La granja:
Revista de
Ciencias de la Vida
pISSN:1390-3799; eISSN:1390-8596
http://doi.org/10.17163/lgr.n27.2018.10

Scientific paper / Artículo Científico

Sustainable rural development

Milk quality management of small and medium cattle ranchers of collection centers and artisan cheese factories, for continuous improvement. Case study: Carchi, Ecuador.

Gestión de calidad de leche de pequeños y medianos ganaderos de centros de acopio y queserías artesanales, para la mejora continua. Caso de estudio: Carchi, Ecuador.

Eloy Guillermo De la Cruz[1], Paola Simbaña Diaz[2], Nancy Bonifaz[3]

[1]* *Graduated from the Masters in Economics and Agricultural Administration, ESPOCH, Riobamba Ecuador.*
[2] *Milk Quality Laboratory of the Salesiana Polytechnic University, Cayambe Support Center: Av. Natalia Jarrín and 9 de Octubre Telf. (593-2) 3962885, Ecuador.*
[3] *NUNKUI WAKAN research group, Salesiana Polytechnic University, Campus El Girón: Isabel la Católica N. 23-52 and Madrid.*

*Author for correspondence: ede@ups.edu.ec; psimbana@ups.edu.ec

Article sent on August 13, 2018. Accepted, after review on November 23, 2018. Published on March 1, 2018.

Abstract

To stablish the efficiency of the forest in the subject of ecological services and ecosystems functions, involve to discover the conditions to set its performance, which ones that keep the relationship with the functional characteristics of the vegetable species, in order to contribute with knowledge about this requirements, it takes the present investigation, considering the behavior of the species in the performance of the environment, or habitat, important value, interactions, intra- and interspecific, in order to reach and determinate the quantity of the stored carbon in the arboreal stratum of the natural forest Tinajillas, located in the south east Andes range in the canton Limon Indanza, Morona Santiago province, in order to reach it, we apply the suggested method for the support manual of the National evaluation of Ecuador, and the professional forest judgment of the Intergovernmental Panel on Climate Change, with this results of the investigation , we stablish that in the 118 ha forest, the volume of the timber is 1 3570 m^3, it means 115 m^3/ha represented in the majority of the Family species Melastomataceae, in this one is the Miconia sp. The quantity of the stored carbon is 4 835 tones, and the result is 41 tones per hectare. The Family, Melastomataceae has more quantity of carbon (13 tones per hectare), then the specie with more quantity of stored carbon is Miconia sp, with a value of 8 t/ha the result of the indices of the important value in favor of this species and judging for the edge of the natural classes, it understands that the forest is in a period of the vegetable sucetion, situation that contribute to generate an important dynamic in the way to capture Carbon.
Keywords: bovine milk, somatic cells, microorganisms, lacto fermentation, cryoscopy.

Resumen

Establecer la eficiencia de los bosques en materia de servicios ecológicos y funciones ecosistémicas, implica descubrir las condiciones que regulan su desempeño, mismas que guardan relación con las características funcionales de las especies vegetales. A fin de aportar con conocimiento sobre estos requerimientos, se condujo la presente investigación, considerando el comportamiento de las especies en función del hábitat, valor de importancia, interacciones intra- e interespecíficas, para con ello, arribar a la determinación de las cantidades de carbono almacenado en el estrato arbóreo del bosque natural Tinajillas, ubicado al sur de la Cordillera Oriental de los Andes, cantón Limón Indanza, provincia de Morona Santiago. Para el efecto, se aplicó el método recomendado por el Manual de Campo de la Evaluación Nacional Forestal del Ecuador, y los criterios del Panel Intergubernamental para el Cambio climático. Como resultado de la investigación, se estableció que en las 118 ha de bosque, el volumen de madera es de 13 521 m^3, es decir 115 m^3/ha, representado en su mayoría por especies de la familia Melastomataceae, entre las que consta Miconia sp. La cantidad de carbono almacenado, es de 4 835 t, resultando 41 t/ha. La familia Melastomataceae contiene mayor cantidad de carbono (13 t/ha), mientras que la especie con mayor cantidad de carbono almacenado es Miconia sp con un valor de 8 t/ha. Al resultar los índices de valor de importancia en favor de estas especies y juzgando por las Clases Naturales de Edad, se desprende que el bosque se encuentra en un período de sucesión vegetal, situación que contribuye a generar una importante dinámica en materia de captura de carbono.
Palabras claves: leche bovina, células somáticas, microorganismos, lacto fermentación, crioscopia.

Suggested citation: De la Cruz, E. G., Simbaña Diaz, P. and Bonifaz, N. 2018. Milk quality management of small and medium cattle ranchers of collection centers and artisan cheese factories, for continuous improvement. Case study: Carchi, Ecuador.. La Granja: Journal of Life Sciences. Vol. 27(1):122-133. http://doi.org/10.17163/lgr.n27.2018.10.

