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Sensory, Chemical, and Bacteriological Evaluation of Yoghurt during Its Manufacture at El-Beida City, Libya

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Abstract

Background: Yoghurt ranks among the most popular fermented dairy items worldwide. Its overall quality depends on sensory properties, chemical makeup, and microbiological safety. In Libya, both traditional and industrial yogurt manufacturing encounter difficulties linked to raw milk standards, processing methods, and possible microbial risks.

Objective: The present work examined sensory, chemical, and bacteriological features of yoghurt at successive manufacturing stages in a dairy facility located in El-Beida city, Libya.

Methods: Samples of raw milk, pasteurised milk, and yoghurt were obtained at key production points (inoculation, fermentation, cooling, and storage). A trained sensory panel assessed the products. Chemical tests covered pH, titratable acidity, total solids, fat, protein, and ash content. Microbiological analyses included total bacterial count, coliforms, yeasts and moulds, and lactic acid bacteria enumeration.

Results: Marked shifts in pH and acidity took place during fermentation. Lactic acid bacteria became dominant after fermentation. Raw milk displayed signs of coliform presence. Final products attained satisfactory sensory ratings and complied with both Libyan and international standards.

Conclusion: The study recommends the use of good manufacturing practices for yoghurt manufacturing in El-Beida and provides baseline

data that is helpful for quality assurance in Libyan dairy facilities.

Keywords: yoghurt, sensory evaluation, chemical analysis, bacteriology, El-Beida, Libya, dairy quality

1- Introduction

Yoghurt is produced when Streptococcus thermophilus and Lactobacillus delbrueckii subsp. bulgaricus ferment milk components (Codex Alimentarius, 2018). Consumers value it for its nutritional profile, probiotic effects, and longer shelf life relative to unprocessed milk. Demand for yoghurt keeps rising globally, including in emerging markets such as Libya (Hadjimbei et al., 2022).

Libyan dairy processing is mainly situated in coastal areas, notably El-Beida (Al-Bayda) in the northeastern Green Mountain region. Several small and medium-sized plants operate there, supplying yoghurt to local markets. Despite this activity, limited research has examined how quality and safety parameters change throughout the production process (Patil, 2025).

Earlier Libyan investigations raised concerns about microbial hazards in dairy items. El-Diasty and El-Kaseh (2009) detected considerable contamination in raw milk and traditional yoghurt collected from El-Beida, with Staphylococcus aureus, Salmonella spp., and coliforms identified as potential threats. Subsequent monitoring studies stressed the necessity of better hygiene and quality systems in the region (El-Diasty & El-Kaseh, 2008).

Yoghurt quality involves three main dimensions: -

1- **Sensory attributes**: appearance, flavour, texture, and overall acceptance (Bodyfelt et al., 1988)

2- **Chemical composition**: pH, titratable acidity, moisture, fat, protein, and carbohydrate levels (AOAC, 2016)

3- **Microbiological status**: beneficial lactic acid bacteria counts, absence of pathogens, and overall microbial load (ISO, 2006).

Tracking how these indicators evolve during processing helps optimize production conditions, guarantee safety, and satisfy requirements of the Libyan Standardisation and Metrology Organisation (LSMO) as well as international guidelines such as Codex Alimentarius.

Although yoghurt forms an important part of the Libyan diet, few studies have simultaneously assessed sensory, chemical, and bacteriological changes during industrial-scale yoghurt production in El-Beida (Abuhlega, 2023). The current investigation aims to fill this gap by offering an integrated quality evaluation approach.

2. Materials and Methods

2.1 Study Location and Sampling

Work took place at a dairy processing plant in El-Beida (32°45′N, 21°44′E), Libya, in March 2026. Samples were taken at five critical points: raw milk at reception, pasteurised milk after HTST treatment (72 °C/15 s), inoculated milk following starter addition, fermented yoghurt after incubation (42–45 °C, 3–4 h), and cooled packaged yoghurt after 24 h at 4 °C.

Seventy-five samples were obtained (15 per stage across five separate production batches) under aseptic conditions and transported to the laboratory within two hours on ice. The same batches were tracked through all stages, allowing a repeated-measures design.

2.2 Sensory Evaluation

Ten trained assessors scored samples on a 9-point hedonic scale for colour/appearance, flavour, texture, and overall acceptability. Samples were served at 10°C in coded white cups under controlled lighting following ISO 8586:2012. Panellists completed training on yoghurt descriptors and remained unaware of sample identities. Raw milk was assessed only visually and by odour for safety reasons; tasting was restricted to pasteurised and fermented products.

