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(72) Inventor: LIAM MCCARTY
JOHN O'CALLAGHAN

(73) Patent Granted to: LIAM MCCARTY, an Irish citizen, Glennyriverstick Co. Cork, Ireland
JOHN O'CALLAGHAN, an Irish citizen, Ballymartle Riverstick Co. Cork, Ireland

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A METHOD OF ESTIMATING THE SOMATIC CELL COUNT OF MILK

Technical Field

The invention relates to a method of estimating a somatic cell count for a liquid, typically milk. The invention also relates to a device for use in estimating the somatic cell count of a liquid, typically milk.

Background to the Invention

The production of a high quality milk on dairy farms is the aim of every dairy farmer. Milk is one of the most widely consumed food products worldwide and is a raw material in the production of many other products e.g. cheese, yoghurt, ice-cream, powdered baby milk, etc. Hygiene practices and animal welfare are twin concerns of the dairy farmer. The control of somatic cell count (SCC) levels within the dairy herd is a primary concern of the dairy farmer; a high cell count indicates issues of animal health particularly an occurrence of mastitis that will require immediate intervention. High cell count leading to a bulk tank reading of over >400.000cells/ml will result in financial losses to the farmer and readings <200,000cell/ml will result in the payment of a bonus to the farmer. Additionally, if a cow in the early stages of mastitis can be identified and treated quickly, this obviates the need for use of antibiotics. Thus, reducing SCC levels through careful on-going monitoring will lessen the risks of antibiotic residues entering the food chain.

Methods of estimating the SCC of milk are known. One such method, known as the California Mastitis Test (CMT) employs a reagent which reacts with white cells in milk changing the viscosity of the mixture when the milk has a high SCC count (i.e. above 800,000cells/ml.). Thus, while the test can be employed to detect milk having a high SCC, it does not function reliably with milks having a SCC of less than 800,000cells/ml. nor can it be used as a means of quantitating the SCC of milks. In addition, the test is quite expensive.

It is an object of the invention to overcome at least one of the above-referenced problems.

Brief Description of the Invention

The invention relates to a method of estimating somatic cell count for a liquid, typically milk. The method involves mixing a sample of milk with a detergent, for example a commercially available detergent such as a washing-up liquid, and then allowing the mixture to flow or drip through a narrow bore hole or tube. The time it takes a defined amount of the mixture flow or drip through the narrow bore hole or tube is then correlated with SCC. Correlation may be carried out by any means, for example a standard curve of SCC and drip times, or by means of a pre-programmed processor which is adapted to receive data relating the drip time and correlate the data with a SCC estimate.

The purpose of the detergent is to change the viscosity and/or density of the milk. The Applicants have discovered that the degree to which a specific detergent changes the viscosity of a sample of milk is variable, and depends on the SCC of the milk. Without being bound by theory, it is believed that the detergent lyses the cell membrane of cells present in the milk sample, and catalyses the formation of complexes between the detergent, and DNA and histones released from the cells nucleus, thereby increasing the viscosity of the milk. Thus, milks having a higher level of SCC will have a higher viscosity when mixed with detergent than those having a low SCC. The Applicants have discovered that the relationship between viscosity and SCC is linear, and that viscosity can therefore function as a diagnostic variable of SCC in milk. In addition, the Applicants have further discovered that the SCC of milk can be determined by passing a mixture of the milk and a detergent through a hole of narrow bore and determining the time it takes for the milk to drip through. Thus, this "drip time" functions as a diagnostic variable of SCC in milk.

A key element of the invention is the narrow bore, which should ideally be of sufficient size to allow the milk pass though in drips. Generally, if the bore is too big, the mixture will not drip and will pass through too quickly, and if it is too small, the milk will typically not pass though at all, especially if the sample has a high SCC. The Applicants have found that for most commercially available detergents, for example domestic washing-up liquids, the bore of the hole should be in the 0.5 to 5mm range, preferably 1 to 4mm, and ideally in the 1 to 3mm range.

