Packaged Full-Cream Milk

Good fats, bad fats and some microbiological facts

Gone are the days when one depended only on the local milk vendor for getting fresh milk (once upon a time the cow was brought to the customer's doorstep for milking, but that's another story altogether). Almost all items are now sold in readymade forms in packets and milk is no exception. The growing demand for milk largely explains the spurt in production as also in brands. At the same time, with adulteration of milk – with water, vegetable oils, detergents, caustic soda, urea, starch, blotting paper, white paint, etc. – increasingly becoming a reality and a concern, more and more consumers are switching to branded packaged milk. This report will, among other things, put to rest most of our concerns about milk adulteration and contamination, and affirm or dispute the health-related claims of leading brands of packaged full-cream milk.

A Consumer Voice Report

The testing was carried out in an NABL-accredited laboratory and it was mainly based on the relevant Indian Standard (IS 13688: 1999) and FSS Rules, 2011, for 'packaged pasteurized milk' wherein the categorization of milk has been done based on minimum quantity of milk fat present. Here, full-cream milk means milk or a combination of buffalo or cow milk or a product prepared by combination of both that has been standardized to

fat and solids-not-fat percentage, by adjustment/ addition of milk solids. Full-cream milk shall be pasteurized. It shall show a negative phosphatase test. It shall be packed in clean, sound and sanitary containers properly sealed so as to prevent contamination.

Phosphatase Test

Alkaline phosphatase (ALP) is an enzyme naturally present in all raw milks and is considered to be an indicator of proper milk pasteurization. Complete pasteurization will inactivate the enzyme to below levels that are detectable by conventional methods. Because the heat stability of ALP is greater than that of pathogens that may be present in milk, the enzyme serves as an indicator of product safety. However, the failure to detect ALP activity does not guarantee that the product is pathogen-free.

Packaged milk can be categorized according to fat and solids-not-fat (SNF) content as follows:

a) Full-cream milk: Fat 6.0 per cent and SNF 9 per cent (minimum)
b) Toned milk: Fat 3.0 per cent and SNF 8.5 per cent (minimum)
c) Double-toned milk: Fat 1.5 per cent and SNF 9 per cent (minimum)

The terms 'pasteurization', 'pasteurized' and similar terms shall be taken to refer to the process of heating every particle of milk of different classes to at least 63 degrees Celsius and holding it at such temperature continuously for at least 30 minutes, or heating it to at least 71.5 degrees C and holding at such temperature continuously for at least 15 seconds, or an approved temperature–time combination that will serve to give a negative phosphatase test.

CV Recommendations | Top Performers

Parag Gold | Verka Gold | Paras

BRANDS TESTED

We tested 12 brands of full-cream packaged milk on parameters like milk fat, milk solids not fat, cholesterol and calcium. The brands were subjected to adulteration tests for neutralizers, detergents, urea, caustic sodas, formaldehyde and melamine, in addition to microbiological and sensory tests. Milk is expected to be high in fat content as well as milk solids not fat (SNF), which is an indicator of the quality of milk. Milk tends to spoil if not stored at a holding temperature below 8 degrees C. Therefore it should be boiled before consumption to prevent microbiological contamination.

Comparative Test

Rank	Total Score out of 100 (Rounded off)	Brand	Price (Rs)/500 ml	Manufactured/Marketed by
1	88	Parag Gold	24	Parag Dairy, NOIDA
1	88	Verka Gold	23	Ropar District Cooperative Milk Producers' Union Ltd, Milk Plant, SAS Nagar (Mohali), Punjab
1	88	Paras	24	VRS Foods Ltd, Sahibabad, Uttar Pradesh
2	87	Mother Dairy	24	Mother Dairy Fruit & Vegetable Pvt. Ltd, Delhi
3	86	Reliance Dairy Life	24	Reliance Dairy Foods Ltd, Mankoli, Thane, Maharashtra
3	86	Madhusudan	24	Creamy Foods Ltd, Khurja, Bulandshahr, Uttar Pradesh
4	85	Gopaljee Ananda	24	Gopaljee Dairy Food Pvt. Ltd, Siyana, Bulandshahr, Uttar Pradesh
4	85	Amul Gold	24	Gujarat Cooperative Milk Marketing Federation Ltd, Anand, Gujarat
4	85	Gokul	24	Kolhapur Zilla Sahakari Dudh Utpadak Sangh Ltd, Vashi, Navi Mumbai
5	84	Saras Gold	24	Alwar Dairy, Alwar Zila Dudh Utpadak, Sanakari Sangh Ltd, Alwar, Rajasthan
5	84	DMS	24	Delhi Milk Scheme, New Delhi
6	83	Vita Gold	24	Ballabgarh Cooperative Milk Producers' Union Ltd, Ballabgarh, Faridabad, Haryana