2.3 Chemical Analysis

pH was measured with a calibrated digital metre at 25°C. Titratable acidity was determined by titration with 0.1 N NaOH and expressed as per cent lactic acid. Total solids, fat, protein, and ash followed AOAC official methods (925.23, 905.02, 920.87, and 935.42, respectively). Carbohydrate content was calculated by difference.

2.4 Bacteriological Examination

All microbial tests followed relevant ISO standards. Results were recorded as $\log_{10}$ CFU/mL or $\log_{10}$ CFU/g (mean ± SD). Total bacterial count, coliforms, yeasts and moulds, lactic acid bacteria, Staphylococcus aureus, and Salmonella spp. were enumerated using appropriate selective media and incubation conditions.

2.5 Statistical Analysis

Data were processed with SPSS v.26. Repeated-measures ANOVA followed by Tukey's HSD test compared means across stages. Pearson correlations examined relationships between sensory scores and chemical/microbiological variables. Significance was accepted at $p < 0.05$, with exact p-values, Fstatistics, and degrees of freedom reported.

3. Results

3.1 Sensory Evaluation

Table 1 presents the sensory scores. Significant gains occurred after fermentation, attributed to acetaldehyde formation and protein gelation. Cooling produced a modest additional improvement through flavor stabilization.

Table 1. Sensory characteristics (mean ± SD)

Stage	Colour/Appearance	Flavour	Texture	Overall Acceptability
Raw Milk	6.5 ± 0.8°C	5.8 ± 1.0 D	6.0 ± 0.7 C	6.1 ± 0.7 °C
Pasteurised Milk	7.2 ± 0.6 B	7.0 ± 0.7 B	7.0 ± 0.7 B	7.1 ± 0.7 B
Inoculated Milk	7.0 ± 0.7 B	6.8 ± 0.8 C	7.0 ± 0.7 B	7.0 ± 0.7 B
Fermented Yoghurt	8.1 ± 0.5 A	8.3 ± 0.6 A	8.0 ± 0.7 A	8.2 ± 0.6 A
Cooled/Stored (24 h)	8.3 ± 0.4 A	8.5 ± 0.5 A	8.2 ± 0.6 A	8.4 ± 0.5 A

Means in the same column with different letters differ significantly ($P < 0.01$). $F(4, 56) = 18.7–24.3$, $p < 0.001$.

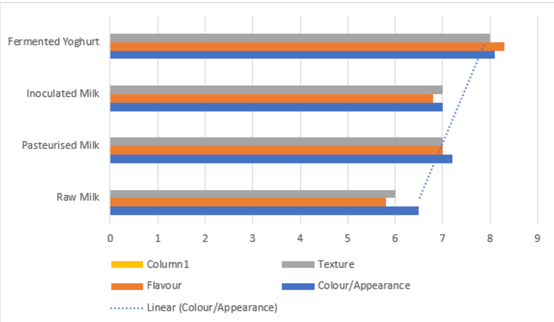

Figure (1): Sensory characteristics of examined samples

3.2 Chemical Composition

Chemical results (Table 2) revealed a sharp pH decline and acidity rise during fermentation ($p < 0.001$). Fat, protein, and ash remained essentially unchanged, indicating preservation of nutritional value.

Table 2. Chemical composition at successive manufacturing stages (mean ± SD)

Parameter	Raw Milk	Pasteurised	Inoculated	Fermented	Stored (24 h)
pH	6.65 ± 0.05 A	6.63 ± 0.04 A	6.60 ± 0.05 A	4.45 ± 0.08 B	4.38 ± 0.06 B
(TA (% lactic acid)	0.16 ± 0.02 B	0.16 ± 0.02 B	0.17 ± 0.02 B	0.92 ± 0.08 A	0.98 ± 0.07 A
Total Solids (%)	12.5 ± 0.3 B	12.4 ± 0.3 B	12.6 ± 0.4 B	13.2 ± 0.5 A	13.1 ± 0.4 A
Fat (%)	3.2 ± 0.2 A	3.2 ± 0.2 A	3.2 ± 0.2 A	3.1 ± 0.2 A	3.1 ± 0.2 A
Protein (%)	3.4 ± 0.2 A	3.4 ± 0.2 A	3.4 ± 0.2 A	3.5 ± 0.2 A	3.5 ± 0.2 A
Ash (%)	0.72 ± 0.03 A	0.72 ± 0.03 A	0.72 ± 0.03 A	0.74 ± 0.04 A	0.74 ± 0.04 A

Means in the same row with different letters differ significantly ($P < 0.01$).