The amount of detergent mixed in the milk is not an essential element of the invention, and it

will be appreciated that when the detergent is a strong detergent, less may be used, and when the detergent is a weaker detergent, more may be employed. Typically, the choice and amount of detergent added to the milk is determined with a view to providing a mixture (of milk and detergent) which is capable of passing the through a narrow bore hole, typically in a drip-wise manner, over a range of SCC, suitably from 50,000 to 1,200,000, and more preferably from 100,000 to 1,000,000. Various types of detergent may be employed in the method of the invention, including domestic washing-up liquids and other types of detergent including, for example, sodium dodecylsulphate (SDS) or other types of domestic and industrial detergents. For example, when a domestic washing-up liquid is employed, the ratio of milk to detergent may be in the range of 100:1 to 10:1, ideally 80:1 to 10:1, preferably 70:1 to 10:1, preferably 60:1 to 10:1, preferably 50:1 to 10: 1, preferably 30: 1 to 10: 1, and ideally about 25:1 to 15:1. Suitably, the detergent is diluted prior to addition to the milk, ideally with water. Thus, in a preferred embodiment, the detergent is half strength (for example, a domestic washing-up liquid diluted to half strength by addition of the same volume of a dilutant, for example water). In a particularly suitable embodiment of the invention, the milk is mixed with a mixture of detergent and water (typically a 50:50 mixture) at a ratio of from 10:1 to 30:1, preferably 15:1 to 25:1, and ideally about 18:1 to 22:1. Ideally, the detergent is a washing up liquid, suitably one having at least 15% (v/v) anionic surfactant, and optionally also including at least 5% non-ionic surfactant. Ideally the detergent is FAIRY washing up liquid, or a detergent having a similar composition to FAIRY liquid, typically FAIRY ORIGINAL washing-up liquid. The composition of FAIRY liquid (original) is stated on the label as including: 15% -30% Anionic Surfactants, 5%-15% Nonionic Surfactants, Geraniol, and Limonene.

In one embodiment, the method of the invention is for identifying milks having a high SCC, suitably milks having a SCC of 800,000 or greater. In another embodiment, the method of the invention is for identifying milks having a low SCC, suitably milks having a SCC of 400,000 or less, 300,000 or less

In a particularly preferred embodiment of the invention, about 1ml of half strength domestic (dish) washing-up liquid (suitably of the type having at least 15% anionic surfactant) is mixed with the milk, ideally from 10 to 30mls milk, preferably 15 to 25mls milk, and ideally about 18 to 22mls milk..

The milk and detergent are mixed to enable dispersion of the detergent in the milk. Ideally, the mixture is agitated by mixing in a closable mixing bottle.

The method typically employs a vessel, suitably funnel-shaped vessel, for receiving the mixture of milk and detergent. The narrow bore tube or hole is typically disposed at a base of the funnel-shaped vessel so enabling the liquid mixture flow into the hole or tube. In one embodiment, the narrow-bore tube or hole is provided by a capilliary tube in fluid communication with the base of the vessel. The narrow bore hole may be provided by a hole in the base of the vessel, or it may be provided by a piece of tubing, for example, capilliary tubing, in fluid communication with the base of the vessel. It may also be provided by another type of narrow bore hole, for example a syringe, or a needle or the like. In one embodiment, the narrow bore tube is syringe needle of 14 guage.

The step of correlating drip time for the mixture of milk and detergent, and SCC, is suitably carried by comparing the drip time with a pre-prepared standard curve or graph that correlates drip-time with SCC. An example of a suitable standard curve is provided in the figures below. In one embodiment of the invention, the vessel may employ a metering device which is adapted to release a defined volume of the fluid mixture into the narrow bore hole or tube, and detection means which is adapted to determine the time it takes for the defined volume to drip through the hole or tube. The detection means may, for example, display the drip time, thereby enabling a user correlate the drip time with SCC. Alternatively, the vessel may comprise processor means which is adapted to correlate the measured drip time with SCC, and typically provides a reading of the SCC.