1 Introduction

The raw milk of artisanal and industrial microenterprises used for the elaboration of dairy products, is a very varied mixture of chemical structures and microorganisms, which makes it difficult to have a product of constant characteristics, due to the cultural and technological variability used in the production of bovine milk by the peasants and mestizos settled in the Inter-Andean alley of Ecuador (Villegas de Gante y Santos Moreno, 2011).

The safety of food is the most important part of public health, this means producing or maintaining the sanitary, hygienic and nutritional quality of the products, free of pathogenic microorganisms that may cause harm to the consumer. The bacteria that cause pollution can be in; the inside of the nipple, manure, materials and equipment for milking, air, personnel, the animal, water, if this is not treated properly (Buxadé Carbó, 2002). Contamination with common microorganisms does not cause diseases to consumers, but they can alter the components of the milk and bring about the deterioration of the characteristics of the products, subtracting quality and commercial value (Villegas de Gante y Santos Moreno, 2011).

To standardize the production of the raw material with quality becomes an important need at the moment to achieve quality dairy products and to be able to commercialize at national level with security and to be able to advance towards the international markets that, by the way, have a high technological level of demand.

Milk quality, understood as "that product that consistently meets the nutritional, health and organoleptic expectations of the consumer whose composition justifies what is being paid for it", i.e. the consumer pays for compliance with the characteristics of the production chai , as is the compliance with the specifications required by the processing plant (first "consumer"), who in turn, must comply with the requirements demanded by supermarkets (second "consumer"), all this to meet the needs of the final consumer. Thus, from the field to the table, the quality of the milk concerns dairymen, veterinarians, processing plants, supermarkets, authorities and of course, the final consumer (CANILEC, 2011).

In a diagnostic study conducted previously, through an inter-institutional agreement between the Universidad Politécnica Salesiana (UPS), Universidad Politécnica estatal del Carchi (UPEC), Fundación Alpina y el Gobierno Autónomo Descentralizado Provincial del Carchi (GADPC), was evidenced the deficient practices of livestock reverberating in the quality of the raw material in the small and medium producers of the province of Carchi (Chuquín Yépez et al., 2016). The constant monitoring of the quality of the raw material is paramount (FAO, 2017) where the producer and the control laboratory must be the main protagonists of the development of the dairy chain in the country. The collection centers and artisan cheese factories are not exempt from the monitoring of the quality of their product, contrary to the cultural diversity in the production, this activity is necessary to try to improve and maintain a quality standard

Due to the above, it is difficult to maintain standardization in the production of dairy products, consequently bringing with it a series of problems in industrialization. Before i happens, it should be proposed to standardize the primary production of small and medium producers to achieve reiterative products in the quality of the raw material in compliance with Ecuadorian standards, and most importantly maintaining the health of consumers that, for the case of Ecuador, its objective is focused in the school stage.

The objective of this research was to evaluate good livestock practices in order to improve the quality of raw milk as a raw material, after a technical intervention, to establish a culture of monitoring, and maintaining a quality standard and thus ensure safety of the final product. A quality raw material must gather all the components and attributes, physical chemistry (composition), hygienic (microorganism), sanitary (diseases of the cows and mammary gland infections) added these qualities you can obtain an "integral quality" as mentioned Villegas de Gante y Santos Moreno (2011), and in this way, the small and medium industry obtain raw material for dairy products of technological quality (Bacilio, 2016).

2 Materials and Metods

2.1 Location of the study area

The province of Carchi is located north of the inter-Andean alley between the parallels 1°12'43" and 0°21'50" of Latitude North and between the meridians 77°31'36"and 78° 33'12" Western Longitude. The relief of the land is irregular and mountainous.

It borders on the north with the Carchi and San Juan rivers on the border with Colombia, on the south with the province of Imbabura, on the east with the province of Sucumbíos, and on the west with that of Esmeraldas. Its climatic floors are from 1,200 meters above sea level, to 4,768 meters above sea level, and with temperatures ranging from 0 to 27 °C in border areas with emeralds. It is divided into six cantons including the capital; Bolívar, Espejo, Mira, Montufar, San Pedro de Huaca, Tulcán (GADPC, 2016).

2.2 Study population

The present study was developed in the first phase with a total of 709 small and medium milk producers, grouped in 16 collection centers, 4 artisan cheese makers, 3 private collection centers and the Agricultural Center of Tulcán, corresponding to 5 cantons of the province del Carchi, territorially distributed as follows: Cantón Tulcán 5 associations, 1 Agricultural Center; Huaca canton 3 associations; Montufar canton 4 associations, 3 collection centers, 2 artisan cheese makers; cantón Espejo 2 associations, 1 artisan cheese-making; cantón Look at 1 association, 1 artisan cheese maker.

In the development of the study, in the second phase, 2 private collection centers and one association were withdrawn due to socio-organizational problems, ending with 15 associated collection centers, 1 private collection center, 4 artisanal cheesemaking workshops, adding the Agricultural Center of Tulcán as a replacement.