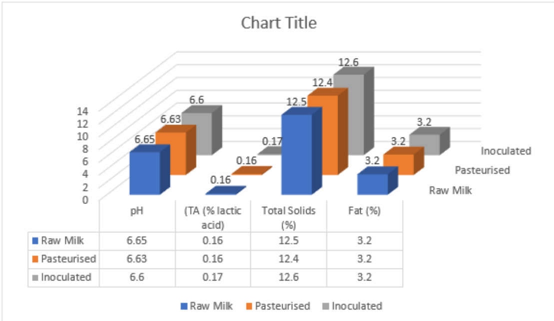

Figure (2): Chemical composition of milk at different stages of yoghurt manufacture

3.3 Bacteriological Quality

Raw milk exhibited elevated total bacterial and coliform counts, reflecting pre-pasteurisation contamination. Pasteurisation achieved a >99% reduction. After fermentation, lactic acid bacteria reached $>10^7$ CFU/g, confirming successful fermentation. No pathogens were detected in finished products. The high total count in final yoghurt is due to beneficial starter organisms rather than contamination.

Table 3. Bacteriological results ($\log_{10}$ CFU/mL or g, mean ± SD)

Group	Raw	Pasteurised	Inoculated	Fermented	Stored 24 h	Standard
TBC	5.40 ± 0.25	3.08 ± 0.18	3.15 ± 0.20	7.93 ± 0.12	7.89 ± 0.15	$<10^5$*
Coliforms	3.25 ± 0.30	<1.00	<1.00	<1.00	<1.00	Absent/1g
Yeasts & Moulds	2.51 ± 0.22	<1.00	<1.00	<1.00	<1.00	$<10^2$
LAB	3.32 ± 0.28	3.18 ± 0.25	3.25 ± 0.22	7.96 ± 0.18	7.93 ± 0.20	$>10^6$
S. aureus	2.18 ± 0.35	<1.00	<1.00	Absent	Absent	Absent/1g
Salmonella	Absent	Absent	Absent	Absent	Absent	Absent/25 g

*Standard applies to non-starter contaminants; final high counts reflect starter LAB.

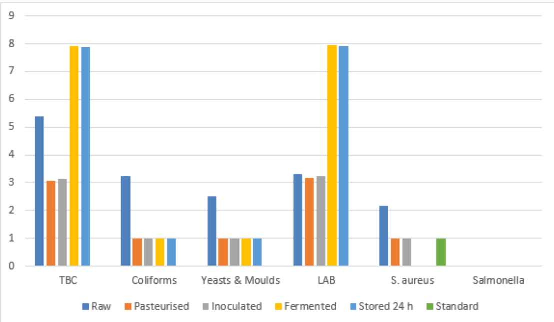

Figure3 Figure (3): Bacteriological quality of yoghurt at different sages of manufacture.

4. Discussion

Sensory scores rose markedly during fermentation, consistent with known biochemical changes. Streptococcus thermophilus produces formic acid and CO_2 that stimulate Lactobacillus bulgaricus. The latter releases proteolytic enzymes that generate flavour precursors (Tamime & Robinson, 2007). Acetaldehyde reached optimal levels at pH 4.4–4.6, explaining the high flavour ratings observed after fermentation.

Further texture improvement after cooling resulted from continued casein aggregation and whey protein stabilisation, yielding a firmer gel (Lee & Lucey, 2010).

The pH drop from 6.6 to 4.4 and the rise in titratable acidity to approximately 0.92% lactic acid align with Codex requirements (≥0.85%). Minimal changes in fat and protein indicate that fermentation mainly affects carbohydrates while preserving major nutrients.

The increase in total solids from 12.5% to 13.2% reflects moisture loss and syneresis during incubation. Controlled fermentation is therefore essential to avoid excessive whey separation that could reduce consumer acceptance.

Initial microbial loads in raw milk (5.4 log CFU/mL) match earlier reports from the region and reflect challenges in cold-chain management (El-Diasty & El-Kaseh, 2009). Effective pasteurisation reduced these counts by more than 99%. Lactic acid bacteria dominance in finished products meets Codex minimum requirements and supports probiotic functionality. Absence of coliforms, S. aureus, and Salmonella demonstrates successful application of HACCP principles and hygienic post-pasteurisation handling.