The method is ideally performed on milk shortly after milking when the temperature of the milk is close to physiological temperature. This allows the milker to decide whether the milk is suitable for addition to the milk bulk tank. The Applicant has determined that temperature of the milk has an effect on the viscosity of the milk (without being bound by theory, it is believed that this is due to an interaction between the somatic cells and the milk fat globules), thus a single standard curve may not be appropriate for use with milks of significantly different temperatures. However, the data below shows a linear association between drip time and SCC both at (or close to) physiological temperature, and at bulk tank temperature (about

10°C).

Typically, the method is for estimating SCC of milk in the 50,000 to 1,000,000 range, preferably in the 100,000 to 900,000 range, and ideally in the 200,000 to 800,000 range.

The invention also relates to a dripping device suitable for estimating the SCC of a liquid, typically milk, and comprising a funnel-shaped vessel for receipt of a test fluid mixture, a narrow bore tube or hole in fluid communication with a base of the funnel-shaped vessel, and a base for supporting the vessel in an upright position. Typically, the bore of the narrow tube or hole is from 0.5 to 5mm, suitably between 1 and 4mm, typically between 1 and 3.5mm, and ideally about 1mm, 2mm or 3mm. In one embodiment, the narrow tube is a capilliary tube, typically between 1 and 10cm, 2 and 8cm, and ideally between 3 and 6cm in length. In one embodiment, the device includes tap means for controlling passage of the liquid from the vessel into the narrow-bore tube or hole. In another embodiment, the vessel includes a lid. This enables the milk and detergent to be mixed in-situ in the vessel. In one embodiment, the base for supporting the vessel comprises a collecting vessel disposed beneath the tube or hole. Suitably, the vessel and base are integrally formed in a single unit. Typically, the vessel has a volume of less than 150mls, suitably less than 100mls, preferably less than 90ml, 80ml, 70ml, 60ml, 50ml, 40ml, or 30mls.

In one embodiment of the invention, the device is fully or partly automated. Thus, the device may comprise detection means for detecting the time it takes for the volume of milk and detergent to drip out of the vessel and, optionally, display means for displaying the drip time. The device may also include processing means, operatively coupled to the detection means, capable of correlating the measured drip time with SCC for the milk sample. In another embodiment, in which the drip time is determined manually, a processing means is provided for correlating drip time with SCC, which processing means ideally includes data input means for manual input of data relating to the drip time, and display means for displaying data relating to the determined SCC for the sample.

In one embodiment, the processor includes means for storing data relating to each sample, for example drip time, or SCC, or both. Suitably, the processor includes means for calculating a mean SCC for all the milk samples tested.

The invention also relates to a kit for estimating the SCC of a liquid, typically milk, and comprising:

- a dripping device of the invention;
- optionally, a detergent; and
- means for correlating dripping time for a defined volume of test mixture with somatic cell count.

In one embodiment, the correlating means comprises a standard curve. It may also be provided on an electronic storage medium, for example, a CD. The CD may also include an algorithm for correlating drip times with SCC, and optionally software for recording drip times and/or SCC for samples, and comparing the drip times or SCC's over time periods.

It will be appreciated that the invention relates to the idea of mixing milk and detergent, and then passing the mixture drop-wise through a narrow-bore tube or hole, and correlating the drip-time with SCC. As such, the exact choice of detergent, the milk:detergent ratio's, the size and/or length of the narrow-bore tube or hole, are all matters of optimization and may be varied with departing from the invention. For example, in one embodiment, FAIRY liquid (original) may be employed as the detergent, and 1ml of a 50:50 mixture of this detergent and water may be mixed with 20mls of milk, and the mixture passed by drops through a 2mm tube to determine the drip time. In another embodiment, the same detergent may be employed, and mixed with 20mls of milk, and the drip time determined using the same device. In another embodiment, the detergent is SUPERVALU ownbrand dishwash detergent, and1ml of this detergent (undiluted) may be mixed with 20mls of milk, and the mixture passed by drops through a 3mm tube to determine the drip time.

The method of the invention may also be employed to determine which quarter from a cow is infected, which information will inform which quarter required treatment.