*Score rating: >90: excellent*****, 71–90: very good****, 51–70: good***, 31–50: average**, up to 30: poor**

KEY FINDINGS

- Parag, Verka and Paras scored top among the brands tested.
- Most of the brands had standard fat contents to just meet the minimum requirement of 6 per cent for fat and 9 per cent for SNF. Verka had the highest fat content, followed by Madhusudan and Gokul. Reliance was found with the highest SNF, followed by Parag and Vita.
- Nine out of the 12 tested brands of milk were found to be microbiologically unsafe for direct consumption (without boiling) as these contained a high level of total plate count. Three brands – Madhusudan, Reliance and Vita – met the total plate count requirement (below 30,000 cfu/gram).
- The Food Safety and Standards Authority of India (FSSAI) has prescribed microbiological standard at plant level only. Such requirement should also be applicable at retailer level so that consumers get a safe product.
- Consumers are advised not to buy milk packets kept in the open. They should buy milk from retailers who keep it in deep freezer/refrigerator.
- All brands of packaged milk were found free from adulteration by neutralizers, detergents, caustic sodas, urea, formaldehyde and melamine. No synthetic milk traces were found. Oxytocin was also not detected in any brand.

TEST RESULTS

FOR PHYSICOCHEMICAL PARAMETERS

Milk fat | Milk solids not fat | Cholesterol | RM value | BR reading | Saturated fat | Calcium | Vitamin A

◆ Milk fat

The fat content of milk is the proportion of milk made up by butter fat. As per Indian Standard and FSS Rules, 2011, fat content of full-cream milk should not be less than six per cent by mass.

- *All brands met the minimum required limit for fat content.*
- *Verka (6.69 per cent) had the highest fat content, followed by Madhusudan (6.65 per cent) and Gokul (6.60 per cent). Gopaljee Ananda (6.0 per cent), Saras (6.01 per cent) and Reliance (6.2 per cent) just about fulfilled the minimum requirement.*

◆ Milk solids not fat

Milk has mainly two constituents: fat and solids not fat (SNF). Solids such as vitamins, minerals, protein and lactose together make up SNF. SNF is the most essential part of the milk. As per Indian Standard and FSS Rules, it should not be less than nine per cent by mass

- *Reliance (9.80 per cent) was found with the highest SNF, followed by Parag (9.65 per cent) and Vita (9.30 per cent).*

- *SNF in Mother Dairy (8.96 per cent) and Saras (8.98 per cent) was marginally less than the minimum requirement. All other brands met the minimum requirement for SNF.*

◆ Cholesterol

Cholesterol plays a central role in many biochemical processes but is best known for the association of cardiovascular disease. Cholesterol, especially bad cholesterol (low-density lipoproteins, LDL), also increases the risk of nervous system problems, weak brain synapse connectivity, gall bladder stones and perhaps even cancer. These cholesterols are inherently found in the milk fats. The intake of cholesterol should not be more than 300 mg/day.

- *Paras (6.48 mg/100 g) had the lowest cholesterol content, followed by Saras (8.10 mg/100 g) and Verka (8.67 mg/100 g).*
- *DMS (13.63 mg/100 g) was found with the highest cholesterol content, followed by Amul (12.48 mg/100 g) and Madhusudan (11.72 mg/100 g).*

◆ Reichert Meissl (RM) value

The Reichert Meissl (RM) value determines adulteration, if any.

- *All brands had more than the minimum value required to ensure the quality of milk fat.*

◆ BR reading

This can be used to check the adulteration of milk fat, particularly if adulterated with vegetable oils. If BR reading defers from the prescribed limit of variability (not more than 42 in case of non-cotton tract area and 45 in case of cotton tract area), presence of foreign fat may be suspected.

- *BR reading in all the brands was below 45.*

PHYSICOCHEMICAL

Parameter ↓	Weightage (%)	Parag Gold	Verka Gold	Paras	Mother Dairy	Reliance Dairy Life
Milk fat	15	11.28	12.57	10.71	12.24	11.10
Milk solids not fat	12	10.95	9.03	9.06	8.88	11.40
Cholesterol	8	6.21	6.53	7.41	6.50	5.39
RM value	5	4.39	4.40	4.45	4.47	4.42
BR reading	5	3.69	3.69	3.90	3.96	3.57
Saturated fat	5	3.46	4.18	3.34	3.02	3.30
Calcium	6	5.36	4.49	5.48	3.98	3.68
Vitamin A	4	3.07	3.42	3.56	3.47	3.41

◆ Saturated fat

Saturated fats are inherent fats in milk. These are mainly animal-based fats like milk fat, ghee and butter. An average person should limit the daily intake of saturated fat to not more than 8 to 10 per cent. Intake of a lot of saturated fat increases the level of bad cholesterol in the blood and it is generally acknowledged that high levels of LDL can place one at risk of heart disease.

