



Assessment of the Cheese-making Ability of Individual Cow's Milks from the Experimental Farm of the University of Mostaganem, Algeria

H. Tahlaiti, A.A. Dahou, S.N. Rechidi, A. Homrani

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ABSTRACT

Background: The cheese-making ability of milks varies due to its chemical composition and several factors related to good farming practices.

Methods: Among these factors, the lactation stage was studied on a batch of 15 Prim'Holstein dairy cows under real production conditions at the experimental farm of the University of Mostaganem. The fresh milks produced were tested with simple criteria of chemical composition in protein rate, butyrous rate, mineral intake, on coagulation ability and cheese yield with a repeatability spread over 3 months.

Result: The results indicated that the lactation stage has a significant effect, on the composition of milk, especially in terms of protein and mineral richness and on its ability to coagulate. In addition, the urea dosage showed a deficiency in the food ration of digestible nitrogen to the herd directly influenced the protein mass of milk and consequently on the technological processing times and cheese yields.

Key words: Cheese-making ability, Chemical composition, Lactation stage, Prim holstein.

INTRODUCTION

The dairy industry has implemented a milk quality policy at the production level that has allowed them to gain a better control over their processing skills (Vignola and Amiot, 2002).

Breeders and dairy producers, seek by good breeding practices, to ensure a quality of the raw material "milk" that meets the expectations of the dairy processing industry (Perreau, 2014 and Raja Sekhar *et al.*, 2017).

However, the difficulty lies in the notion of quality. Indeed, it remains very subjective and it has different definitions at each level of the chain; for the producer, the quality is a lack of impurities and a presence of the high level of useful materials; industry demands a raw material with high processing efficiency, while the consumer wants a product without pathogenic risk and satisfactory organoleptic qualities (Pougheon, 2001 and Cremo, 2003).

The objective of our study is to test through the repeatability over time of the milk cheese-making ability indicator (ability to coagulate-cheese yield) used on individual samples of a herd of the same breed from the experimental farm of the University of Mostaganem and to try to explain through the composition of the milks used; failures that negatively affected their cheese ability (repeatability spread over 3 months).

MATERIALS AND METHODS

Livestock and experimental period

The milk samples were taken before the morning and evening milking on fifteen Prim Holstein dairy cows from the experimental farm of Hassi-Mamèche affiliated with the

Experimental farm of Hassi-Mamèche, Laboratory of Sciences and Technics of Animal Production, Faculty of Nature and Life Sciences, Abdelhamid Ibn Badis University, Mostaganem, Algeria.

Corresponding Author: A.A. Dahou, Experimental farm of Hassi-Mamèche, Laboratory of Sciences and Technics of Animal Production, Faculty of Nature and Life Sciences, Abdelhamid Ibn Badis University, Mostaganem, Algeria.
Email: abdelkader.dahou@univ-mosta.dz

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Established Analyses

Chemical analysis

Through a Milko Scan FT2 (Series No. 8100) for the determination of the chemical composition of milks in protein level P.L, Fat content F.C, pH, mineral content Ca and P and dosage of urea.

Characterization of Cheese Ability

Determining clotting times

Cheese-making ability is determined by the measurement of flocculation time and taking time using the Alais method

(1982) and updated by Lij and Daligleish, 2006. The flocculation time, from a sample of milk carried in a bath at 30°C, is the time interval between the time of stacking and the appearance of the first casein flakes visible to the naked eye (Hurtaud *et al.*, 2001). Taking time is the time when the first droplets of whey (early whey exudation) appear on the surface of the gel, also called coagulum, which becomes rigid and no longer flows on the walls of the experimental tube (Hurtaud *et al.*, 2001). For any clotting, the intake time is usually about double the flocculation time: for a normalized flocculation time between 5 and 8 minutes, the intake time is between 10 and 16 minutes (FAO/WHO, 1999).

Calculating cheese yield

The cheese yield is usually expressed in kg of cheese obtained from 100 liters of milk. In order to be able to track the evolution of cheese yield, one must always weigh the curds obtained at the same stage of lactation and compare them to the I.D.F standard, for milks from the same species and the same technology. The values obtained are measured on average by 03 weighing repetitions on the same curd obtained (Eck and Gillis, 2006).

Statistical analysis

The study of the similarity of the averages of the fruitiness results of the milk samples tested was made possible by the use of a statistical test of SYSTAT SOFTWARE MYSTAT 12. The threshold of statistical significance is estimated at $P < 0.05$.

RESULTS AND DISCUSSION

Chemical test results

Evaluation of the chemical quality of the milk of the 15 dairy cows of the experimental farm are illustrated in the following tables: The processing ability of milk is assessed from milk quality for appropriate technological assignment (Cauty and Perreau, 2009; Jakob *et al.*, 2011). The technological interest in milk processing lies in its richness in basic nutrients, proteins and lipids, but also in mineral matter (Kumar *et al.*, 2016). It is clear that the analysis of milks prior to processing and chemical characterization can help to better guide technologists on the possibilities of their industrial

exploitation and their effective recovery. The chemical quality of the milks has been assessed and the results are grouped in (Table 1).

