
Draft COMESA/East African Standard

Raw cow milk — Specification

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Foreword

Raw cow milk — Specification

1 Scope

This COMESA/ East African standard specifies requirements, methods of sampling and test for raw cow milk.

2 Normative references

The following referenced standards are indispensable for the application of this COMESA/East African Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced standard (including any amendments) applies.

CAC/MRL 02-2006, Maximum residue limits for veterinary drugs in foods.

CAC/RCP 57, Code of hygienic practice for milk and milk products

CODEX STAN 193-1995, Codex general standard for contaminants and toxins in foods.

ISO 2446, Milk — Determination of fat content (Routine method).

ISO 4833, Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of microorganisms — Colony-count technique at 30 °C

ISO 5541-1, Milk and milk products - Enumeration of coliforms - Part 1: Colony count technique at 30 °C

ISO 5764, Milk — Determination of freezing point — Thermistor cryoscope method

ISO/TS 6090, Milk and dried milk, buttermilk and buttermilk powder, whey and whey powder — Detection of phosphatase activity

ISO 6731, Milk, cream and evaporated milk — Determination of total solids content (reference method)

ISO 13366, Milk — Enumeration of somatic cells

3 Definition

For the purpose of this COMESA/East African Standard, milk means the normal, clean and fresh secretions, without any addition or subtraction, extracted from the udder of a healthy cow, and free from colostrum, i.e. excluding that got during the first seven days after calving.

4 Principal compositional requirements

4.1 Chemical

4.1.1 When determined in accordance with ISO 2446, Milk shall contain not less than 3.25 % milk fat and not less than 8.50 % milk-solids-not-fat when determined in accordance with ISO 6731. It shall not contain added water, preservatives or other added substances, nor shall any proportion of a natural constituent be removed.

4.1.2 Density of milk at 20°C shall be within the range of 1.028 g/ml – 1.036 g/ml

4.1.3 When determined in accordance with ISO 5764, the freezing point depression of milk shall be not less than 0.525 °C and not more than 0.550 °C.

4.1.4 When tested in accordance with the appropriate method in Annexes A to h, milk shall:

- have a characteristic creamy – white color, free from off flavours and taints
- be free of objectionable matter
- not coagulate in the clot on boiling test
- test negative to the alcohol test
- have no more than 0.17% titratable lactic acid
- test positive to phosphatase when tested according to ISO/TS 6090.
- pass the 10 minutes resazurin test or 4.5 hours methylene blue test

4.2 Bacteriological Grades

Milk shall conform to the following microbiological limits

4.2.1 Total plate count

The total plate count shall be determined in accordance with ISO 4833. The counts shall be graded as specified in table 1

Table 1 — Microbiological limits

Grade	cfu/ml
I or A	< 200,000
II or B	>200,000 – 1000,000
III or C	>1000,000 – 2000,000

4.2.2 Coliform plate count

The coliform count shall be determined in accordance with ISO 5541 part 1. The counts shall be graded as specified in table 2

Table 2 — Coliform limits

S/N	Quality	Counts (per ml)
a)	Very good	0 – 1000
b)	Good	1000 - 50000

4.2.3 Somatic cell count

When determined in accordance with ISO 13366, the somatic cell count shall not exceed 300 000 per millilitre.

5 Contaminants

5.1 Pesticides residues

Milk shall conform to the maximum limits of pesticide residues as specified in Codex Alimentarius

Commission standards.

5.2 Veterinary drugs residues

The products covered by this standard shall comply with the maximum residue limits specified in CAC/MRL 2-2006

5.3 Heavy Metals and other contaminants

The products covered by this standard shall comply with the maximum limits as specified in *CODEX STAN 193-1995*

6 Hygiene

Milk shall be produced, processed and handled in accordance with *CAC/RCP 57*.

Note: Reference to *CAC/RCP 57* does not mean an endorsement of the use of lactoperoxidase system as a means of preservation of raw milk as contained therein.

7 Methods of sampling

Sampling of butter for analysis shall be done in accordance with ISO 707.

8 Rapid platform tests on quality of raw milk

See Annexes A to H.

Annex A (normative)

Organoleptic test and temperature

A.1 General

Judging the quality of milk by its physical and sensory characteristics requires considerable skill, which could only be acquired by practice. Organoleptic tests are used in all dairies and an experienced person can pick out bad samples with a high degree of accuracy.

A.2 Procedure to be adopted on the receiving platform

A.2.1 Colour

Observe the colour of the milk. If abnormal in colour, it should be held over for submission to confirmatory tests.

