Conditions of mechanical milk meters through in a Uruguay test platform

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Abstract

This paper attempts to present levels of functionality and accuracy of 193 milk meters (MM), verified and tested in a basic milk meters test platform (MMTP) in Uruguay. The MMs belonged to 8 dairy producers and 9 independent controlling companies, which specialize in offering milk control services in the country. The universe evaluated, corresponding to 2 of the main brands in the market, used in permanent milking cycles in different dairy farms to estimate milk production of each animal. The results obtained showed that 50,8% of MM, was above 3% error, being classified as “unfit” to perform measurements at dairy farm level by following the recommended criteria of the International Committee for Animal Recording (ICAR). MM admitted to MMTP, had never been valued by an independent body; only 26% of them were evaluated for a second time and 4% for a third, in the period covered by this evaluation from 2008 to 2012.

The results of the checks carried out, allow to the conclusion that it is necessary and indispensable, created in Uruguay, a regulatory body that establishes limits of error and technical requirements, following international standards. The MM had been experiencing intense wear and tear for the continuous and permanent use, between dairy farms, leading an author to suggest following up a verification year, ensuring the accuracy used to establish management measures in the herd and making productive, reproductive, nutritional and genetic management.

Keywords: Milk meter, Accuracy, Verification.

Introduction

In Uruguay, the productivity of dairy farms in terms of the ratio of “milking cows/cows’ mass” has been above 72%. (DIEA,2018). With practically the same number of animals per herd (approximately 425,000 cows’ mass and 308,000 milking animals), the production went from 1,073 million litters remitted to plants in the financial year 1994/ 1995, to 1,900 million in the first 9 months of 2018. (INALE,2018). The increase in individual milk production per cow has been the main factor in the growth of milk production in the country in recent decades, and annual litters per cow are increasing at a rate of 2% per year. The evaluation of productivity within each herd and estimation of milk production per animal requires measurements and production databases, which, together with the genetic background of the production of the animals and their parents, allow to select the animals genetically superior and drive progress in certain features of economic importance (Mark, T.2004; Madouasse A. et al., 2010).

Nowadays in Uruguay, the measurement of milk production per cow is carried out mostly by portable mechanical instruments and to a lesser extent by fixed electronic devices. Both are designed to be added to any type of milking system and quantify the individual milk production, without affecting milk output time or udder health as established by the Dairy Herd Information Association, (DHIA,2011). They are used to control milk production, establish management measures in the herd (productive, reproductive, nutritional and genetic). The equipment is inserted between the collector and the milk pipe, in each of the descents, permanently or only during the milk control, they can be their own or belong to independent controlling companies, which specialize in offering this service.

The MM are basic instruments composed of at least 5 fundamental parts: cover plastic, base assembly, flask, tap with strap and rubber gaskets (Figure 1).

The operating conditions lead to MM wear due to which, like any instrument or equipment used to quantify a quantity, must be subjected to calibration and verification procedures, to limit the uncertainty of the measurements, within a field of acceptable tolerance. (ISO: 5725-6,1994) and the International Committee for Animal Recording (ICAR) advises, to be verified at least once every 12 months. In Uruguay, most of the meters used to belong to the brands Waikato® (Hamilton, New Zealand) and Tru Test® (Palmerston Norte, New Zealand) and have similar characteristics of operation and use (Photo 1).

In this sense, the verification process in control banks is carried out reproducing the milking conditions to which the MM or lactometer is subjected, using water instead of milk, verifying by weight the precision of the sample contained inside it. Because the monthly and regular measurement is decisive for the proper management of the farm's milk production, the precision and correct functioning of these lactometers, during their useful life is essential for efficient use. It is necessary to have independent organizations that qualify and evaluate the status of these instruments, whether owned by private control operators or by the producers themselves.

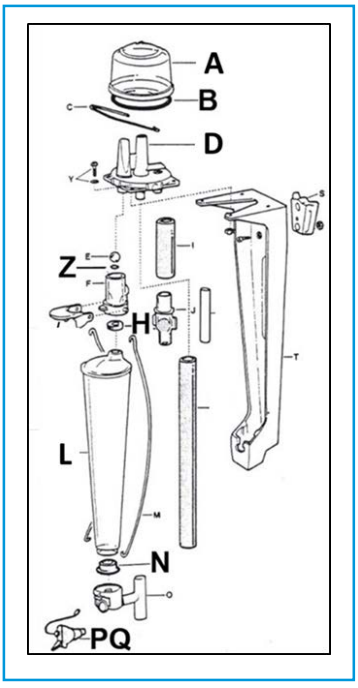

Figure 1. Basic scheme of milk meter (Waikato). Parts: Cover Plastic (A), Base Assembly (D), Flask (L), Tap with strap (P-Q), rubber gaskets (B, Z, H y N).

Figure 2. Main brands of mechanical milk meters used in Uruguay, Waikato® (left), Tru Test® (right).

The main objective of this work was to determine the fitness of 193 MM mechanics used in our country to quantify the dairy production of animals. At the same time, the level is described in terms of functional acceptability reached by them when verified for 5 years, in an independent evaluation platform that was installed in Uruguay in 2008 and the main causes of malfunction of MMs at a structural level. and the way of use.