Mineral content

Based on the results, calcium and phosphorus levels on our milks are below the I.D.F standard of 120 to 140 mg/100 ml for calcium and 85 to 90 mg/100 ml for phosphorus. The mineral fraction of milk plays an important role in dairy technology and more precisely in cheese maker, in the coagulation-syneresis phase and in improving the texture of the cheese curd. Indeed, any change in the mineral distribution affects the technological properties of milks and the rheological properties of coagulum (Bousbia *et al.*, 2018; Eck and Gillis, 2006).

pH

Through our results the pH values of our milk samples are standardized in our dairy cows between 6.65 and 6.7 tolerable by the I.D.F norm standard is between 6.6 and 6.8. Any drop in pH below the standard promotes the solubilization of minerals, the destabilization of casein micelles leading to excessive losses in whey during the processing directly influence on the quality of our cheeses (Eck and Gillis, 2006).

Fat content

Based on the results of the fat content rate obtained we note that our milk samples have rates around 3.02 to 3.3% in accordance with the I.D.F standard which varies between 3 and 3.6%. Fluctuations in fat content is influenced by breeding conditions such as lactation stage, diet (much more concentrated-based feeding strategy), milking practices (Perreau, 2014). The texture of the cheeses, extra hard, half-soft, soft, depends on the fat content of the milk (Hurtaud *et al.*, 2001 and Pougheon, 2001).

Protein rate

Based on the results, we observe that milk samples from our dairy cows have unacceptable levels of protein in the range of 2.84 to 3.05% giving processed milk with an unrepeatable protein level for cheese processing and according to the I.D.F's recommendations for dairy

Table 1: Evaluation of the chemical quality of milk from lactating dairy cows.

Variables	Medium in high lactation	Medium in average lactation	Medium in low lactation	Standard I.D.F
Mineral matter				
Calcium mg/100 ml	92±0.25	85±0.75	82±0.5	120 to 140
Phosphorus mg/100 ml	73±0.35	71±0.2	67±0.15	85 to 90
Physical-chemical characters				
pH	6.7±0.02	6.68±0.03	6.65±0.02	6.6 to 6.8
Protein level %	3.05±0.01	2.94±0.05	2.84±0.02	3.1 to 3.4
Fat content %	3.3±0.15	3.18±0.08	3.02±0.12	3 to 3.6
Urea mg/l	175±1.2	170±1.8	167±1.5	200
Quantity produced				
Liters/cow/day	26±0.25	19.25±0.15	16.25±0.15	25 to 30

processing it is necessary to produce milks reaching the range of 3.1 to 3.4% of P.L. Caseins are transformable proteins (80% of milk proteins). The formation of the cheese gel is done from the settlement of caseins (Cremona, 2003 and Jakob *et al.*, 2011).

Urea

The dosage of urea in milk allows for control of the protein diet of dairy cattle (Perreau, 2014). The interpretation of the results provides guidance on the balance of the ration. The average urea content for cow's milk on our controlled herd is below 200 mg/l: between 163 and 175 mg/l.

On our cow's milk samples, the rate of 200 mg/l shows that the food ration is unbalanced in our Prim Holstein dairy cows requiring the revision of the nitrogen level in the daily food ration by digestible protein intake.

Testing the cheese suitability of our milk samples

The principle of cheese processing is the coagulation by a change in the state of the milk from half-solid liquid to coagulum (Eck and Gillis, 2006). The product then separates into two phases: whey and coagulum. Milk has caseins responsible for clotting because they are responsible for the stability of the crumbling.

In this sense, the technological clotting times give an average flocculation time of 8.5 minutes against a taking time of 17 minutes for milk samples from high-lactating dairy

cows. While those of the average lactation gave an average flocculation time of 9.5 minutes against a taking time of 19 minutes and finally the low lactation milks; an average flocculation time of 13.5 minutes and a taking time 27 minutes. The applicable I.D.F standard must be between 5 and 8 minutes for the flocculation time and 10 to 16 minutes for the take time. These results obtained (Table 2) are non-compliant with successful coagulating activity and kinetics suitable for any cheese processing (Fig 1).

Determining cheese yield

Cheese yield is generally expressed in kg of cheese obtained from 100 liters of milk or in g per 100 ml of milk (Eck and Gillis, 2006). Our cow's milk samples have a % cheese yield with an average of 10.8 to 12.8%, above tolerable standards of 8.5 to 9% (see Table 2). This non-compliance reflects the weakness of our cow's milks in direct protein on our cheese yields obtained (Fig 2). Specifically, it is the casein content (coagulable proteins) that promotes yield.