A.2.2 Odour and Taints

Smell the milk in the container immediately after removing the lid. In case of foul or abnormal smell, hold over the milk for submission to confirmatory tests.

Annex B (normative)

Determination of insoluble matter

B.1 Sediment test

B.1.1 Sediment test on raw milk reveals the extent to which visible insoluble matter has gained entrance to the milk and the extent to which such material has not been removed from milk by single service strainers.

The Sediment test represents a simple, rapid and quantitative measure of indicating the cleanliness of milk with respect to visible dirt.

Allow a measured quantity of milk to pass through a fixed area of a filter disc and compare the sediment left with the prepared standards.

B.1.2 Apparatus

- a) *Sediment tester* with filtering surface 24 mm in diameter.
- b) *White lintine cotton discs*, 32 mm in diameter, expected filtration area 28 mm in diameter.
- c) *Sampling dipper*, of 500 ml capacity for sampling from milk cans or weighing vats.
- d) *Standard sediment discs*. Use commercially available standard sediment discs

B.1.3 Procedure

Take a milk sample from well-stirred cans or vats of milk with the sampling dipper. Measure the quantity used with reasonable accuracy. Filter the milk through a properly adjusted, firm lintine cotton

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disc (rough side facing milk) held in the sediment tester so that a filtration area of 28 mm is exposed. Compare the sediment disc with the prepared sediment standard discs and record the sediment score.

B.1.4 Interpretation

For the purpose of comparison, it is convenient to use about five prepared standard discs so as to classify the milk with respect to its sediment content in accordance with the specific requirements of the dairy or the milk collection depot. For the former, five discs showing 0.1, 0.2, 0.5, 1.0 and 2.0 mg may suffice. Under rural conditions, discs showing 0.0, 0.5, 2.0, 5.0 and 7.0 mg sediment may be more convenient to start with. In either case, no attempt shall be made to estimate the degree of sediment in milk in more than five classes, for example, Excellent, Good, Fair, Bad and Very Bad. No attempt shall be made to grade as sediment, any hair, flies, piece of hay or straw or any large particles of dirt. These shall be reported separately.

The presence of appreciable sediment in unprocessed milk supplies indicates careless or insanitary dairy farm practice. However, the lack of sediment is not always indicative of ideal conditions, since visible sediment may be readily removed by straining at the dairy farm.

Annex C (informative)

Determination of pH

C.1 General

The pH value or hydrogen ion concentration gives a measure of the true acidity of milk. The relationship between pH and acidity of milk is only approximate. In normal cow milk the pH ranges from 6.6 to 6.8. The value is reduced by the development of acidity. On the other hand, the pH value of milk from a cow suffering from mastitis is alkaline in reaction, the value being over 7.0. The pH test is mainly used for the detection of abnormal mastitis in milk. The pH of milk may be determined rapidly by using the indicator strips.

C.2 Indicator strips

Indicator paper strips or discs are made by soaking strips of absorbent paper in a suitable indicator and drying them.

A rough estimate of pH is obtained by dipping a strip of the prepared paper in milk and observing the colour. Bromocresol purple (pH range 5.2 to 6.8 colour changes from yellow to purple) and bromothymol blue (pH range 6.0 to 7.6 colour changes from straw yellow to bluish-green) are commonly used as indicators. Both narrow and wide range ready-made indicator papers are available over the pH range 2.0 to 10.5.

NOTE - Indicator paper strips shall always be kept in closed glass bottles and under dry conditions.

C.3 Interpretation

In normal milk the pH is well below 6.9. On an average, cow milk gives a pH of 6.6. Milk of pH over 6.9 should be regarded with suspicion as indication of some diseases of the udder or of late lactation milk.

Annex D (normative)

Clot-on-boiling (C.O.B.) test

D.1 General

This is a quick test to determine developed acidity and the suitability of milk for processing.

D.2 Apparatus

- a) **Test-tube:** 15.6 cm x 1.9 cm, preferably with a mark at 5 ml.
- b) **Water-bath.**

D.3 Procedure

Transfer 5 ml of the sample to the test-tube and smell. Place the tube in a boiling water-bath and hold for about 5 min, and smell again for any acidic flavour. Remove the tube and rotate it in an almost horizontal position and examine the film of milk or side of the test-tube for any precipitated particles. The formation of clots is indicative of a positive test.

D.4 Interpretation

The principal features of the boiling test are speed and definiteness of results. Milk either remains unchanged or coagulates. Milk, which gives a positive C.O.B. test, has acidity generally above 0.17 % (as lactic acid) and is not suitable for distribution as liquid milk or for processing.