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Material and methods

Work was carried out on a basic MMTP, located in a laboratory situated in Nueva Helvetia, Colonia, Uruguay, at the end of 2008. It consisted of a room, with a group of vacuum motor pump SAC, of 1.5 Hp set at 50 kPa, (15 “Hg), 20 L stainless steel vacuum and interceptor lines, dead weight type vacuum regulator, 30 L stainless steel bucket, an inlet tube, a vacuum gauge (indicates Vacuum level) and a shut-off valve To perform the mass adjustment, a MercoCity scale, model ACS-L2 III, with a range between 0.2 - 30 Kg, and an accuracy of 0.010 Kg was available. A MM analysed corresponded to the brands Waikato (75%) and Tru Test (25%). All MMs that entered the MMTP was evaluated following the procedure followed by (DHIA, 2011), and approved by (ICAR, 2016). There were 193 instruments traced at the level of 251 records made in the MMTP during the period n study was recorded if the use of MMs was individual or shared.

The structural reason for the MM malfunction was sought and the frequency with which they were found in the instruments was established, considering also the brand of the same.

The instruments to evaluate belonged to 17 owners of different sites of the dairy basin, who attended by only, 2 and 3 times, in 70%, 26%, and 4% respectively.

Prior to each measurement, the instruments were disassembled and cleaned with citric acid and industrial detergent. Then, each MM was mounted on the test platform, verifying by a level, its vertical position (within ± 0.5 degrees). The suction hose of the MM was carried to an open bucket (30 L), directly below the meter. An air intake restrictor was used, to guarantee a flow of 3.5 to 4.0 L / min., At the level of available vacuum. Drinking water was used at a temperature of 19 ± 5 ° C.

Each meter was subjected to 3 consecutive test measurements, expressing the readings according to criteria established by ICAR, (2016), and the manufacturers of Waikato Milking System, (2002), where the acceptance range is ± 3%, on the average of the readings made. The MMs that did not pass the test were classified as “unfit use”, and they underwent repair, replacement of parts and recalibration, being delivered to their owner in conditions of aptitude. Of the 193-equipment verified in the MMTP, 2 MM were discarded, due to severe deterioration of some of its parts, not being able to be replaced, and its disposal recommended. In general, if it could not be repaired, it was suggested that the service be withdrawn.

The data were analysed and presented as an average ± standard deviation.

Results and discussion

When using different types of instruments or equipment, to measure any type of quantifiable quantity, it is convenient to have a series of key concepts, which belong to the field of metrology, of course. For this, it is necessary to distinguish the management of two concepts, which are closely related, such as verification and calibration, but which are different (JCGM 200, 2012). The calibration applies only and exclusively to measuring instruments; of any kind of quantifiable magnitude when compared with values of a previously established pattern. On the other hand, in the Verification, the instrument is compared, but not done with the previous reference standards, but it is “compared” directly, with another instrument, (previously calibrated, of course), to verify that the calibration of The first instrument is the correct one.

In relation to the study that motivates this communication, it is possible to say that the certificates issued by the MMTP inform the users in relation to the verification of the MMs, giving objective evidence that this instrument complies with the requirements specified by the manufacturers or the rules. (UNIT-ISO 10012, 2003).

Verification should not be confused with a calibration where it has been adjusted and if it should have been calibrated.

Of the 193-equipment verified in the MMTP, 2 MM was discarded, due to severe deterioration of some of its parts, not being able to be replaced, and its disposal recommended. Of the MMs verified belonging to 17 owners who participated in the evaluations, 100% had never been valued by an independent organization, MMTP type, as created in 2008. Once the evaluation system began to operate in the MMTP, only 9 owners of MM batches checked their equipment a second time, and only 2, for a third time. This frequency of verification is not enough, and it departs from the international recommendations to undergo evaluation between periods of 12 months (ICAR, 2016). In relation to the fitness of the total equipment verified, it was found that 50.8% was above 3% error, being classified as “unfit” measurements at the dairy level.

Table 1. Deviation values in the measurement (%) with respect to the reference method in the mechanical milk meters.

	Ranges (%) *	N° Equipment
Fit	0-2,9	95
	03-may	49
Unfit	5,1-10	44
	>10	3
Total		191

* *Deviation from the value of the reference method, according to the criteria of IRAM 8042 which establishes the fitting as ≤ 3%.*

97% of MMs classified as unfit presented a deviation with respect to the reference measurement, in values between 3 and 10%, with 3 instruments having higher values than the latter. This means that when they are used at the dairy farm level to measure production, there are animals that are being poorly qualified.

The percentages of the diversion of MMs in relation to the reference measurement are illustrated in Table 1.

The achievement of this situation gave rise to erroneous indicators, which influenced the making of wrong decisions at the level of the owners of the animals, with erratic economic implications based on results above or below their real value.

