding requires the control of rationing and breeding conditions to overcome the gap between milk production and needs.

Keywords: Cows; dairy production; food; milk

Introduction

In Algeria, national milk production reached 3.52 billion liters, including more than 2.58 billion liters of cow's milk (which represent 73% of the total production) (MADR, 2018).

Feed represents the largest part of the operational costs of animal production, and it ranged from 25 to 70 % of the total cost of production (Phocas et al., 2014). It has an important role. It can vary the butyric and protein levels independently. Besides, the production as well as the quality of the milk can be varied according to the nature of food (forage or concentrate), its mode of distribution, its physical aspect (coarse or finely chopped), its level of nitrogen and energy contribution, therefore the feeding is a rapid reversible, and often effective lever for influencing the composition of milk (Legarto et al., 2014). An adequate diet for dairy cattle must meet their daily needs, without exceeding them. These requirements include all important nutrients for maintenance, milk production, growth and reproduction.

In this context, we conducted a study about the feeding behavior in the North-West part of the province of Khenchela (Algeria), in order to appreciate if the distributed rations in the cattle breeding herds in this region are balanced rations that meet real needs.

Materials and Methods

Study site and animals

The province of Khenchela is located in the North of Algeria, at the foothills of the Aurès Mountains, between 34°06′36″ and 35°41′21″ North latitudes; and between 06°34′12″ and 07°35′56″ East longitudes. Its area is 9715.6 km^2. It is geographically limited to the north by the province of Oum El Bouaghi, to the south by the province of El Oued, to the east by Tébessa, to the west by Batna and to the south-west by Biskra.

This study was carried out in the North-West of Khenchela. The choice of localities was made with the support of the Agricultural Sector (Agricultural Subdivision), and professional organizations of ruminant breeders, taking into account the presence of a large number of cattle and the accessibility of farms in all seasons. Furthermore, these areas are characterized by the practice of agriculture as the main activity of the inhabitants, and the high concentration of cattle breeders in these localities. Their climate is semi-arid, with alternating rainy season (November to April) and dry season (May to October). The major types of crops grown are cereals (durum wheat, barley and oats) then fodder crops (alfalfa, maize and sorghum). The species bred are mainly cattle, sheep, goats and poultry.

Data collection was done on the basis of a semi-structured questionnaire in individual interviews according to the retrospective survey methods proposed by Lesnoff et al. (2008).

The survey sheet took into account mainly the crops grown by breeders, the identification of local food resources, food management and watering. All of the collected food (concentrate and coarse) has been identified and analyzed physico-chemically in the laboratory.

The cows have an average live weight of 557.23±40.37 kg in the farm B and 588.10±26.04 kg in the farm A. The weight is estimated from the measurement of the thoracic circumference, that is the most correlated to live weight and approved by ICAR (2018), then deduced by Crevat's formula:

$LW = (CC)^3 \times 80$; knowing that:
LW = Live Weight (kg), CC = Chest Circumference (m).

Moreover, control measures in both farms were regular, and calvings were more or less grouped together thanks to artificial insemination (Table 1).

Table 1. Characteristics of farms A and B

Farms	A	B
Total number cows	37	35
Number of dairy cows	30	30
Breeds	Montbéliard	Montbéliard
Average live weight (kg)	588.10 ± 26.04	557.23 ± 40.37
Average milk production (L.day^{-1})	25.40 ± 2.36	18.30 ± 2.12
Mode of distribution of food	Manual	Manual

Source: Authors' own elaboration

Feeding conduct

Feed is a determining factor in the productivity of dairy cows, both in quantity and quality. Fodder production, its rational use, as well as supplementation with concentrated feed, represent the key to the success of rationing. We noticed that the most common foods on both farms were the oat hay, wheat straw, and concentrate, while the corn silage and the green barley were used in the farm A only. The fodder calendars were marked by the diversity of cultivated species (maize, alfalfa, sorghum). Besides, oat hay and straw were used during all seasons. Green fodder is practically available with a longer grazing period for the farm A. On the other hand, we noted the total absence of rationing practice in accordance with the needs of the animals. Thus, all lactating cows receive the same ration, regardless of their physiological stages and their production (Table 2).