Therefore, the analysis was made based on the centers that completed the study with the second taking of 630 samples.

2.3 Sampling

In order to carry out this research, we counted on Veterinary Zootechnicians of the Alpina Foundation and the technical support of the GADPC conformed by; the Directorate of the Department of Economic Development, two Veterinary Zootechnicians, a Zootechnist Engineer, and a Promoter, for mobilization: the two institutions contributed with three mobile veterinary clinics, the GADPC and a van of the Alpina foundation. The analyzes were carried out in the UPS Quality Laboratory, located in the Cayambe support center.

Two samples were taken; the first as an initial diagnosis and the second for the evaluation of the technical assistance provided by the mobile veterinary clinics of the GADPC to the producers with hygienic and sanitary problems. Samples were taken by the technical staff of the GADPC, and technicians granted by the Alpina Foundation, previously trained by the Milk Quality Laboratory (LCL) of the Salesian Polytechnic University (UPS), following the protocol based on the NTE INEN-ISO 707 (2014), the samples were taken in the morning milking, for microbiology a 40ml bottle was aseptically taken and 4 drops of preservative azidiol (sodium azide) was added, and it was stored in a refrigerator with ice for Keep the cold chain to the laboratory. For the physical-chemical analysis, a 40ml bottle was taken and a bronopol preservative tablet was added and stored in a cooler with ice until transport to the LCL. The samples for cryoscopy, Ph, lactofermentation were taken in aseptic flasks of 100ml the amount of 80ml of sample without preservative and ensuring the cold chain of 4-6 °C; in the case of the CMT test, no samples were taken directly at the reception using a syringe, taking the ratio of two ml of sample and 2 ml of the CMT reagent (commercial), and at the foot of the animal using a pallet for CMT following the technique.

A sample was taken per producer, in the case of producers with more than two barrels it was taken in a jug proportionally from each barrel to then take a sub sample. The samples without preservative were analyzed in the space of one hour, in the case of samples with preservatives they were stored in refrigeration at 4 to 6 °C and were entered before 48 hours of taken to the LCL for analysis, they were analyzed in the course of 12 hours of arrivals.

2.4 First phase

In this phase, a global diagnosis of hygienic, sanitary and physical (compositional) chemical quality was made in the UPS. The protein stability test, potential oxide reduction; and the CMT utility at the reception in the centers. The producers were classified according to laboratory results, those above 500,000/ml somatic cells indicating sanitary problems (mastitis); bacterial counts (CBT) greater than 600,000/ml, indicating hygienic problems (MAGAP, 2013).

Once the diagnosis was made in the first sampling, the technical assistance with the professionals granted by the GADPC was carried out, and then a second sample was taken and their progress was

analyzed.

2.5 Second phase

In this phase, the intervention of mobile clinics was given to producers with hygienic, sanitary and physical-chemical problems. In the case of sanitary problems greater than 500,000 cs/ml, an individual diagnosis was made by CMT to a total of 1094 milk cattle belonging to the small and medium producers of the collection centers and the cheese makers.

This test was also carried out on the fresh milk that is received in the cooling tanks in order to monitor its progress in sanitary quality. In the case of hygienic problems, training was carried out on "Hygienic and sanitary quality of milk"; Management of Antibiotics and adulterants for the case of cryoscopy, granted by teachers of the UPS. In this phase, protein stability tests were also carried out (Alcohol test), at the time of collection, potential oxide reduction, cryoscopy and lacto fermentation after reception. Cryoscopy was considered positive (+) to results less than -530 mH° and negative (-) to results greater than or equal to -530 mH-530 mH° (NTE INEN 9, 2015).

2.6 Beginning of the tests

Total Counting of Bacteria (CBT acronym in English), its principle is flow cytometry, standardized under the ISO16297-IDF 161: 2013 standards. The Somatic Cell Count (CCS), its principle image cytometry standardized under ISO 13366-2 standards; IDF 148-2: 2016. Chemical physicist (compositional), its principle is infrared medium spectrophotometry under standard ISO 9622-IDF 141: 2013.

The basic laboratory tests performed in the reception of raw milk; CMT (*California Mastitis Test*) used to control the health status of the udder (*mastitis*), the alcohol test to control the thermos-stability of protein is manifested by mixing milk with an equal volume of ethanol at 71% by weight and/or 78% in volume (NTE INEN 9, 2015), since the alcohol at that concentration causes flocculation or coagulation of the product when the acidity is equal to or greater than 22.5 ml 0.1 N NaOH/100 ml, a positive alcohol test indicates little stability of the milk to heat, which it is very important if the milk has pasteurization purposes; the blue methylene (reductase) test used to quantitatively estimate the hygienic quality of milk through the principle of oxide-reduction potential (Eh), raw milk contains +0.35 to +0.40 volts (350 to 450 milli volts), which is mainly due to the dissolved oxygen content in the product. If for any reason that oxygen is separated, the Eh decreases, this occurs when the microorganisms grow in the milk and consume the oxygen, if the number of microorganism is very high, the oxygen consumption will be higher and therefore the Eh will descend quickly; if on the contrary, the number of microorganisms is small, the Eh will decrease slowly (Universidad de Zulia, 2003); Cryoscopy estimates the addition of water according to the standard (NTE INEN 9, 2015) from -0,512 °C to -0,536 °C is the range of a normal raw milk and lacto fermentation another test used to refer to the hygienic quality of fermentable lacto type such as coliforms and proteolytics (Universidad de Zulia, 2003).