- *Verka (3.52 per cent) was found with lower saturated fat content compared to the other brands, followed by Gokul (3.90 per cent). Madhusudan (5.0 per cent) was found with highest saturated fat.*

◆ Calcium

Calcium plays an important role in building stronger, denser bones early in life and keeping bones healthy later in life. Calcium deficiency can lead to rickets and poor blood clotting and osteoporosis. Milk is a well-known source of calcium and hence expected to be rich in calcium content.

- *Paras (168.19) was found with the highest calcium content, followed by Parag (166.2) and Gokul (164.08).*

◆ Vitamin A

Vitamin A is essential for good health – notably for eyes and skin, immune function, reproduction and bone growth. Milk is a rich source of vitamin A.

- *Gopaljee Ananda (2.11 mg/kg) was found with higher vitamin A content, followed by Paras (1.83 mg/kg) and Mother Dairy (1.76 mg/kg).*
- *Vitamin A was not detected in Vita and Saras.*

Heavy Metals

Heavy metals have a relatively high density and are toxic or poisonous at high concentrations. We analysed milk for lead, copper, arsenic, tin, zinc and cadmium content. As per the requirement laid down by FSS Rules, lead should not be more than 2 ppm, copper not more than 30 ppm, arsenic not more than 0.1 ppm, tin not more than 250 ppm, zinc not more than 50 ppm, and cadmium not more than 1.5 ppm.

Lead, arsenic, tin and cadmium were not detected in any of the brands. Zinc and copper were found in some brands but were well below the maximum specified limit. Overall, all brands passed the tests for heavy metals.

SCORES

	Madhusudan	Gopaljee Ananda	Amul Gold	Gokul	Saras Gold	DMS	Vita Gold
	12.45	10.50	11.97	12.30	10.53	11.13	10.86
	9.18	9.30	9.00	9.54	8.94	9.15	9.90
	5.31	5.86	5.02	5.78	6.72	4.55	6.12
	4.66	4.40	4.70	4.43	4.40	4.43	4.43
	3.87	3.66	3.75	3.69	4.32	3.39	3.87
	3.00	3.36	3.08	3.88	3.38	3.34	3.44
	4.11	3.97	4.28	5.10	4.94	4.73	3.64
	3.17	3.89	3.10	2.88	0.80	2.94	0.80

FOR MICROBIOLOGICAL ACTIVITY

Total plate count | Methylene blue reduction time

Microbiological contamination is a very serious issue for milk. Microorganisms are responsible for many food-borne diseases. We conducted tests for total plate count and methylene blue reduction time (MBRT). These tests were carried out on poly-packed milk purchased from retailers. It may be noted that FSSAI has specified requirement at plant level only; no requirement is specified for retailer level.

◆ Total plate count, colony-forming units (cfu)/ml

The total plate count is a measure of the biological activity in milk sample. This is a count of all bacteria, fungi and yeast that will grow in aerobic conditions. As per FSS Regulation, total plate count should not be more than 50,000 cfu/gram at plant level.

- *Madhusudan, Reliance and Vita met the TPC requirement.*
- *Other brands did not meet the requirement for total plate count. Gokul (7,200,000 cfu/ml) was found with highest total plate count, followed by Verka (710,000 cfu/ml) and Amul (410,000 cfu/ml).*

Keeping in view the very high level of microbial count (that is, total plate count), we do not recommend these brands as safe for direct consumption unless adequately boiled

A high level of microbial count in milk may be due to not maintaining cold chain during storage and transportation (below 8 degrees C) from plant to retailer. Similar results were found in our previous study conducted in 2011. FSS Rules, 2011, and Bureau of Indian Standards (BIS) state that milk should meet the specified requirement for microbial content at processing/plant level only. The fact is proper temperature needs to be maintained all the way to the delivery point – the cold chain must be maintained at 8 degrees C to avoid microbial growth. Consumers are advised to avoid buying milk packets kept in the open.

◆ Methylene blue reduction time (MBRT)

Methylene blue reduction time is an indicative test to check the bacterial load in milk. As per Indian Standard, MBR time for milk is not less than five hours.