Corn silage preserved by wrapping (Forage Wrapper Machine) has several advantages, including better nutrient retention, reduced yield losses and ease of management when feeding livestock.

The water requirements for a dairy cow that produces 20 kg of milk is 70 to 100 L.day^{-1} (Boudon et al., 2013).

Chemical analysis

Representative samples of each diet were taken for chemical analysis according to the Official methods of the Association of Analytical Chemists (AOAC, 1990). These analyzes were done in triplicate. The results were expressed in percentage of the dry matter. These chemical analyzes focused on dry matter (DM), organic matter (OM), total nitrogenous matter (TNM), crude cellulose (CC), and fatty matter (Fat).

Calculations of energy (Milk Forage Units 'FU' and Meat FU), and nitrogen values (intestine digestible protein IDP) were done based on the equations given by Sauvant et al. (2004) and Noziere et al. (2018).

Table 2. Forage calendar for the studied farms

Farms	Food types	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
A	Oat hay												
	wheat straw												
	Concentrate												
	Pasture (Barley in green)												
	Corn silage												
B	Oat hay												
	wheat straw												
	Concentrate												
	Alfalfa hay												
	Sorghum in green												

Source: Authors' own elaboration

Data analysis

The results of chemical composition of foods were compared by the ANOVA test, at the significance level 5 %, using Statistica software (10th version). Furthermore, a post hoc test was performed by applying the Fisher L.S.D test.

Results

Chemical analysis

Chemical analysis of feed given to cows showed that alfalfa hay has a higher TNM content than corn silage and oat hay (Table 3). The content of total nitrogenous matter in alfalfa hay (16.42 % of the DM) is close to that, reported by Jarrige (1988), with a value of 17 % of DM.

The use of corn silage to cover the winter period has improved following the government policy for the subsidy of this kind of fodder (Table 4).

Regarding the chemical composition of the feed distributed, the results do not differ from those published Alane et al. (2016), and therefore the Milk FU and IDP values are

Table 3. Chemical composition of distributed feed

Food	DM %	OM	TNM	Fat	CC
		(% of the DM)			
Concentrated feeds	$85.65^{a}\pm0.13$	$89.00^{c}\pm1.00$	$17.43^{a}\pm0.40$	$03.73^{a}\pm0.15$	$09.96^{c}\pm0.21$
Alfalfa hay	$80.37^{c}\pm0.55$	$91.98^{ab}\pm0.10$	$16.42^{b}\pm0.13$	$02.03^{c}\pm0.06$	$17.17^{a}\pm0.15$
Oat hay	$83.53^{b}\pm0.35$	$87.53^{d}\pm0.21$	$12.25^{c}\pm0.15$	$03.03^{bd}\pm0.21$	$17.03^{a}\pm0.15$
Barley in green	$28.28^{e}\pm0.45$	$92.60^{a}\pm0.03$	$04.40^{e}\pm0.26$	$03.30^{b}\pm0.17$	$10.59^{b}\pm0.51$
Corn silage	$37.27^{d}\pm0.28$	$91.41^{b}\pm0.08$	$06.63^{d}\pm0.16$	$02.93^{d}\pm0.15$	$10.53^{b}\pm0.35$
P	0.000 ***	0.000***	0.000 ***	0.000 ***	0.000 ***

^{abcde}: Means in the same row without common letter are different at $p < 0.05$
***: Very highly significant
DM – Dry matter; OM – Organic matter; Fat – t; TNM – Total nitrogen matter; CC – Crude cellulose
Source: Authors' own elaboration

Table 4. The nutritional value of the constituents of the food rations distributed