Annex E (normative)

Alcohol test

E.1 General

The alcohol test is used for rapid assessment of stability of milk to processing, particularly for condensing and sterilisation.

The alcohol test is useful as an indication of the mineral balance of milk and not as much as an index of developed acidity. The test aids in detecting abnormal milk, such as colostrum, milk from animals in late lactation, milk from animals suffering from mastitis and which the mineral balance has been disturbed.

E.2 Apparatus

- a) **Test-tubes,** 150 mm x 19 mm, preferably with graduation marks at 5 ml and 10 ml.
- b) **Measure for alcohol,** for 5 ml.

E.3 Reagent

Ethyl Alcohol, 68 % by weight or 75 % by volume (density 0.8675 g/ml at 27°C).

E.4 Procedure

Place 5 ml of milk in a test tube and add an equal quantity of alcohol. Mix the contents of the test tube by inverting several times.

Note any flakes or clots. The presence of a flake or a clot denotes a positive test.

E.5 Interpretation

A negative test indicates low acidity and good heat stability of milk sample.

Milk showing positive is not considered suitable for the manufacture of evaporated milk, which has to be sterilised to ensure its keeping quality.

Annex F (informative)

Alizarin-alcohol test

F.1 General

This test is similar to the alcohol test and the incorporation of alizarin helps to indicate the approximate percentage of acidity.

F.2 Apparatus

Same apparatus as described in **E.2**.

F.3 Reagent

Alizarin Solution, 0.2 % in ethyl alcohol (6.8 % by weight or 75 % by volume, density 0.867 5 g/ml at 27 °C).

F.4 Procedure

Place 5 ml of milk in a test-tube and add an equal quantity of the alizarin solution. Mix the contents of the test-tube by inverting several times. Note the colour of the mixture and presence of flakes or clots. Also note whether the flakes, if any, are small or large.

F.5 Interpretation

The general interpretation of the results is as indicated for the alcohol test (**see E.5**). For acidity of 0.14 % upwards, the graduation in size of the flakes and colour is approximately as follows:

Colour	Size of flakes	Approximate acidity (% lactic acid)
Lilac	---	Up to 0.14
Pale red	---	0.4 to 0.17
Reddish-brown to brown	Small flakes	0.17 to 0.20
Brownish-yellow	Large flakes	Over 0.20

If acidity has not developed and yet coagulation occurs, it indicates the presence of rennet producing bacteria (sweet curdling). Milk from animals suffering from mastitis is alkaline in reaction and when mixed with alizarin-alcohol solution, violet or purple colour is produced. From the practical point of view, it is of little material difference whether milk clots through the production of acid or the production of rennin by bacteria as in either case it is unstable to heat.

Annex G (normative)

Ten-minute resazurin test

G.1 General

This test provides a rapid measure of the sanitary condition and keeping quality of milk. Resazurin reduction occurs in two stages, the first an irreversible change from the blue resazurin to the pink resorufin and the second a reversible change from the pink resorufin to the colourless dihydroresorufin. The first stage of reduction or colour change from blue to pink is fairly easily brought about so that the quality of milk is assessed in much shorter time. Taking advantage of the two-stage reduction, several procedures have been proposed for reading the end point of resazurin test.

With fresh milk the observed change in resazurin reduction is due to the bacteria present and the leucocytes content. The reduction brought about by leucocytes, however, diminishes with the age of milk. Reduction can be assumed to be brought by the leucocytes if the colour in the down graded milk sample (for example, milk from animals suffering from mastitis) remains unchanged for a longer time than observed normally.

The test is intended as a platform test for detecting milk of poor keeping quality and shall be carried out on samples collected for bacteriological analysis.

G.2 Apparatus

- a) **Sterile test-tube without rims**, 150 mm x 16 mm internal diameter 13.5 mm \pm 0.5 mm accurately marked at 10 ml. If not used directly after sterilisation, they shall be kept in closed boxes protected from dust.
- b) **Sterilised rubber stoppers**, for closing the test tubes.
The stoppers are sterilised by immersing in a boiling water bath for not less than 10 min.
- c) **Sterile 1 ml pipettes**, straight-sided, blow-out delivery pipettes for measuring the dye solution (**see G.3**) shall preferably comply with the following specifications:

Overall length	300 mm
External diameter	7.5 mm to 8.5 mm
Graduation	one mark only at 1 ml level
Distance of graduation from tips	140 mm to 180 mm
Internal diameter	2.3 mm to 3.0 mm

The pipettes shall also be calibrated to deliver 1 ml of water at 27 °C when the contents are blown out with the tip touching the side of the vessel, three seconds allowed for drainage and the accumulated drop then blown out. No pipette should have an error of more than \pm 2 %, i.e. the amount delivered should be between 0.98 ml and 1.02 ml.