Brief Description of Figures

Figure 1 is a standard curve of drip time v. SCC for milk at or close to physiological; temperature;

Fig. 2 is a standard curve of drip time v. SCC for milk at bulk tank temperature;

Fig. 3 is a graph of drip time v. Time for a single quarter from a specific cow suspected of having an infected quarter; and

Fig. 4 shows a dripping device according to the invention.

Detailed Description of the Invention

Referring to Fig. 4, there is illustrated a dripping device according to the invention and indicated generally by the reference numeral 1. The device 1 comprises a funnel-shaped vessel 2, a drip tube 3 having an internal bore of approximately 14guage, and a tap 4 disposed at the base of the vessel. A base 5 is provided for supporting the vessel 2 in an elevated position, the base comprising a collection vessel 6 disposed underneath the drip tube 3 and adapted to collect the milk that drips through the drip tube. The vessel 2 and collection vessel 6 are connected by a supporting stem 7, and the vessels 2 and 6 and stem 7 are integrally formed.

In use, the pre-mixed mixture of milk and detergent are placed in the funnel-shaped vessel 2 with the tap 4 closed. The tap is then opened and time taken for the milk mixture to pass through the drip tube is measured. Although not shown in Fig. 4, the device may also include a cap adapted to close a top of the funnel. This allows the milk and detergent to be easily mixed in the vessel 2 without the need for a separate mixing bottle.

Example 1 -

100 samples of milk taken from a single herd of cows located in Ballymartle were analysed for SCC at Dairygold Mallow Ireland using a Fossomatic 5000™ machine. Each sample was also tested for drip time using the device of Fig. 4 immediately after milking when the milk is at or close to physiological temperature. The following protocol was employed

1. 60ml of FAIRY liquid (original) is mixed with 60ml water to provide a half strength detergent;
2. 1ml of the half strength detergent is added to 20mls of milk sample;
3. The milk and detergent is thoroughly mixed for 30 seconds;
4. The mixture is placed in the funnel of the vessel of Fig. 4 with the tap closed;

5. The tap is opened, and the time is taken for all of the mixture to drip through the tube is measured – the 14guage needle is employed as the narrow bore tube;
6. The drip time for all of the samples is recorded, and plotted on a graph against the measured SCC for each sample.

The results are shown in Figure 1, and show that at or close to physiological temperature, drip time functions as a reliable diagnostic variable of SCC.

Example 2

59 samples of milk taken from a single herd of cows located in Ballymartle were analysed for SCC at Dairygold Mallow Ireland using a Fossomatic 5000™ machine. Each sample was also tested for drip time using the device of Fig. 4 after storage of the milk in the bulk tank for a period of time. The same protocol of Example 1 was employed for the drip test.

The results are shown in Figure 2, and show that at bulk tank temperature, drip time functions as a reliable diagnostic variable of SCC.

Example 3

A sample of milk is taken from each of a cows quarters cow and subject to the above protocol shortly after milking. The drip time is determined to be (for each quarter) 61secs, 60secs, 61secs, and 63 secs. Referring to Fig. 1, these times correlate with a SCC for each quarter of in the region of about 350,000-380,000. This inform the milker that (a) the milk has a low SCC and may be added to the bulk milk tank, and that (b) the cow does not have clinical mastitis in any of the cows quarters.

Example 4

Two samples of milk are taken from a bulk milk tank and subject to the above protocol – the milk is determined to be at about 10°C. The drip times are determined to be 72 and 74secs. Referring to Fig. 2, these times correlate with a SCC for each sample of in the region of about 400,000. This informs the milker that the bulk milk has a low SCC, and also informs the price he should receive from the Creamery.

Example 5

The method of the invention is also employed to monitor the effectiveness of antibiotic

treatment of a specific cows 4th quarter. Initially, the cow was identified as being possibly ingfected due to a long drip time of 121 seconds. Applying the method of the invention to each of the cows quarters identified to infected quarter. Antibiotics were administered to the infected quarter, and the SCC of that quarter was monitored during the days following antibiotic treatment using the method of the invention (Fig. 3) until the SCC level indicated that the infection was cleared.

The invention is not limited to the embodiments hereinbefore described which may be varied in construction and detail without departing from the spirit of the invention.