3 Results and discussion

3.1 Hygienic quality

Table 1, testifies the results obtained in the monitoring of the hygienic quality of raw milk in the first phase, obtaining 37.0% of small and medium producers with CBT>600,000/ml, this result indicates that 233 farmers still manage the product in unsanitary conditions in its milking and transport system. Milking is a determining factor in the quality of milk, a study conducted by Ramírez Vásquez et al. (2011), to 130 producers reveals that 41 (32%) did not wash their hands before milking and 58 (45%)) does not wash the udders, which is why they presented high bacterial counts, reducing the quality of the product. It is evident that these poor management conditions are happening with producers in the province, their results confirm these anomalies, however, constant training can raise awareness among producers and change these realities. In the second analysis, 30.7% of breeders with counts greater than 600,000 IBC/ml are obtained, observing a reduction of 6.3, it can be argued that the technical intervention has an effect, however, it is not wahat was expected, the technical staff and provincial coordination will have to propose new strategies of intervention and awareness to small and medium producers to continue advancing in the development of good livestock practices in this border province. (Chuquín Yépez et al., 2016) summarizes in the first diagnosis made in the province that 57% was considered acceptable milk for the sale in the

province, today 70% is considered salable milk according to the obtained results.

To advance the hygienic quality of the milk, it is necessary to maintain a technological level in the milking routine, starting with a good routine of cleaning the dairy cows, keeping in mind that dirty animals present a higher risk of suffering from udder pathology. Correct management is essential (Bonifaz y Conlago, 2016). Managing environmental hygiene is paramount in the technology that produces milk, as the elementary measures of hygiene of the milker, keeping his clothes clean, nails trimmed, not suffering from diseases, hand hygiene, are a determining factor in contamination. Buxadé Carbó (2002), states that 50% of the operators are contaminated before starting the milking routine. Another of the main factors of environmental hygiene to consider is the quality of water, in rural areas should be considered critical for the poor treatment of water both for consumption and for the work of milking (González et al., 2010). All the above-mentioned factors and others determine the hygienic quality of the milk in a farm. Producers in the province must work hard on these issues, if the goal is to stay in the market and start competing as suppliers of milk of integral quality.

Table 1. Cell and bacterial counts of small and medium-sized associated producers, from the 5 cantons of the Carchi province.

Associations	Total Samples		CCS >500.000				CBT >600.000			
	TM 1	TM 2	Sampling 1	%	Sampling 2	%	Sampling 1	%	Sampling 2	%
Linea roja	112	87	43	38.4	37	42.5	10	8.9	13	14.9
20 de marzo	13	10	5	38.5	5	50.0	2	15.4	3	30.0
Tuquer	23	13	5	21.7	3	23.1	4	17.4	4	30.8
Pizan	25	13	6	24.0	1	7.7	10	40.0	3	23.1
Progresista mirador	29	29	8	27.6	7	24.1	6	20.7	5	17.2
Taya	30	23	4	13.3	5	21.7	5	16.7	3	13.0
Avancemos juntos	15	13	4	26.7	3	23.1	7	46.7	4	30.8
Incca promsa	24	20	8	33.3	5	25.0	9	37.5	10	50.0
Mariscal sucre	27	18	11	40.7	9	50.0	19	70.4	14	77.8
Chitán	38	31	12	31.6	17	54.8	19	50.0	21	67.7
Centro agricola tulcán	18	12	6	33.3	7	58.3	11	61.1	6	50.0
Bicundos	42	16	15	35.7	3	18.8	26	61.9	8	50.0
Palo blanco	10	9	3	30.0	2	22.2	3	30.0	1	11.1
Emprendedores	18	15	7	38.9	3	20.0	8	44.4	3	20.0
San pedro	52	41	24	46.2	16	39.0	14	26.9	11	26.8
Sendero campo fertil	22	19	9	40.9	7	36.8	15	68.2	3	15.8
Delicia	95	58	29	30.5	17	29.3	47	49.5	18	31.0
Q'señor	20	12	5	25.0	4	33.3	10	50.0	8	66.7
Agroincas	17	10	6	35.3	3	30.0	8	47.1	0	0.0
TOTAL	**630**	**449**	**210**	**33.3**	**154**	**34.3**	**233**	**37.0**	**138**	**30.7**

