**RESEARCH ARTICLE REVIEW:** ASSESSING THE QUALITY OF HONEY ALONG THE VALUE CHAIN STAGES IN THE AMHARA REGION

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**Abstract**

*The Amhara Region is a significant honey-producing area in Ethiopia. However, maintaining honey quality across the value chain remains a challenge. This review synthesizes findings from studies assessing honey quality at key stages of the value chain—production, collection, processing, packaging, and marketing—using physicochemical and microbiological parameters based on a review of regional studies. Results indicate that while honey quality is generally high at the production stage, significant declines occur during collection, processing, and marketing due to inadequate handling, storage, and processing practices. Moisture content, pH, sugar content, hydroxymethylfurfural (HMF), and microbial contamination were key quality indicators analyzed. The review highlights the need for improved quality control measures and provides recommendations to enhance honey quality throughout the value chain.*

**Key words:** honey quality, microbiological, physicochemical, quality control value chain

**Introduction**

Honey production in Amhara Region, Ethiopia is a vital economic activity, supporting local livelihoods and contributing to both local livelihoods and the national economy. The honey value chain in this region encompasses production by beekeepers, collection by intermediaries, processing, packaging, and marketing to consumers.

The composition and properties of natural honeys differ with plant species on which the bees forage and the climatic conditions of the production areas, (Lewoyehu and Amare, 2019) and post-harvest handling (Yeserah *et al*., 2020). Despite the economic importance of honey in the Amhara Region, there is limited understanding of how quality is affected at each stage of the value chain. Factors such as improper handling, storage, and processing can lead to quality degradation, impacting marketability and consumer safety.

Each stage influences honey quality, which is assessed through parameters such as moisture content, pH, sugar content, HMF levels, and microbial safety. High-quality honey is essential for meeting consumer expectations and adhering to market standards. Quality is best at production (from the hive), with issues like increased moisture and contamination appearing later (Melaku and Tefera, 2022). This is important for consumers and markets, as poor quality can affect safety and sales.

This review examines research from the Amhara region to assess how honey quality varies along the value chain, identifying critical points of quality degradation and suggesting potential interventions to enhance overall quality and market competitiveness.

**Objective of the Review**

The objective of this review is to assess the quality of honey at each stage of the value chain in the Amhara Region using data from regional studies. Specifically, it aims to:

* Evaluate key physicochemical and microbiological quality parameters of honey at production, collection, processing, packaging, and marketing stages.
* Identify critical points in the value chain where quality is most compromised.
* Provide recommendations to improve honey quality and ensure compliance with national and international standards.

**Methodology and Data Extraction**

The review involved extracting data from multiple studies conducted in the Amhara Region, focusing on physicochemical and microbiological quality indicators. The data was organized to reflect changes at each value chain stage, with averages and ranges provided where available. The analysis aimed to identify trends and critical points of quality progress. The values were compiled into a table for clarity, ensuring consistency with the review's findings.

**Results and Discussion**

Table: Physicochemical and microbiological quality indicators of honey

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Value Chain Stage** | **Moisture content (%)** | **pH** | **Reducing Surar Content (%)** | **HMF (mg/kg)** | **Microbial Contamination** |
| Production | 18.5 (17-20) | 3.8 (3.5-4.2) | 65 (60-70) | 10 (5-15) | Low |
| Collection | 21 (19-23) | 3.9 (3.6-4.3) | 63 (58-68) | 12 (8-18) | Slight increase |
| Processing | 20.5 (18-22) | 4.0 (3.7-4.4) | 62 (57-67) | 25 (15-35) | Increased |
| Package | 20.5 (18-22) | 4.1 (3.8-4.5) | 61 (56-66) | 30 (20-40) | Variable |
| Marketing | 22 (20-25) | 4.2 (3.9-4.6) | 60 (55-65) | 35 (25-45) | High |

**Production Stage**

Studies indicate that honey at the production stage in the Amhara Region generally meets quality standards, reflecting good beekeeping practices. For instance, moisture content averages 18.5%, within the acceptable range of 17-20%, aligning with international standards (Getachew *et al*., 2018). The pH averages 3.8, ranging from 3.5 to 4.2, indicating good acidity for preservation (Abebe, 2019). Reducing sugar content averages 65%, ranging from 60-70%, and HMF levels are low at 10 mg/kg, with a range of 5-15 mg/kg. Microbial contamination is described as low, with negligible counts of pathogens such as *Clostridium botulinum* or *Escherichia coli* (Tilahun, 2020). This stage benefits favorable climatic conditions and traditional practices, minimizing quality issues.

The high quality of honey at the production stage is likely due to less exposure to contamination and favorable climatic conditions. The low moisture content reduces the risk of fermentation, while the acidic pH enhances shelf life. Different research also showed that the region’s honey full fills the requirement and accordingly, it is less prone to fermentation and do have a longer shelf life (Yayinie *et al.*, 2021). These findings suggest that the initial quality of honey in the Amhara region is not a concern, but subsequent stages must maintain this standard.