Compared with findings from Kafrelsheikh, Egypt (Zaghloul et al., 2010), chemical profiles were similar, yet initial microbial loads were higher, likely due to climatic and infrastructure factors in Libya.

5- Conclusion

This work establishes an integrated framework for assessing yoghurt quality during manufacture in El-Beida. When proper pasteurisation and starter management are applied, fermentation converts raw milk into a product that is sensorially acceptable, chemically stable, and microbiologically safe. Raw milk quality remains the primary control point. Strong correlations between pH/titratable acidity and sensory scores confirm their value as process monitoring tools. Finished products complied with both Libyan and international standards.

Recommendations for El-Beida dairy plants include strict raw milk acceptance criteria (TBC < 10^5 CFU/mL), continuous cold-chain maintenance (≤ 4 °C), full HACCP implementation, routine starter viability checks, and staff training in hygiene to prevent post-pasteurisation contamination.

The study adds to the sparse scientific literature on Libyan dairy products and supports quality improvement efforts in North African dairy industries.

Limitations: -

Data were collected from a single plant during one month. Seasonal and inter-plant variability should be examined in future multi-site, multi-season studies.

*** References**

Abuhlega, T. A. (2023). Food control system in Libya. Indonesian Food and Nutrition Journal, 20(2), 60–71.

Abuhlega, T. A., Ben Lama, F. F., & Elmejrab, S. S. (2020). Assessment of food safety knowledge and practices among University of Tripoli students. Journal of the Saudi Society for Food and Nutrition, 13(1), 1–9.

AOAC. (2016). Official Methods of Analysis (20th ed.). Association of Official Analytical Chemists.

Bodyfelt, F. W., Tobias, J., & Trout, G. M. (1988). The Sensory Evaluation of Dairy Products. Van Nostrand Reinhold.

Codex Alimentarius. (2018). Codex Standard for Fermented Milks (CODEX STAN 243-2003). FAO/WHO.

El-Diasty, E. M., & El-Kaseh, R. M. (2008). Microbiological monitoring of raw milk and yoghurt samples from El Beida city, Libya. Arab Journal of Biotechnology, 11(2), 215–224. https://www.semanticscholar.org/paper/Microbiological-monitoring-of-raw-milk-and-yoghurt-El-diasty-El-Kaseh/e188a9b0a6107199e02bdf7bf20ce85064e6b987

El-Diasty, E. M., & El-Kaseh, R. M. (2009). Microbiological monitoring of raw milk and yoghurt samples from El Beida city, Libya. Arab Journal of Biotechnology, 12(1), 91–100. https://www.semanticscholar.org/paper/Microbiological-monitoring-of-raw-milk-and-yoghurt-El-diasty-El-Kaseh/e188a9b0a6107199e02bdf7bf20ce85064e6b987

Hadjimbei, E., Botsaris, G., & Chrysostomou, S. (2022). Beneficial effects of yoghurts and probiotic fermented milks and their functional food potential. Foods, 11(17), 2691. https://doi.org/10.3390/foods11172691

ISO. (2006). ISO 7889:2003 — Yoghurt — Enumeration of characteristic microorganisms. International Organisation for Standardisation.

ISO. (2012). ISO 8586:2012 — Sensory analysis — Selection and training of sensory assessors. International Organisation for Standardisation.

Lee, W. J., & Lucey, J. A. (2010). Formation and physical properties of yoghurt. Asian-Australasian Journal of Animal Sciences, 23(9), 1127–1136.

LSMO. (2010). Libyan Standard for Fermented Milk Products. Libyan Standardisation and Metrology Organisation.

Patil, A. (2025). Libyan dairy products market analysis. Persistence Market Research.

Tamime, A. Y., & Robinson, R. K. (2007). Tamime and Robinson's Yoghurt: Science and Technology (3rd ed.). Woodhead Publishing.

Zaghloul, A. H., El-Shafei, K., El-Shenawy, M., & Ali, S. (2010). Sensory, chemical and bacteriological evaluation of yoghurt during its manufacture. Kafrelsheikh Veterinary Medical Journal, 6(1), 45–56. https://ejournals.epublishing.ekt.gr/index.php/jhvms/article/view/27528