CCS= Conteo de Células Somáticas
CBT= Conteo Bacteriano Total
TM= Toma de Muestras

3.2 Sanitary quality

Of 630 producers in the province, 33.3% (210) of them were found with Somatic Cell count >500,000/ml, evidencing that they maintain sanitary problems due to the delicate health of the mammary gland that they are presenting, that is, there is a presence of subclinical and clinical mastitis; In the first phase, 16.8% (106) of producers presented high CS/ml and CBT/ml counts, revealing hygienic and sanitary problems in the milk sold to the industry. The data obtained in phase two compared to

the data from phase one shows that the somatic cell count >500,000/ml, there was no positive difference of improvement rather there was an increase of 1%, this confirms that the problems remained sanitary in the cows of the cattlemen in the province during the technical intervention. Chuquín et al. (2017), reveals in the first diagnosis carried out in the province that only 21.4% of breeders detect and perform the control of mastitis, currently this serious problem is still evident in sanitary control, the same author also describes that only 52.7% comply with the criteria of preventive treatment of mastitis at the time of drying, this may explain why sanitary quality continues to be a problem in the province, adding to this that less than 50% of farmers use professional work for the sanitary treatment, this can have repercussions in more uncontrollable problems in dairy cows in the future. With respect to the first diagnoses made in the province, Chuquín et al. (2017), highlights that 65% of the milk sold in the province is of acceptable sanitary quality, currently 67% would be considered with a cell count less than 500,000 cs/ml.

3.2.1 Sanitary quality of dairy herds

The follow-up to 33.3% of the producers with somatic cell count greater than 500,000/ml, the diagnosis was made to a total of 1094 producing cows, obtaining the following results, as indicated in Tables 2.

Table 2. CMT test carried out on 1094 dairy cows of 210 producers from the 5 cantons of the province of Carchi.

CMT Tests	Result in % (affected nipples)
- (Negative)	60.09
T (traces)	15.05
+ (Positive level 1)	15.88
++ (Positive level 2)	7.07
+++ (Positive level 3)	0.8
Lost nipples	1.12
Total:	**100%**

The 39.9%, that is to say, more than a third of the cows in production of the cattlemen of the province present serious problems in the control of the bovine mastitis, this problem possibly is the effect of the negligence of the small and medium producer in the good practices of milking (Bonifaz y Requelme, 2011), as also noted by Ramírez Vásquez et al. (2011) that 90% of mastitis is caused by deficiencies in milking, which means that this disease occurs under favorable conditions that the producer itself provides them, such as: bad milking, lack of hygiene at the time of milking, lack of hygiene of the milking area, not to separate the affected animals from the healthy ones, not to give the adequate treatment nor the correct and necessary dose to each sick animal (Buxadé Carbó, 2002). For this reason subclinical mastitis remains the most expensive silent disease in the province due to the loss of production, the low quality of the product and consequently problems in industrialization, this entails a severe economic loss for the producer (Mellado Bosque, 2010; Bonifaz y Conlago, 2016), for this reason it is important to monitor the disease in the animals and the quality of the milk at the reception and then be sold to the dairy industry.

3.2.2 Sanitary quality by supplier through CMT

The CMT test performed on each supplier at the reception of the associations and collection centers yielded the following results from Table 3

Table 3 shows the results of the two phases where there is apparently an improvement of 13.16% of producers negatively detected in the CMT test, demonstrating that this type of quick tests are important tools in a basic laboratory for quality control in a reception center for raw milk.

According to the data obtained, the raw milk of small and medium producers associated in this province improved 13.16% compared to the results of the first phase, these results motivate to continue looking for models of development in the awareness of disease control (mastitis) to achieve milk from small-scale producers of sanitary quality.

Table 3. CMT test carried out in the milk reception to the producers of the 5 cantons of the province of Carchi.

CMT Tests	Percentage (%) of producers First sampling	Percentage (%) of producers second sampling	Difference
- (Negative)	35.41	48.61	13.16
T (traces)	37.01	31.02	-5.99
+ (Positive level 1)	19.59	15.51	-4.08
++ (Positive level 2)	6.97	3.94	-3.03
+++ (Positive level 3)	1.02	0.93	-0.09
Total positive	64.59	51.39	-13.2
Total:	**100 %**	**100 %**	

3.3 Chemical-physical quality of raw milk

3.3.1 Chemical composition

The results of Table 4 indicate that 7.47% and 8.12% of small and medium milk producers have problems regarding the percentage of fat and protein respectively, reflecting possible problems of adulteration with water or deficient nutrition of dairy cows. Regarding nutrition, after non-genetic, the genetic factors such as nutrition is the determining factor in the production of fat and protein in milk. The climate of the region also plays a crucial role in the nutritional management of the cow, as the rainy seasons should take into account the availability and digestibility of pastures especially in protein rationing, while in dry times the high temperatures and the increase of grassland fiber can affect the quality of the daily ration supplied, affecting the production of total solids in milk, Valdés y Canto (2015) argue that the contribution of fiber in the food ration for example fat can increase up to 1% and protein in 0.3%., also note that food directly affects the production of fat, while the protein depends on the genetic factor, but that the feed defines the effective roof in both cases. The NTE INEN 9 (2015) establishes that raw milk must contain a minimum of 3% fat and 2.9% protein, so it is not yet fully fulfilled in the province.