Claims

1. A method of estimating somatic cell count for a sample of milk comprising the steps of mixing the milk sample with a detergent, allowing the mixture drain through a narrow bore hole or tube to determine a drip or flow time for the mixture, and correlating the drip or flow time with somatic cell count (SCC).

2. A method as claimed in Claim 1 in which the detergent is a domestic washing-up liquid.

3. A method as claimed in Claim 1 in which the milk sample is mixed with a detergent in a ratio of from 10:1 to 50:1, wherein the detergent comprises at least 15% anionic surfactant (v/v) and at least 5% non-ionic surfactant (v/v), and in which the narrow-bore hole or tube has a bore of from 1 to 4mm.

4. A dripping device (1) suitable for estimating the SCC of milk, and comprising a funnel-shaped vessel (2) for receipt of a sample of milk, the vessel having a volume of less than 100mls, a narrow bore tube or hole (3) in fluid communication with a base of the funnel-shaped vessel, and a base (5) for supporting the vessel in an upright position, in which the bore of the narrow tube or hole (3) is from 0.5 to 4mm.

5. A kit of parts suitable for estimating the SCC of milk, and comprising:

- a dripping device of Claim 4;
- optionally, a detergent; and
- means for correlating dripping time for a defined volume of test mixture with somatic cell count.