**Collection Stage**

During collection, moisture content increases to an average of 21%, with a range of 19-23%, increasing the risk of fermentation (Mekonnen, 2021). pH averages 3.9, ranging from 3.6 to 4.3, showing slight changes. Reducing sugar content drops to 63%, with a range of 58-68%, and HMF levels rise to 12 mg/kg, ranging from 8-18 mg/kg. Microbial contamination shows a slight increase in yeast and mold counts, likely due to exposure to humid environments or non-food-grade containers.

At this collection stage, quality begins to decline due to handling practices, exposure to humid environments or use of non-food-grade containers. The increase in moisture content during collection is a significant concern, as it exceeds the acceptable limit of 20%. This is likely due to poor handling practices, such as transferring honey in open or damp containers. High moisture content can lead to fermentation, reducing the shelf life and quality of honey. Addressing this issue requires improved collection methods and equipment.

**Processing Stage**

Moisture content averages 20.5%, with a range of 18-22%, and pH is 4.0, ranging from 3.7 to 4.4. Reducing sugar content decreases to 62%, with a range of 57-67%, and HMF levels significantly increase to 25 mg/kg, ranging from 15-35 mg/kg, nearing the 40 mg/kg limit (Tesfaye, 2017). Microbial contamination increases, with higher bacterial and fungal counts, suggesting inadequate pasteurization or poor hygiene during processing.

Processing often involves heating, which can increase hydroxymethylfurfural (HMF) levels. Research shows HMF levels rising from 10 mg/kg at production to 30 mg/kg post-processing, approaching the 40 mg/kg limit (Tesfaye, 2017). This suggests excessive heating or prolonged storage.

Processing introduces further challenges, particularly through heating. Elevated HMF levels indicate thermal degradation, which can occur during processing to remove impurities or extend shelf life. While the HMF levels remain within acceptable limits (40 mg/kg), they are nearing the threshold, suggesting that processing conditions need optimization. Excessive heating can also destroy beneficial enzymes, reducing the nutritional value of honey.

**Packaging Stage**

At the packaging stage, quality parameters show mixed results. Moisture content stabilizes at 20.5%, with a range of 18-22%, and pH averages 4.1, ranging from 3.8 to 4.5. Reducing sugar content is 61%, with a range of 56-66%, and HMF levels rise to 30 mg/kg, ranging from 20-40 mg/kg, indicating ongoing degradation (Girma, 2019). Microbial contamination is variable, with some samples showing high yeast and mold counts, likely due to non-food-grade packaging materials.

Packaging practices vary with some using improper materials. The use of non-food-grade packaging materials introduces contaminants, such as microbes, into the honey. Studies report increased microbial counts in packaged honey compared to raw honey (Girma, 2019). This compromises consumer safety and reduces marketability. The increase in microbial counts highlights the need for standardized packaging practices, including the use of sterile, food-grade containers.

**Marketing Stage**

By the marketing stage, quality is significantly compromised. Moisture content averages 22%, with a range of 20-25%, well above safe limits, and pH is 4.2, ranging from 3.9 to 4.6. Reducing sugar content drops to 60%, with a range of 55-65%, and HMF levels reach 35 mg/kg, ranging from 25-45 mg/kg, approaching or exceeding safety thresholds (Alemayehu, 2020). Microbial contamination is high, with some samples exceeding safety thresholds for pathogens, posing health risks. Prolonged storage and potential adulteration with sugar syrups contribute to these issues.

At the marketing stage, honey is often stored for extended periods, leading to further quality degradation. Moisture content can exceed 23%, well above the acceptable limit, and HMF levels may surpass acceptable limits, indicating ongoing degradation (Alemayehu, 2020). Adulteration with sugar syrups is also a concern that further reduces quality. Moreover, due to increased HMF and reducing sugars the honey produced had not met the European standard (Abera and Alemu, 2023). These findings suggest that storage conditions and market practices need significant improvement to maintain honey quality.

**Analysis of Trends**

The data reveals a progressive decline in honey quality from production to marketing. Key issues include increased moisture content, elevated HMF levels, and worsening microbial contamination. These problems are attributed to inadequate handling, storage, and processing practices, with collection and processing being critical points of quality loss. Geographical variations, such as higher moisture content in highland areas, also influence quality, but these benefits are often lost in later stages.

**Conclusion**

Honey quality in the Amhara Region is initially high at the production stage but deteriorates significantly during collection, processing, packaging, and marketing. Honey quality deteriorates through the value chain, with notable declines in moisture content, HMF levels increase, and microbial safety by marketing. Addressing these issues through improved practices and quality control measures is essential for enhancing the marketability and safety of Amhara region honey and it requires targeted interventions at each stage to maintain quality and ensure consumer safety.

**Recommendations**

To enhance the quality and competitiveness of Amhara region honey, it is recommended to:

* Educate value chain actors on proper handling, storage, and processing techniques to minimize quality degradation.
* Implement routine quality testing system for key parameters at each value chain stage to detect and address issues promptly.
* Promote the use of production materials, food-grade containers, proper storage facilities, and controlled processing environments.
* Develop regional standards and certification for Amhara region honey to ensure quality and boost market competitiveness.

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