Shelf-life determination practices among cottage and small-scale food firms and their implication for consumer safety

by
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Abstract

This study investigates shelf-life determination practices among cottage and small-scale food manufacturers (CSIs) in Bhutan, a sector critical to domestic food supply and local enterprise development. Despite increasing regulatory attention to food safety, 98 percent of surveyed producers rely on intuitive, experience-based methods rather than scientific testing. Limited access to analytical laboratories, gaps in technical knowledge, and the absence of standardized national guidelines emerge as key constraints preventing adoption of evidence-based approaches. The findings highlight potential consumer safety risks, particularly for high-moisture and oil-based products prone to rapid spoilage. The study proposes practical interventions—including establishment of accessible testing services, development of product-specific shelf-life standards, and targeted technical training—to improve safety assurance and support the professionalization of Bhutan's expanding food processing industry.

Keywords: shelf-life determination, consumer safety, cottage and small industries, food processing, Bhutan

Background

Cottage and small-scale food firms constitute an essential part of Bhutan's food ecosystem, contributing to household incomes, entrepreneurship, and the availability of diverse food products such as baked items, fried snacks, and fermented or pickled foods. As production volumes increase and markets expand beyond local communities, the accuracy of shelf-life labeling becomes increasingly important for consumer safety and trust.

However, small-scale producers often operate with limited access to technical knowledge, laboratory services, and standardized guidance. Internationally recognized frameworks require microbial, physicochemical, and sensory assessments that are seldom feasible for small firms without institutional support. In Bhutan, anecdotal evidence suggests that producers commonly rely on intuition, peer advice, or imitation of others' practices when determining expiration dates. This study documents these practices among Thimphu's CSI food processors, assesses the extent to which scientific methods are understood and applied, identifies systemic barriers, and proposes feasible interventions suited to Bhutan's regulatory and economic context.

Methods and Materials

A stratified random sample of 54 food processors was selected from Thimphu's approximately 120 registered CSIs. The sample ensured representation across major product groups: baked goods, fried foods,

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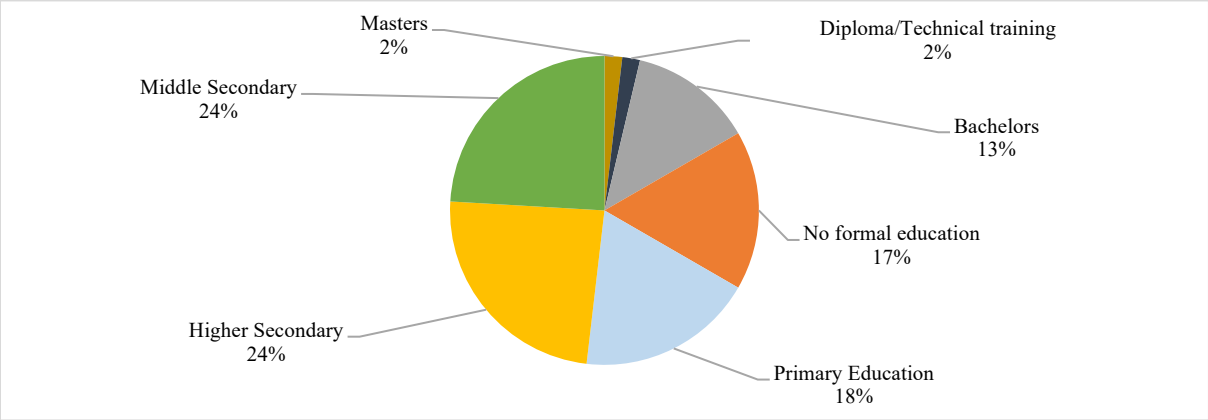
and fermented or pickled items. Data were collected through structured, face-to-face questionnaires to minimize misunderstanding of technical items and to improve response accuracy.
Information was gathered on demographic and educational characteristics, training background, production processes, shelf-life determination methods, perceived competencies, awareness of scientific protocols, and infrastructural or institutional constraints. Descriptive and thematic analysis was applied to synthesize findings.

Results and Discussion

The average age of the businesses, excluding two statistical outliers of 25 and 32 years, was approximately 6.87 years, reflecting a young and evolving sector. While most producers had basic education sufficient for general food safety principles, technical grounding in food chemistry or microbiology was limited. About 35 percent had primary-level education or none, reducing their ability to interpret scientific shelf-life concepts.

Fig. I: Educational background of small-scale food processers



Formal training in food processing was limited; only 31 percent had completed any structured training, and none had undergone instruction specifically focused on shelf-life determination. Although nearly all had attended the BFDA Basic Food Safety and Handling Course, this training does not include stability testing or microbial risk assessment.