The quality payment table issued in September 2013 by the MAGAP establishes that the cost of sustaining the liter of raw milk is 42 cents, with the fat content of 3.0% and protein in 2.9%. With this argument the milk of the province 92.5% and 91.9% of fat and protein respectively their raw milk is entitled to payment for quality, however, this price may fall or rise because of the bacterial content, which the table stipulates that it must contain $\geq$ 300,000 IBC/ml or 300,000 cfu/ml to obtain the respective bonuses, otherwise it is penalized by lowering its cost including support.

Regarding the first diagnosis, fat and protein were maintained at 90 and 86% respectively, currently it can be mentioned that there is an improvement of 2.5 and 6% respectively, lying compositional quality (Chuquín et al., 2017).

Table 4. Percentage of fat and protein in the raw milk of the producers of the 5 cantons of the province of Carchi.

Associations	N° prov	Fat		Protein	
		<3	%	<2.9	%
Agroincas	42	6	14.29	2	4.76
San francisco/línea roja	27	3	11.11	7	25.93
A. Bicundos	29	5	17.24	4	13.79
A. Emprendedores	22	-	-	1	4.55
A. San pedro	9	2	22.22	2	22.22
Centro agrícola tulcán	8	-	-	1	12.5
Chitán	8	2	25	-	-
La paz	48	8	16,67	7	14.58
Mariscal sucre	47	3	6.38	2	4.26
Piartal	10	1	10	1	10
Pizán	24	2	8.33	2	8.33
Comercializadora/taya	30	4	13.33	5	16.67
Tuquer	13	3	23.08	1	7.69
Progresista mirador	18	1	5.56	2	11.11
Q'señor	52	6	11.54	13	25
Total:	**616**	**46**	**7.47**	**50**	**8.12**

3.3.2 Protein stability reaction (Alcohol test)

The results of Table 6 are related to high bacterial counts, this implies that these raw milks tested positive for alcohol, confirming the poor hygienic quality. The percentages 13.93% and 13.19% in the two phases analyzed respectively corroborate the lack of quality of the milk that is deposited in the collection centers in the province.

Table 5. Summary of the alcohol test carried out on the producers of the 5 cantons of the province of Carchi.

Results	First sampling	Second sampling	Difference
Negatives	86.07	86.81	-0.75
Positives	13.93	13.19	0.74

The alcohol test must be done every day in the collection centers of raw milk, because every day is a separate reality, an oversight in the system and the results are unsatisfactory in the quality of the product, the only way to control the compliance or breach of the minimum standards of hygiene in the process. It is the only empirical and rapid test that can help to judge the product at the time of reception.

3.3.3 Cryoscopy

The cryoscopy results show that 16.43% of producers included in this study apparently adulterate the milk with water, but before judging by this test it is suggested to follow up in the dairy herd to closely identify the problem of watering or others as a nutritional deficiency, lactation time, environmental temperature, physiological pathologies of the animal that they may be going through (González Cuascota, 2013), and consequently the cryoscopy this outside the state norms.

Chuquín Yépez et al. (2016), reveals that 70% of breeders exceeded the requirements of the standard (NTE INEN 9, 2015), in the first diagnosis made in the province, currently we can see a 13.57% advance in the control of adulteration with water.

3.3.4 Methylene blue reduction time (Reductase test)

The average of the percentages of the farmers of the 5 cantons of the province responded to the treatment, there is a significant progress after the technical intervention. However, this progress is not satisfactory or expected, in the first phase 70.64% (308) of the producers obtain a quality milk checked by this examination at the time of receipt, while in the second phase 81.29% (352)) of the producers provide quality milk according to this test.

The reductase test in the qualification of the hygienic quality of raw milk, indicates in a rough manner the degree of bacterial contamination. In the Tabla **??**. It is observed that the averages in the two samples taken before and after the technical intervention, there is an increase of 10.65% of the averages >to 5 hours that according to the NTE INEN 9 (2015), the product is of quality.

In a study conducted by Buñay y Peralta (2015), in 168 samples of suppliers of raw milk in the province of Cañar, only 32.1% meet the quality criteria imposed by NTE INEN 9 (2015) by >3 hours what evidence that in the province of Carchi the advance is significant in the control of the quality of the raw material, but still needs to continue.

This test maintains a careful process, but with training is manageable to control the hygienic state of the milk, the collection centers must maintain it for daily control and monitor the quality of the received product (Zambrano y Grass, 2008) and be able to take the measurements with the associated users and to be able to advance in the quality process.