Food type	Milk FU	Meat FU	IDP
Concentrated feeds	$1.12^{b}\pm0.02$	$1.13^{b}\pm0.02$	$169.92^{a}\pm3.73$
Alfalfa hay	$0.93^{d}\pm0.02$	$0.88^{d}\pm0.03$	$157.20^{b}\pm0.92$
Oat hay	$0.85^{e}\pm0.01$	$0.80^{e}\pm0.01$	$121.37^{c}\pm1.06$
Barley in green	$1.15^{a}\pm0.02$	$1.16^{a}\pm0.02$	$84.26^{e}\pm1.50$
Corn silage	$1.09^{c}\pm0.01$	$1.09^{c}\pm0.02$	$89.01^{d}\pm1.06$
P	0.000 ***	0.000 ***	0.000 ***

^{abcde}: Means in the same row without common letter are different at $p < 0.05$
***: Very highly significant
Milk FU – Milk Forage Units; Meat FU – Meat Forage Units; IDP – Intestine digestible protein
Source: Authors' own elaboration

Table 5. Rationing of lactating cows (Farm A)

Farm A	Composition of food ./kg- of DM			Ingested quantities kg/.cow-1. day-1	Nutrient intake /cow/day		
	DM (kg)	Milk FU	IDP (g)		DM (kg)	Milk FU	IDP (g)
Concentrate food	0.85	1.12	169.92	06	5.10	5.71	866.59
Corn silage	0.37	1.09	89.01	10	3.70	4.03	329.34
Barley in green	0.28	1.15	84.26	20	5.60	6.44	471.86
Total Nutrient Intakes				36	14.40	16.18	1,667.79
Detection of daily maintenance needs						4.93	394.05
Availability for production						11.25	1,273.75
Needs for 1kg of milk with 4 % fat						0.44	50
Milk production allowed by the ration						25.56	25.47

Source: Authors' own elaboration

Table 6. Rationing lactating cows (Farm B)

Farm B	Composition of food .kg-1 of DM			Ingested quantities kg.cow-1. day-1	Nutrient intake.cow-1day-1		
	DM (kg)	Milk FU	IDP (g)		DM (kg)	Milk FU	IDP (g)
Concentrate food	0.85	1.12	169.92	06	5.10	5.71	866.59
Alfalfa hay	0.80	0.93	157.20	06	4.80	4.46	754.56
Oat hay	0.83	0.85	121.37	08	6.64	5.64	805.90
Total Nutrient Intakes				20	16.54	15.81	2,427.05
Detection of daily maintenance needs						4.74	378.62
Availability for production						11.07	2,048.43
Needs for 1 kg of milk with 4 % fat						0.44	50
Milk production allowed by the ration						25.16	40.97

Source: Authors' own elaboration

almost identical to those of other protein forages (Boillon and Roux, 1996) (Table 5).

Imported dairy cows, whose diet must be adapted to dairy performance, receive a ration distributed regardless of their physiological stage or their level of production throughout the year (Bouzida et al., 2010; Kaouche et al., 2012) (Table 6).

Summary of the distributed rations at the studied farms

From the compositions of the distributed rations by the breeders, we deduce that the ration distributed in farm B is not balanced (Table 7) and (Table 8).

Table 7. The real needs of the cows in the two farms

		Milk FU	IDP
Farm A	Maintenance needs	4.93	394.05
	Production needs	11.18	1.270
	Total	16.11	1.664.05
Farm B	Maintenance needs	4.74	378.62
	Production needs	8.05	915
	Total	12.79	1.293.62

FU; Meat Forage Units. IDP; intestine digestible protein.
Source: Authors' own elaboration

Discussion

Calculation of the rations of the two farms

The different rations distributed to lactating cows, as well as the quantities ingested cow-1·day-1 in kg crude, and their equivalent in DM is presented in tables 5 and 6. The distribution of food is done collectively according to their level of

Table 8. Comparison between real needs and distributed quantities by breeders in the studied farms