At the cheese maker level, improving cheese yield simply starts with monitoring and improving protein level. The statistical analysis of the results, carried out by the statistical software SYSTAT SOFTWARE MYSTAT 12, gave meaning values of less than 5% with an almost similar cheese ability for milks from a herd of the same breed and 03 phases of lactation. The kinetics of clotting represented by the technological times of flocculation and taking is also

Table 2: Cheese-making ability and cheese yield of milk from lactating dairy cows.

Criteria for cheese-making milk	Medium in high lactation	Medium in average lactation	Medium in low lactation	Standard I.D.F
Time to flocculation in minutes (*)	8.5±0.02	9.5±0.03	13.5±0.01	5 to 8
Time to take in minutes (*)	17±0.03	19±0.04	27±0.12	10 to 16
Cheese yield %	10.8±0.01	11.5±0.01	12.8±0.01	8.5 to 9

(*) No significant difference ($P < 0.05$).

I.D.F: International Dairy Federation.

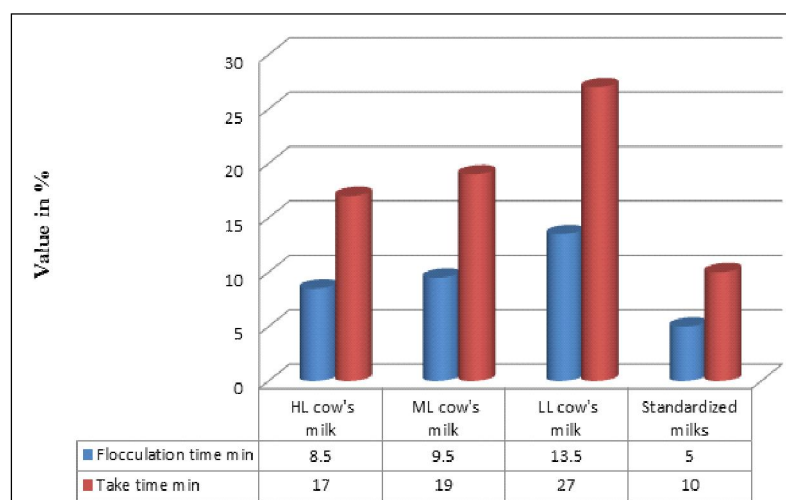


Fig 1: Technological time in the cheese-making ability of our milks.

HL : High lactation, ML : Medium lactation, LL : Low lactation.

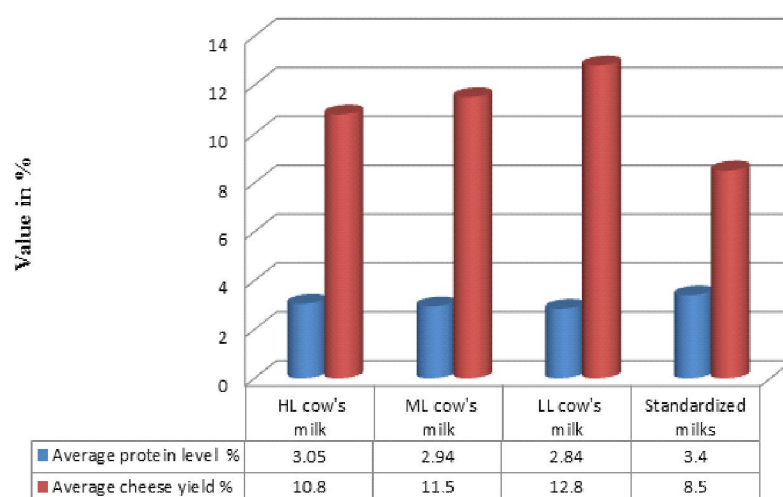


Fig 2: Impact of protein level on cheese yield.

HL : High lactation, ML : Medium lactation, LL : Low lactation.

almost identical for our experimental milk samples with non-compliance with the I.D.F standard.

The lactation stage had an effect on the amount of milk produced; correlated with the chemical quality of milk. In general, the results were unsatisfactory for the majority of the parameters evaluated, especially for mineral matter, P.L protein level and urea dose in our various samples. There is also a gradual decrease in the protein rate from the first stage to the third stage of lactation in proportion to the amount of milk produced.

The correlation approach allowed us to conclude that the lactation stage seems to have a significant effect on chemical and technological variables especially mineral matter, P.L and technological times and on the other hand the breeding conduct and more specifically the feeding of the herd, controlled by the dose of urea in the milks produced, had such a significant effect on our controlled variables.

On the cheese-making ability aspect, the low protein content of the milks produced by our experimental herd directly affected technological times, minimized the retention capacity of whey and yielded low hydration rates of the lactic curds obtained. This retention capacity is essential to the proper control of cheese yields and the obtaining of expected dairy products.

CONCLUSION

This study allowed us to confirm with a controlled herd most of the factors of variation in the cheese ability of our milk samples highlighted under experimental conditions. Thus, at the scale of the operation, the factors of variation are now well known and the levers of action available to the experimental farm to improve this criterion and achieve the expected cheese yield are well identified. They are mainly food-related (improving the energy level of rations and mastering good farming practices).

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