The standards of IRAM standard 8042, (1989) and DHIA, (2011), establish that MMs must be tested every 12 months, subject to inspection and maintenance at least once a year. The acceptance ranges for both establish satisfaction when the result ranges between 1.5 and 2.5%, being somewhat more demanding than the one used in this work. If so, it would increase the percentage of MM outside working conditions. Surely the nonconformity of the lots is since 100% of the equipment entered in this MMTP did not receive a regular verification that complied with the provisions of ICAR, (2016).

The results obtained give objective evidence that 50% of the instruments used at the national level, to evaluate the dairy herd and to analytically grade milk at the laboratories level, do not satisfy the specified requirements nor the internationally approved standards. If it is taken into account that in Uruguay approximately 140,000 animals/ month, are subject to the official and private milk control system, using these instruments, it is possible to say that: with the range of error found, almost 45% of the estimates made were able to be a sub or overvalued. These non-conformities generate more impact if we consider that the individual milk samples collected with these MMs were sent mainly to central analysis laboratories, for the improvement test of dairy herds. These instruments that estimate the production of milk and serve to obtain the sample to qualify for the parameters of fat, protein, urea nitrogen, and somatic cell count, etc., should provide producers with a guarantee of accuracy in the operation.

The figures handled at the country level indicate that 25-30% of all dairy cows participate in the monthly milk yield record and are the basis for making decisions on components such as herd management (health services of the udder, feeding, etc.) and genetic improvement.

The system of a monthly contract to independent control operators, who transfer the MMs between establishments, leads to mechanical wear of the pieces due to the frequency of operation and impacts caused by the displacement between sites. Additionally, there are no established error limits, nor specific technical requirements approved at the national level, which assess the precision with which these instruments

Table 2. Frequent defects observed in milk meters which cause incorrect measurements (n = 127)

	N° Equipment (%) /Brand	
Error´s Cause	Waikato	Tru-Test
Wear of Gaskets	62 (49%)	27 (21,1%)
Wear of Gaskets + Tap with strap	0	9 (7,1%)
Wear of Gaskets + Flask	11 (8,6%)	0
Wear of Gaskets + Cover plastic	18 (14,2%)	0

are measuring. This takes on a greater dimension if we consider that the producer makes a genetic improvement, supported by the selection of superior animals based on productive merits that are valued through these instruments.

The MM as any measuring instrument, requires maintenance, cleaning, and regular adjustment. Being manually operated devices for daily, weekly or monthly milk registration, the components of these have a limited shelf life, subject to use and handling; since they experience wear of some pieces, which, when not replaced when required, generate incorrect measurements, such as those found in this period, in the MMTP.

If we analyze in detail which was the pieces that showed the greatest wear and tear, as can be seen in Table 2, it is possible to say that failure errors are the most frequent wear of joints, followed by breakage of caps and measuring cup. In most cases, (except for the 2 instruments eliminated), once the altered parts were evaluated and detected, the spare parts were replaced, the error was solved and returned in “fit “conditions to the users and owners.

The shared use of MMs by more than one controller and between different properties leads to greater wear of the equipment that causes severe failures in the measurements. MMs that have a single owner, unlike the property shared by a group of producers, translate into a better state of the instruments, probably due to better care and

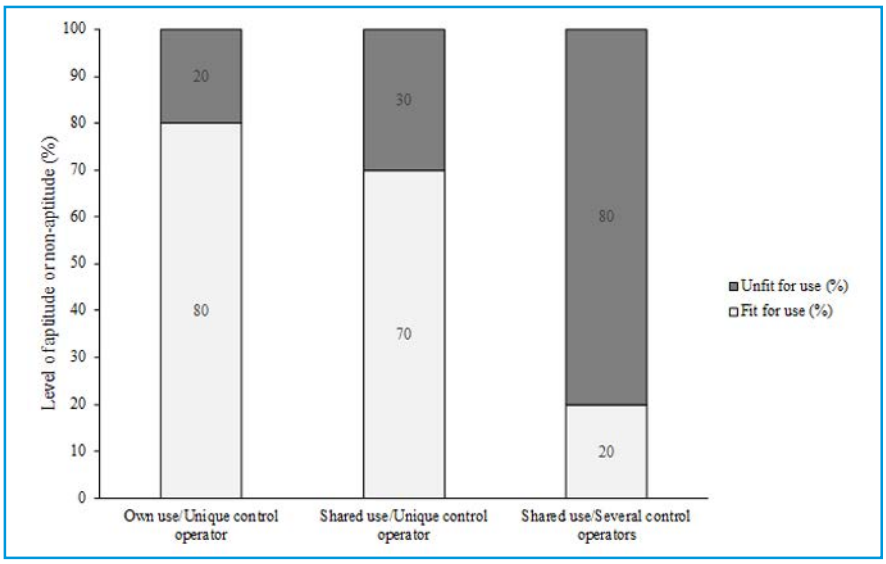

Figure 2. Level of aptitude or non-aptitude (%) of mechanical milk meters according to the type of uses.

conservation of these. On the other hand, the use in a single property reduces the assemblies in the milk lines, as well as the transfer of the equipment, which leads to lower levels of wear and tear of key pieces.

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