	Farm A		Farm B	
	Milk FU	IDP	Milk FU	IDP
Distributed quantities	16.18	1.667.79	15.81	2.427.05
Real needs	16.11	1.664.05	12.79	1.293.62
Difference	+0.07	+3.74	+3.02	+1.133.43

FU; Meat Forage Units. IDP; intestine digestible protein.
Source: Authors' own elaboration

production, the basic rations consist mainly of a mixture of roughage distributed in dry (hay) and green (barley). The type of fodder used depends on the season. The concentrated feed is composed of bran, wheat flour, corn, soybean meal, etc. During our investigation, the distribution of concentrate was practiced during the lactation period, and estimated at 6 kg. $cow^{-1}day^{-1}$, (5.10kg) of DM for the cows of the two farms.

Concerning the ration of farm A, the proportion of coarse/concentrate recorded is 83 % of DM for coarse against 17 % of DM for concentrate. Whereas for the ration of farm B, the proportion of coarse/concentrate recorded is 70 % of DM for coarse against 30 % of DM for concentrate. This proportion is not conform to the standard. According to Sauvant and Milgen (1995), the recommended norms is a proportion of 75 % for coarse in the ration and a proportion of 10 to 25 % for concentrate. The distributed diet in the farm B could generate an energy overfeeding, causing the appearance of fat which influences milk production. Moreover, it causes a drop in production and a decrease in milk quality due to the decrease in fat content. In addition, it constitutes a source of metabolic diseases such as acidosis, because the ration is rich in concentrate. According to Bousbia et al. (2013), the quantitative and qualitative inadequacy of fodder leads to excessive use of concentrates to more than 60 %, which suggests that milk is essentially produced from concentrate. Nevertheless, a large part of the concentrate is not used for dairy production, which leads to wasted energy.

The milk production allowed by the distributed rations

The obtained results revealed that the average of the theoretical production allowed by Milk UF and IDP is, respectively, 25.56 and 25.47 kg for farm A, which is similar to the real milk production recorded in the farm (25.40 ± 2.36 kg). In contrast, the actual quantity of milk produced in the farm B is low (18.30 ± 2.12 kg) compared to that allowed by Milk UF and IDP, estimated at 25.16 and 40.97 kg, respectively (Table 6), for the distributed ration. This is probably due to a deviation of the metabolism causing lipogenesis instead of milk secretion.

According to the recorded results, the food waste at the level of the two studied farms is of the order of 0.07 and 3.02 Milk FU, which means a quantity of wasted milk of the order of 0.16 and 6.86 kg, respectively; in addition to wastage of 3.74 and 1133.43 IDP, which represents a quantity of wasted milk of 0.07 to 22.67 kg in the farms A and B, respectively (Table 8). Therefore, the distributed ration for the cows of farm A is almost balanced in comparison to the real needs.

The ration distributed by the breeders of farm B presents a huge waste of IDP and energy presented by the Milk FU compared to the needs, which influences the food cost of production. There is a bad rationing for the cows of this farm as the same ration is distributed throughout the lactic phase, with the dominance of concentrated food, which leads to a drop in the level of production and causes anomalies of digestive origin.

Conclusion

Our study was carried out in the region of Khenchela (Algeria). We conducted surveys at the level of two farms, to evaluate the feeding situation of dairy cattle and the quantities of milk produced, in order to know whether breeders master and distribute balanced cattle rations. Our findings showed that the breeders of farm A control their rationing, while the breeders of farm B do not control the rationing since they distributed the same ration for all dairy cows whatever their weight, their physiological states, their lactation stages or their milk production (genetic potential) and they distributed rations dominated by concentrate.

The balanced ration proposal must be based on the gradual increase in the proportions of coarse foods in parallel with the reduction in the proportions of concentrated foods until the recommended standard is reached, with a special focus on the use of feed available at the farm level, and respecting the real needs of cattle to minimize waste.

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