- d) **Sterile 10 ml pipettes**, Straight-sided, blowout type.

- e) **Sampling dippers**, these shall be sterilised by keeping in boiling water for 30 min. Water shall be changed at frequent intervals when a series of samples are to be examined.
- f) **Pipette case of metal.**
- g) **Water-bath**, Maintained at $37.5\text{ }^{\circ}\text{C} \pm 0.5\text{ }^{\circ}\text{C}$, fitted with a cover to exclude light and containing a metal rack designed to hold test tubes when immersed in water. The water-bath shall preferably be thermostatically controlled. The level of water in the bath shall be maintained above the level of the milk in the tubes. The interior of the bath shall be completely dark.
- h) **Stop watch.**
- i) **Hot air oven autoclave or steam-steriliser.**
- j) **Wire baskets**, for holding test tubes.
- k) **Glass marking pencil.**
- l) **Bunsen burner or spirit lamp.**
- m) **Comparator with standard resazurin disc.** The comparator may be provided with artificial daylight source of illumination.
- n) **Sterile 50 ml measuring flask or cylinder.**
- o) **Glass distiller**, for preparing distilled water.

G.3 Reagents

Sterile standard resazurin solution

Prepare 0.05 % (W/V) stock solution of resazurin in glass distilled, sterilised water. Preserve in tightly stoppered amber-coloured bottle in a refrigerator. Prepare a 0.005 % bench solution by diluting with sterile water. It shall be prepared fresh after every 8 h. When actually not in use, keep it in a cool dark place.

Resazurin powder shall conform to the following requirements:

- i) It shall contain sodium resazurate equivalent to $60\% \pm 3\%$ resazurin;
- ii) apart from traces of sodium resocerate, no other dyestuff shall be present;
- iii) the remaining part shall consist of sodium carbonate and/or sodium acetate and moisture only;
- iv) it shall give a colourless water-clear solution on reduction in alkaline solution; and
- v) at a concentration of 1 to 220 000 in fresh normal mixed cow milk of 3.4 % fat, it shall give a tintometer disc reading of not less than 6.

G.4 Procedure

Start the test as soon as possible after a group of samples has been taken and at least within 30 minutes.

Shake the sample container at least 25 times, each shake being an up and down movement with an excursion of about 30 cm, the whole process of shaking not exceeding 12 seconds. After shaking, take 10 ml for the test in the test tube. Place the tubes in numerical order, with the thumb and fingers

of the left hand, taking care not to touch the mouth of the tube. Measure 1 ml of the resazurin solution with a sterile pipette, insert the pipette about half an inch into the mouth of the tube and expel the solution by blowing.

Replace the stopper and invert the tube twice in 4 seconds and return to the rack. When resazurin has been added to a batch of not more than five tubes, place immediately in the water-bath and note the time. The delivery jet of the pipette shall not touch the milk in the tube. Any pipette becoming contaminated shall be immediately discarded. Use a fresh sterile pipette for every group of five samples.

At the end of 10 minutes and 30 seconds, remove the tubes from the water-bath and immediately match the colour with the resazurin disc in the comparator, recording the results for the tubes in the right section. The comparator and stand are placed on a bench at such a height that the operator is able to look down on the two apertures. The disc is then revolved until the sample is matched and the disc reading noted. When the colour falls between two disc numbers, it shall be recorded as the half value; for example, a reading between 3 and 4 shall be recorded as 3.5. Tubes giving a reading between 0 and 1, streaky pink or very pale pink are recorded as 0.5.

NOTE: It is an advantage for two persons to work in a team when a number of samples are to be taken rapidly, one to take the samples and the other to handle the containers and check the identity of the samples. Similarly, at the time of reading, one person to watch the tubes and another to record.

G.5 Precautions

The following precautions are necessary to get consistent results:

- a) All testers should be trained to correctly match the colours in the comparator.
- b) The control and experimental test tubes shall be of the same type and thickness of glass.
- c) Control samples used shall be from the same consignment as milk tested to compensate for the natural colour of milk.
- d) Resazurin solution, milk, and milk to which resazurin has been added shall not be exposed to direct sunlight in the laboratory.
- e) The water-bath shall be kept covered during the test.
- f) The temperature of the water-bath shall be checked before commencing each batch of tests.