Table 6. Summary of the alcohol test carried out on the producers of the 5 cantons of the province of Carchi.

Associations	<3hours	3-5 hours	<5hours	<3hours	3-5 hours	>5 hours
	% first sampling			% second sampling		
20 de marzo	7.69	23.08	69.23	0	0	100
Agroincas	33.33	47.62	19.05	0	14.29	85.71
A. Juntos	29.41	23.53	47.06	23.53	23.53	52.94
Bicundos ii	20.45	22.73	56.82	4.55	0	95.45
Emprendedores	0	0	100	7.69	19.23	73.08
La delicia	12.36	21.35	66.29	11.11	11.11	77.78
Mariscal sucre	25.93	25.93	48.15	44	0	56
Dolorosa	20	10	70	30	20	50
Pizán	7.69	15.38	76.92	4.35	4.35	91.3
Progresista m.	3.7	0	96.3	6.06	12.12	81.82
Q'señor	60	10	30	5	20	75
S. C. Fértil	0	9.52	90.48	0	9.52	90.48
San pedro	0	4.65	95.35	2.27	2.27	95.45
Solferino	12.5	4.17	83.33	0	12.5	87.5
Tuquer	0	11.11	88.89	0	16.67	83.33

3.3.5 Lacto fermentation

The 48.2% and 6.57% of producers of the province maintain fermentable (coliform) and proteolytic bacteria problems respectively, 44.91% of producers presented negative milk to the test reflecting a good quality hygienic product, and 0.31% of the samples that did not present coagulation presumably because they contain chemical substances, detergents, pesticides from the stables. The milks with negative results are favorable for the dairy producing cheese industry (Figure 1.) This test helped to identify that the milk of the province has serious deficiencies in the hygienic quality originated in the stables.

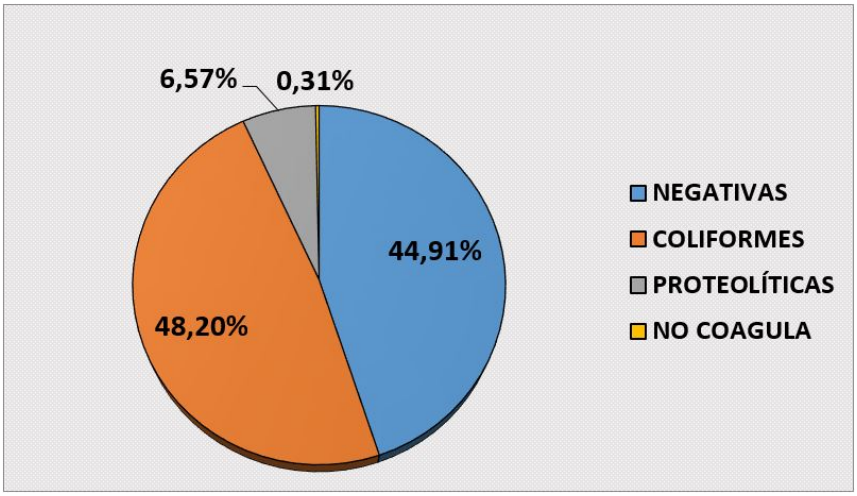

Figure 1. General result of the lacto fermentation test of small and medium producers in the 5 cantons of the province of Carchi.

4 Conclusions

Laboratory analyzes undoubtedly remain a fundamental tool for the diagnosis of the quality of raw milk at the producer level. Qualitative tests such as CMT help diagnose health problems at the producer level; while the test of alcohol, reductase, lacto fermentation helped to roughly determine the hygienic state of raw milk. Quantitative tests such as CBT, CCS, Cryoscopy, are indicative of evident and proven problems of hygiene, health and adulteration of the product.

A third of the population of the cattle ranchers of the province (33.3 %) continue with serious deficiencies in the diagnosis and control of bovine mastitis. It was evidenced that the cell counts higher than 500.000cs/ml of the producers' can, 40 % of them keep animals positive to the CMT test in production, which means that there is still a deficiency in the diagnosis made by the farmer to his cows, making it even more difficult to prevent and treat the disease. Hygienic quality continues to be the topic of all those involved in the value chain of raw milk. No doubt the laboratory results are the reflection of the integral management of the animals in production and improve depend on the effort and unique wisdom of the farmer. The physical and chemical quality, such as fat and protein, meet more than 90 % of the farmers, keeping within the limits established by the state regulations. Proper handling of the food supply can help to obtain better fat and protein results.

Acknowledgements

In a special way to the producers of the provincial of Carchi, to the technical personnel of GADPC; alpina foundation and UPS for the support and delivery to the research project, for all the resources allocated.

References

Bacilio, V. (2016). Evaluación de transferencia de tecnología en unidades de producción de leche en pequeña escala, en el municipio de Aculco, estado de México. In *Tesis de Grado. Universidad Autónoma del Estado de México. Disponible en: https://goo.gl/PyTFvq*.