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FIGURES

FIGURE 1

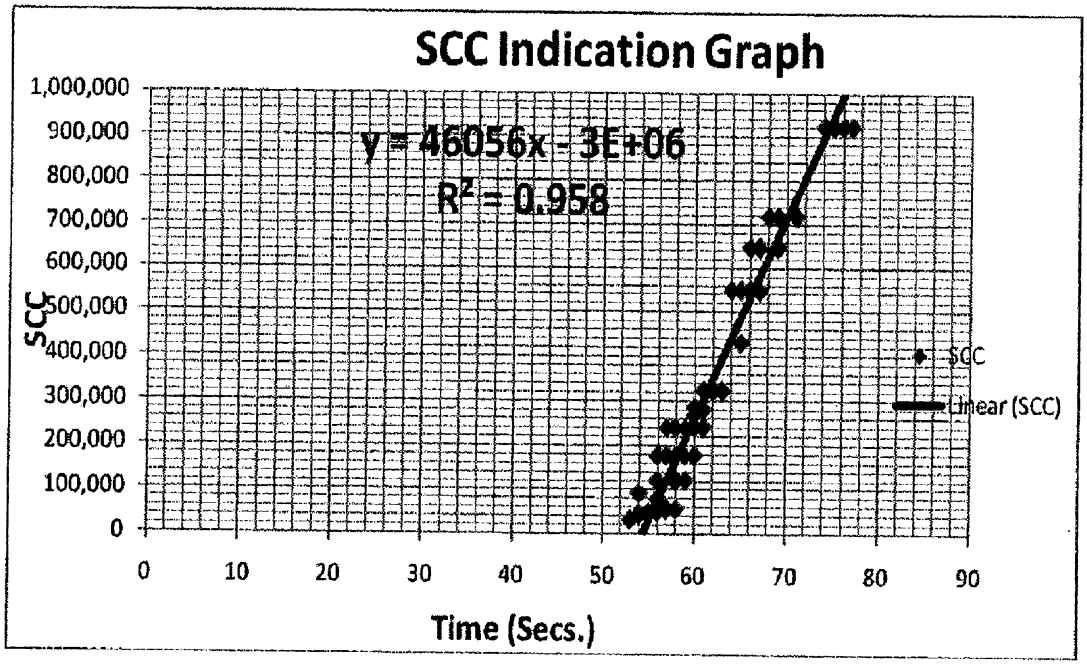

FIGURE 2

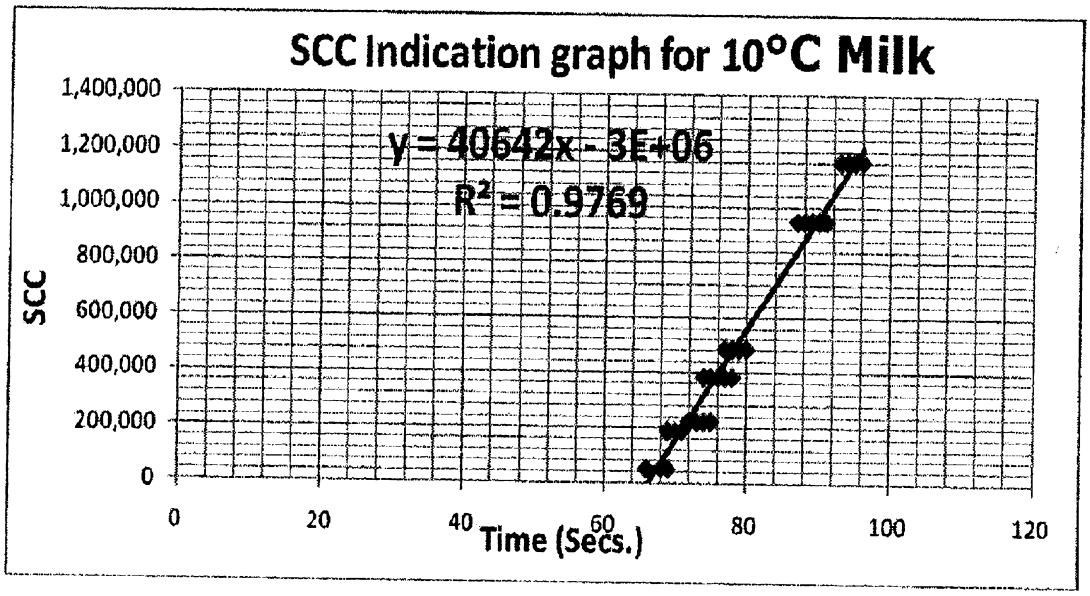

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FIGURE 3

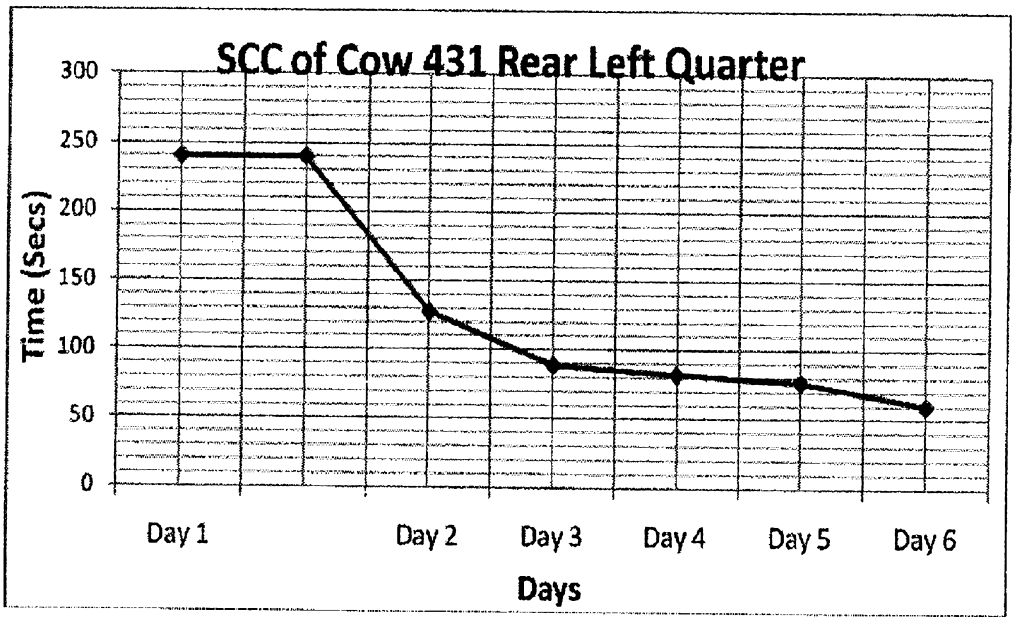

FIGURE 4