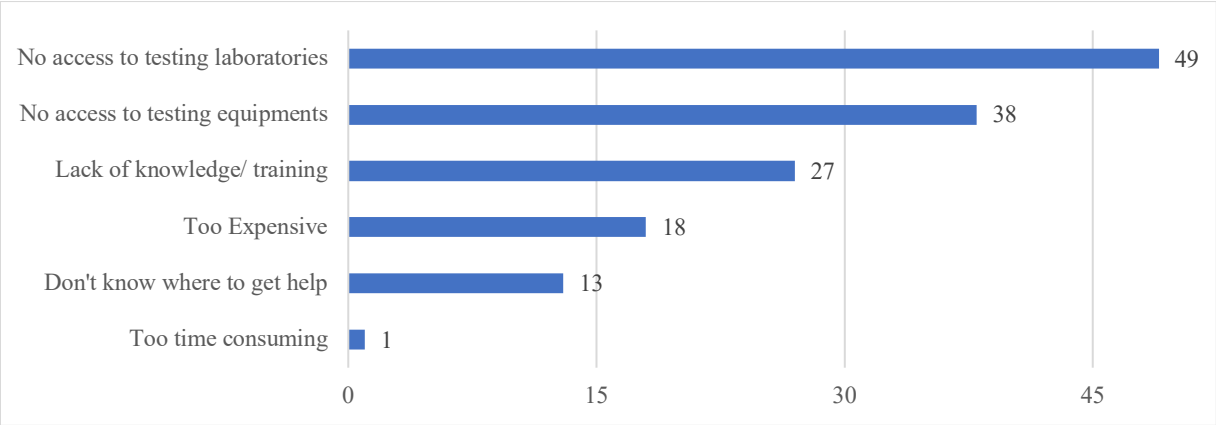
Despite consistently labeling products with production and expiration dates, 98 percent of producers relied on non-scientific approaches—personal judgment, observational experience, peer imitation, or established habits - to determine shelf-life. Only one producer reported exposure to scientific shelf-life methods, which did not match the current product category.

Most producers (77 percent) believed their intuitive methods were adequate due to rapid product turnover and proximity to consumers. Nonetheless, all acknowledged that consuming products beyond their actual shelf-life could pose microbiological or chemical hazards. The very low consumer complaint rate (5.5 percent) reported likely reflects short distribution chains rather than genuine product stability.

Scientific considerations reinforce these risks. Fried foods retain moisture that can support microbial growth, including pathogens such as *Bacillus cereus*. Oil-based items may undergo oxidation leading to rancidity. Baked goods vary widely in stability: dry products resist spoilage, while moist or cream-filled items deteriorate more rapidly. Fermented and pickled foods typically benefit from low pH and high salt levels, yet inadequate fermentation or contamination can introduce safety hazards.

Structural barriers significantly shape producer practices. Over 90 percent cited inadequate access to laboratory services as the major challenge, while 70 percent lacked basic in-house equipment. Half of all producers reported insufficient technical skills to implement or interpret scientific testing. Producers expressed a strong need for guidance, including product-specific shelf-life ranges, affordable testing and capacity-building support.

Fig. II: Challenges faced by food processors in adopting scientific methods of shelf-life determination



International experience demonstrates that small-scale producers can transition to scientific shelf-life determination when institutional support is adequate, including accessible testing, clear guidelines, and regular training. Lessons from other countries indicate that structured regulatory support and simplified protocols can raise compliance without imposing disproportionate burdens on small firms.

Recommendations

Improving shelf-life determination among small-scale food producers in Bhutan requires coordinated regulatory and capacity-building measures. National guidelines should be developed outlining simplified, scientifically grounded, product-specific shelf-life protocols. These should include reference ranges for parameters such as pH, water activity and moisture content, along with practical decision steps for different product categories.

Investments in accessible laboratory services - located within regional offices or technical institutes - are essential. Such facilities could offer accelerated shelf-life testing, microbial analysis and basic physicochemical measurements at an affordable cost for CSIs.

Targeted training programs must accompany these structural improvements. Training should cover fundamentals of food chemistry, microbial growth patterns, deterioration dynamics, documentation methods and interpretation of test results. On-site technical advisory visits or mobile units could further support producers with limited laboratory experience.

Public communication strategies should aim to align expectations among consumers, retailers and food service operators by clarifying the meaning of shelf-life labels and the scientific rationale behind them. Regulatory measures, including phased implementation or tiered compliance incentives, can further facilitate systematic adoption of evidence-based practices.

Conclusion

Shelf-life determination among cottage and small-scale food processors remains largely intuitive and non-scientific, creating avoidable risks for consumer safety. The diversity in product composition and spoilage mechanisms reinforces the need for product-specific, evidence-based shelf-life validation. National guidelines, accessible testing infrastructure, targeted training, and clearer regulatory frameworks are crucial for enhancing consumer safety and supporting the sustainable development of Bhutan's growing food processing sector.

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