Bonifaz, N. y Conlago, F. (2016). Prevalencia e incidencia de mastitis bovina mediante la prueba de california mastitis test con identificación del agente etiológico, en Paquiestancia, Ecuador. *La Granja: Revista de Ciencias de la Vida*, 24(2):43–52. doi: http://dx.doi.org/10.17163/lgr.n24.2016.04.

Bonifaz, N. y Requelme, N. (2011). Buenas prácticas de ordeño y la calidad higiénica de la leche en el Ecuador. *La Granja: Revista de Ciencias de la Vida*, 14(2):43–52. doi: http://dx.doi.org/10.17163/lgr.n14.2011.04.

Buñay, N. y Peralta, F. (2015). *Determinación del recuento de aerobios mesófilos en leche cruda que ingresa a industrias lacto Ochoa - Fernández CIA. Ltda*. Tesis

de grado, Universidad de Cuenca, Ecuador. Disponible en: https://goo.gl/NwBQ3F.

Buxadé Carbó, C. (2002). *El ordeño en el ganado vacuno: aspectos claves*. Ediciones Mundi–Prensa. Disponible en: https://goo.gl/VcK1Sa.

CANILEC (2011). *El libro blanco de la leche y productos lácteos*. CANILEC. Disponible en: https://goo.gl/4HFofL.

Chuquín, H., Ibarra, E., De la Cruz, E., y Simbaña, P. (2017). Diagnóstico de cumplimiento de las buenas prácticas pecuarias en la provincia del Carchi. *Revista Visión Empresarial*, (6):206–2017.

Chuquín Yépez, H. G., Aquino Ruíz, E. L., y De la Cruz González, E. G. (2016). Diagnóstico del manejo de la calidad de leche y del queso en la provincia del Carchi. *Revista Sathiri*, 11(11):153–168. Disponible en: https://goo.gl/FY76kd.

FAO (2017). Calidad y evaluación. Organización de las Naciones Unidas para la Agricultura y la Alimentación. Disponible en: https://goo.gl/Fg7nV8.

GADPC (2016). Gobierno autónomo descentralizado de la provincia del Carchi.

González, G., Monila, B., y Coca, R. (2010). Calidad de la leche cruda. In *Primer Foro sobre Ganadería Lechera de la Zona Alta de Veracruz. Disponible en: https://goo.gl/KvJU83*.

González Cuascota, M. V. (2013). Estudio del punto crioscópico de leche cruda bovina, en dos pisos altitudinales y dos épocas del año. In *Tesis de Grado, Universidad Politécnica Salesiana, Ecuador. Disponible en: https://goo.gl/xANWDZ*.

MAGAP (2013). Acuerdo 394: Regúlese y contrólese el precio del litro de leche cruda pagada en finca y/o centro de acopio al productor y promuévase la calidad e inocuidad de la leche cruda.

Mellado Bosque, M. (2010). *Producción de leche en zonas templadas y tropicales*. Editorial Trillas. Disponible en: https://goo.gl/2XRHWp.

NTE INEN 9 (2015). Leche cruda. requisitos. sexta revisión. Instituto Ecuatoriano de Normalización. Disponible en: https://goo.gl/7fAkQE.

NTE INEN-ISO 707 (2014). Leche y productos lácteos. directrices para la toma de muestras (ISO 707:2008, IDT). Instituto Ecuatoriano de Normalización. Disponible en: https://goo.gl/7cGKi5.

Ramírez Vásquez, N., Arroyave Henao, O., Cerón-Mñoz, M., Jaramillo, M., Cerón, J., y Palacio, L. G. (2011). Factores asociados a mastitis en vacas de la microcuenca lechera del altiplano norte de Antioquia, Colombia. *Revista de Medicina Veterinaria*, (22):31–42. [en línea] disponible en: https://goo.gl/QMZoyv.

Universidad de Zulia (2003). Introducción al control de calidad de la leche cruda, guía práctica. In *Cátedra de Ciencia y tecnología de la Leche. Disponible en: https://goo.gl/EjkpEK*.

Valdés, C. y Canto, F. (2015). *Alimentación de Vacas Lecheras en Pastoreo y sus Efectos en el Contenido de Sólidos Lácteos*. INIA. Disponible en: https://goo.gl/aLVMGm.

Villegas de Gante, A. y Santos Moreno, A. (2011). *Manual básico para elaborar productos lácteos*. Trillas Sa de Cv. Disponible en: https://goo.gl/nNCfTY.

Zambrano, J. y Grass, J. (2008). Valoración de la calidad higiénica de la leche cruda en la asociación de productores de leche de sotará – asproleso, mediante las pruebas indirectas de resazurina y azul de metileno. *Biotecnología en el Sector Agropecuario y Agroindustrial*, 6(2):56–66. Disponible en: https://goo.gl/n1yruK.