G.6 Interpretation

The results shall be interpreted as follows:

Disc reading	Keeping quality
4 or higher	Satisfactory
3.5 to 1	Doubtful
4 or higher	Unsatisfactory

Annex H (normative)

Half-hour methylene blue reduction (m.b.r.) test

H.1 General

The length of time taken by milk to decolourise methylene blue is a fairly good measure of its bacterial content and hence its sanitary and keeping quality.

H.2 Apparatus

Same as in G.2.

H.3 Reagent

Methylene blue solution

Prepare a standard solution of methylene blue by dissolving one of the good quality methylene blue thiocyanate tablets in 200 ml of cold, sterile, glass-distilled water in a sterile flask. It is preferable to allow the mixture to stand for several hours to ensure complete solution.

Depending on the nature of methylene blue tablets used, sometimes the stock solution is further diluted with 800 ml of sterile glass distilled water. A concentration of 1 part of methylene blue thiocyanate in 300 000 parts of milk is used to obtain satisfactory results. The solution shall be stored in a sterile glass-stoppered amber-coloured bottle in a dark place and at no time exposed to light. The solution remains stable in the dark for a considerable time but no stock solution more than two months old shall be used.

The amount of methylene blue required for a day's work shall be poured off from the stock bottle into a suitable glass container. On no account shall the pipette used for transferring the methylene blue solution to the tubes of milk be introduced into the stock bottle. Moreover, if at any time during the filling of the tubes methylene blue solution should become contaminated with milk carried into it by a pipette, which has inadvertently come into contact with the milk, the methylene blue solution shall be immediately discarded and replaced by a fresh stock.

H.4 Procedure

Thoroughly mix the sample of the milk by inverting and shaking the sample bottle as described in Clause G.3 and then pour the milk in the test-tube up to the 10 ml mark.

While doing this, remove the stopper or cap of the bottle under aseptic conditions, the pouring lip of the bottle and the mouth of the test-tube being flamed, and then pour the milk rapidly into the tube up to the 10 ml mark. While pouring into the tube, take care to leave one side of the interior unwetted with milk. Add 1 ml of methylene blue solution to the tube from a pipette taking care that the pipette does not come into contact with any of the milk in the tube or with the wet side of the interior of the tube. If this occurs, discard the pipette immediately. During delivery, hold the tip of the pipette against the dry side of the tube about 1 cm to 2 cm above the level of the milk and expel the methylene blue solution by blowing with the mouth or by means of a jet in the pipette. After the lapse of 3 seconds, blow out the solution remaining in the tip of the pipette and withdraw the pipette. Close the tube with sterile forceps or by the tips of the fingers on the extreme upper end. On no account shall the fingers come into contact with the mouth of the test-tube or end of the stopper which comes into contact with the test-tube. Invert the tube slowly once or twice so that the whole column of contained air rises above the level of the milk and then within 5 min, place the tube in the water-bath.

Put up the following control tubes with each batch:

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- i) 10 ml of mixed milk + 1 ml of tap water.
- ii) 10 ml of mixed milk + 1 ml of methylene blue solution.

The milk for the control tubes shall consist of a mixture of milk, preferably from several products, so as to have an average fat content and colour. Fit the control tubes at (i) and (ii) with stoppers and immerse for 3 minutes in boiling water in order to destroy the natural reducing system present in the milk.

Comparison of the experimental tubes with control tube (ii) will show when decolourisation begins and comparison with control tube (i) will show when it is complete.

Inspect the tube after 30 minutes. Regard the milk as decolourised when the whole column of milk is completely decolourised or is completely decolourised up to within 5 mm of the surface. If a trace of colour persists at the bottom of the tube and does not extend upwards for more than 5 mm, it may be ignored. Record the time at which decolourisation is observed. Where a tube is found not to be decolourised within 30 minutes, the sample conforms to the test.

H.5 Precautions

The following precautions shall be taken:

- a) It is important that the methylene blue solution when not in use should be kept in the dark. It shall at no time be exposed to sunlight.
- b) It is essential that the interior of the water-bath during the progress of the tests shall be completely dark since sunlight, diffused daylight and even artificial light catalyse the reduction of methylene blue.
- c) The sterilisation of the rubber stoppers for the test tubes and their subsequent satisfactory manipulation can be facilitated by employing a simple rack for holding a large number of rubber stoppers immersed in a suitable vessel of boiling water.
- d) The precautions against the contamination of the milk sample described in the method for carrying out the test shall be carefully observed.

H.6 Interpretation

The samples, which show complete decolourisation of blue colour on incubation for 30 minutes or less, shall not be suitable for acceptance.