- *Except Gokul, all other brands met the requirement for MBRT.*

All Pass

- ✓ All brands passed the phosphatase test.
- ✓ All brands of milk were found free from adulteration with neutralizers, detergents, caustic sodas, urea, formaldehyde and melamine. They met the requirements of Indian Standard and FSS Rules.
- ✓ Oxytocin was not detected in any brand. (Daily oxytocin injections given immediately before milking increase milk production. Oxytocin does not increase the amount of milk but makes it flow faster.)

FOR SENSORY ATTRIBUTES

The product was judged by panel members on these parameters: colour and appearance, flavour, odour and taste. Among other things, milk should be free from suspended particles, filth and foreign matters. It should not have stale, acidic or any other abnormal odour. Milk should not have any cooked, oxidized, rancid, metallic or neutralizer flavour. It should be free from any objectionable flavour due to adulterants and other additives. Milk should be free from watery, ropy and curdy body.

- *All brands performed well in the sensory tests.*

Packing and Marking

Milk should be packed in food-grade poly pack to retain its natural properties within its shelf life.

Each packet of milk should be marked/labelled with these particulars:

a) Name and type of product with proper prefix (toned, full cream, etc.)

b) Name and complete address of manufacturer and manufacturing unit/packer

c) Batch or code number

d) Net quantity in litre/millilitre

e) 'Use by' date

f) MRP

g) Storage instructions

h) Nutritional information per 100 ml

i) Name, address, telephone number, email address of person/office to be contacted in case of consumer complaints

- *All brands were properly packed in poly pack.*
- *All brands provided all required information on their pack.*
- *Only Madhusudan has the green dot – however, it is not a mandatory requirement.*

TERMS TO KNOW

Pasteurization

Pasteurization is the process of heating a food, usually liquid, to a specific temperature for a definite length of time, and then cooling it immediately. This process slows microbial growth in food.

Unlike sterilization, pasteurization is not intended to kill all microorganisms in the food. Instead, pasteurization aims to reduce the number of viable pathogens so they are unlikely to cause disease (assuming the pasteurized product is stored as indicated and consumed before its expiration date).

Pasteurization is typically associated with milk. It is the main reason for milk's extended shelf life. High temperature–short time (HTST) pasteurized milk typically has a refrigerated shelf life of two to three weeks. There are two main types of pasteurization used today: HTST and extended shelf life (ESL) treatment. In the HTST process, milk is forced between metal plates or through pipes heated on the outside by hot water, and is heated to 71.7 degrees C (161 degrees F) for 15–20 seconds. ESL milk has a microbial filtration step and lower temperatures than ultra-high temperature (UHT).

Sterilization

Sterilization refers to any process that eliminates (removes) or kills all forms of life, including transmissible agents (such as fungi, bacteria, viruses, spore forms, etc.) contained in a food, liquid, etc.

To keep milk for longer than few days at ambient temperature, it needs to be sterilized. The traditional process involves heating milk in a sealed container in the temperature range 114–120 degrees C for 20–30 minutes.

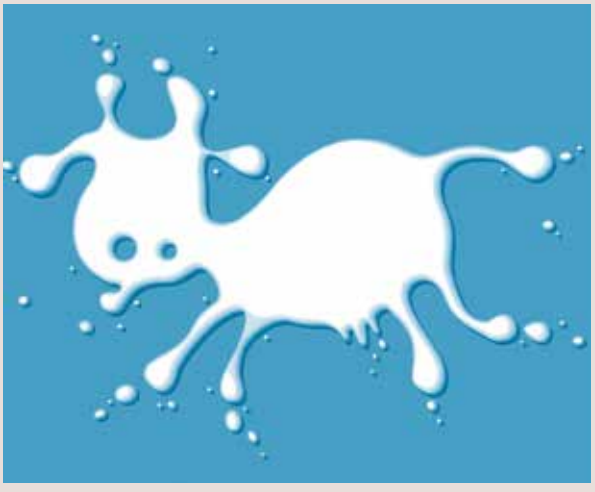
More recently, UHT processes have been introduced. When UHT is combined with sterile handling and container technology (such as aseptic packaging), it can even be stored unrefrigerated for 6–9 months. UHT processing holds the milk at a temperature of 135 degrees C (275 degrees F) for a minimum of one second.

Milk simply labelled 'pasteurized' is usually treated with the HTST method, whereas milk labelled 'ultra-pasteurized' or simply 'UHT' has been treated with the UHT method.

Microorganism

Microorganism is the term applied to all microscopically small living organisms. We tend to associate microorganisms with disease. Microorganisms that cause disease are called pathogens. However, few microorganisms are pathogens and microorganisms play a crucial part in the life of our planet. For example, they provide food for fish; they occur in soil where they provide nutrients for plants; and they play an important role in ruminant digestion.

In dairying, some microorganisms are harmful (for example, spoilage organisms, pathogens) while others are beneficial (cheese and yoghurt starters, yeasts and moulds used in controlled fermentations in milk processing). The microorganisms principally encountered in the dairy industry are bacteria, yeasts, moulds and viruses.



Bacterial growth is affected by (a) temperature, (b) nutrient availability, (c) water supply, (d) oxygen supply, and (e) acidity of the medium. Milk fresh from a healthy cow contains few bacteria, but contamination during handling can rapidly increase bacterial numbers. Milk is an ideal food and many bacteria grow readily in it. In addition to being a nutritious food for humans, milk provides a favourable environment for the growth of microorganisms. Yeasts, moulds and a broad spectrum of bacteria can grow in milk, particularly at temperatures above 16 degrees C. The temperature of freshly drawn milk is about 38 degrees C. Bacteria multiply very rapidly in warm milk and milk sours rapidly if held at these temperatures.

Microbes can enter milk via the cow, air, feedstuffs, milk-handling equipment and the milker. Once microorganisms get into the milk, their numbers increase rapidly. It is more effective to exclude microorganisms than to try to control microbial growth once they have entered the milk. Milking equipment should be washed thoroughly before and after use—rinsing is not enough.

Microbial growth can be controlled by cooling the milk. Most microorganisms reproduce slowly in colder environments. Cooling milk also slows chemical deterioration.

Our Advice

- For better shelf life, store the poly-packed milk below 8 degrees C.
- Consume the poly-packed milk after boiling, because boiling of milk kills the microbial load.
- Raw milk should also be boiled as early as possible.
- Tetra-packed milk is sterilized – that is, all living organisms are killed. While it is safe and does not need boiling, it is expensive for most consumers.

Boiling of Milk

As per a study published in *The Journal of American Science*, boiling of milk is recommended as follows:

Milk boiling for two minutes provides the required safety. However, continuous stirring is essential, particularly at boiling temperature, to make sure that the formed foam is exposed to boiling temperature.

A large number of people heat and re-heat the same milk again and again, and that too at a high temperature for a long time, thus killing the nutrients. According to experts, milk subjected to less heating retains its nutrient value. Experts say milk should ideally be boiled not more than twice and not for more than 2 to 3 minutes.

Aren't raw or natural foods better than processed foods?

Many people believe that foods with no or minimal processing are better for their health. Many people also believe that small, local farms are better sources of healthy food. However, some types of processing are needed to protect health. For example, consumers process raw meat, poultry and fish for safety by cooking. Similarly, when milk is pasteurized, it is heated just long enough to kill disease-causing germs. Most nutrients remain after milk is pasteurized.

Does drinking raw milk prevent or cure any diseases, such as asthma, allergies, heart disease, or cancer?

No. There are no health benefits from drinking raw milk (milk that has not been pasteurized to kill harmful germs) that cannot be obtained from drinking pasteurized milk that is free of disease-causing bacteria. The process of pasteurization of milk has never been found to be the cause of chronic diseases, allergies, or developmental or behavioural problems.

How does pasteurization work in milk?

Pasteurization is the process of heating milk to a high-enough temperature for a long-enough time to kill illness-causing bacteria contained in the milk. As most commonly applied, pasteurization heats milk to a high temperature for a short time, which kills the bacteria that cause illness. It was invented in a time when millions of people became sick and died of diseases like tuberculosis, scarlet fever, typhoid fever and other infections that were transmitted through raw milk.

Raw milk contains bacteria, and some of them can be harmful. So, if you're thinking about consuming raw milk because you believe that it is a good source of beneficial bacteria, you need to know that it isn't and you may instead get sick from the harmful bacteria. If you think that certain types of bacteria may be beneficial to your health, consider getting them from foods that don't involve such a high risk. For example, so-called probiotic bacteria are sometimes added to pasteurized fermented foods, such as yogurt.

How does milk get contaminated?

Milk contamination may occur from:

- Cow faeces coming into direct contact with the milk
- Infection of the cow's udder (mastitis)
- Cow diseases (for example, bovine tuberculosis)
- Bacteria that live on the skin of cows
- Environment (for example, faeces, dirt, processing equipment)
- Insects, rodents and other animal vectors
- Humans (for example, by cross-contamination from soiled clothing and boots)

Source: http://www.cdc.gov/