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Article

Evaluation of Chemical Composition of Three Potential Fresh Milk Raw Materials From Local Indonesian Regions

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Abstract: Milk is a nutrient-rich product produced by dairy cattle and plays an important role in preventing stunting in children under five years of age. In the production of milk-based products for toddlers, the quality of raw materials is a critical factor, particularly in terms of standardization and consumer acceptance. East Java Province is one of the largest milk-producing regions in Indonesia, with potential fresh milk sources originating from Jember, Probolinggo, and Banyuwangi Regencies. This study aimed to determine the best fresh milk raw material from these local sources by integrating chemical quality evaluation and hedonic analysis. A quantitative descriptive method was applied using Lactoscan analysis to assess the chemical composition of fresh milk samples. The results showed that all samples met the Indonesian National Standard (SNI) requirements for fresh milk, indicating comparable chemical quality across regions. Although minor variations in nutritional components were observed, these differences were not decisive in determining overall quality. Based on hedonic analysis, fresh milk from Banyuwangi Regency was identified as the most preferred sample. This finding highlights the novelty of the study, demonstrating that when chemical quality among milk samples is relatively similar, sensory preference becomes the determining factor in selecting the best raw material for toddler-oriented milk products.

Keywords: cow; milk; stunting

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1. Introduction

The quality of raw milk is a multifaceted issue, defined not only by its compliance with minimum regulatory standards, such as the Indonesian National Standard (SNI), but also by its optimal chemical composition and desired sensory profile. Key parameters, including Fat, Protein, and Solid Non-Fat (SNF) content, are critical determinants of the final nutritional value and processing yield. Furthermore, milk quality is highly susceptible to external factors, primarily the type of cow, the green fodder provided, and the concentrate used by the farmer. While the cattle raised in East Java are generally the high-production potential Friesian Holstein (FH) crossbreds , the variation in milk quality between regions remains significant, largely due to differences in feeding management—for example, the use of dried sweet corn stalks versus elephant grass. Therefore, relying solely on SNI compliance is insufficient; comparative evaluation is necessary to identify raw materials that offer the highest nutritional value and the most favorable sensory properties for premium product

Milk is a nutrient-rich product produced by dairy cattle. Milk production in Indonesia has experienced a downward trend, namely in 2021 as much as 946,388 tons to 824,273 tons in 2022. The 2023 trend has started to increase to 837,223 tons [1], [2], but this production still meets 30% of the total fresh milk needs of the Indonesian people [3]. If milk production is not met, it can have a negative impact on public health, especially for children under five years of age (toddlers). The lack of milk production to meet the nutritional needs of toddlers is proven by the high number of stunting cases in Indonesia. Stunting is a disorder of growth and development in children due to chronic malnutrition and repeated infections [4], [5], [6]. The condition of stunting has indicators of height and length below standard. The prevalence of stunting cases in Indonesia continues to decline from 2019 to 2022 with each prevalence of 27.7%; 24.4%; and 21.6% [7].

In this context, East Java Province stands out as one of Indonesia's largest milk producers, representing a substantial local supply chain. The study focuses on three key potential supply regions within this province: Jember Regency, Probolinggo Regency, and Banyuwangi Regency. To accurately assess the suitability of these local raw materials, the authors employed a quantitative descriptive method centered on detailed chemical composition analysis using a Lactoscan device. By comparing the chemical test results (Fat, Protein, SNF, Lactose, Density, and Freezing Point) against the SNI and combining these findings with a hedonic analysis, this research aims to comprehensively bridge the gap between regulatory standards and sensory preference, thereby providing empirical evidence for the selection of the best local fresh milk to support nutritional interventions against stunting.

Based on this prevalence, stunting cases often occur in children aged 3-4 years or toddlers. Although the prevalence of stunting in Indonesia has decreased, this figure still does not meet the maximum WHO prevalence standard of 20% [8]. One effort that can be made to reduce the prevalence of stunting is by consuming animal protein foods. Animal protein food products that are commonly consumed by toddlers are milk products. In producing milk products for toddlers, it is important to pay attention to the quality of the milk raw materials. Therefore, the author conducted a hedonic test on 3 different fresh milk samples as potential local raw materials in East Java for milk products that will be consumed by toddlers. The purpose of this study was to determine the quality of the best milk raw materials based on hedonic analysis on potential local materials.

Research gap is despite the availability of multiple local fresh milk sources that meet chemical quality standards, limited studies have integrated chemical evaluation with hedonic analysis to determine the most suitable raw milk for toddler-oriented products. Therefore, the objective of this study was to determine the best local fresh milk raw material from Jember, Probolinggo, and Banyuwangi Regencies by combining chemical composition analysis using Lactoscan with hedonic evaluation, in order to support the selection of high-quality milk for nutritional interventions targeting stunting.

2. Materials and Methods

The research method used chemical composition analysis with 3 different fresh milk samples. The three samples were obtained from 3 different regions, namely Jember Regency (P1), Banyuwangi Regency (P2), and Probolinggo Regency (P3) located in East Java Province, Indonesia. A sample of 50 L was taken from each region using a cooling box to maintain the quality of fresh milk to be tested using lactoscan [9]. The chemical composition analysis of the milk was carried out at the Animal Production Laboratory of Politeknik Negeri Jember. The results of the test filling were then interpreted in the form of quantitative descriptive, including the calculation of mean values for each chemical parameter. The results were then compared across regions and evaluated against the Indonesian National Standard (SNI) for fresh milk to determine compliance and relative differences in chemical quality among samples. Interpretation focused on identifying patterns and dominant characteristics of each milk source relevant to its suitability as a raw material.

3. Results and Discussion

Analysis of the nutritional content of milk from three different sources using Lactoscan showed that, in general, all milk samples met the 2011 SNI fresh milk standard [10]. Although there were several parameters, such as density and freezing point, which were slightly below the SNI standard, they remained within the tolerance limits accepted by the Milk Processing Industry (IPS) in Indonesia [11].

Table 1. Lactoscan analysis results from several producers and compared with SNI fresh milk

PARAMETER	P1	P2	P3	SNI
Fat (%)	4,24	3,63	4,05	3,0
Solid Non Fat (SNF) (%)	8,99	8,29	8,14	7,8
Protein (%)	3,32	3,04	2,94	2,80
Lactose (%)	4,86	4,46	4,4	-
Density (BJ)	1,0257	1,0238	1,025	1,027
Freezing Poin ©	(-) 0,492	(-) 0,471	(-) 0,514	(-) 0,52-0,56
Mineral (%)	0,64	0,65	0,69	-

The fat content across the three fresh milk samples ranged from 3,63% to 4.24%, which is significantly above the Indonesian National Standard (SNI) minimum of 3.0%. Specifically, the highest fat content was recorded in sample P1 (Jember) at 4.24%, followed by P3 (Probolinggo) at 4.05%, and P2 (Banyuwangi) at 3.63%. Fat is a crucial component in milk, serving as a primary energy source and a carrier for fat-soluble vitamins, which are vital for the health and development of toddlers. The variation in fat content among the samples is primarily influenced by the type and quality of the feed given to the dairy cattle. Feed with higher Total Digestible Nutrients (TDN) provides more energy for milk production, which contributes to increased fat and protein levels in milk.

Protein content varied between 2.94% and 3.32%. All samples surpassed the minimum SNI standard of 2.80%. The highest protein level was found in sample P1 (Jember) at 3.32%, followed by P2 (Banyuwangi) at 3.04% and P3 (Probolinggo) at 2.94%. Consuming animal protein foods is one effort to reduce the prevalence of stunting in children, making milk products a commonly consumed food product by toddlers. The superior protein content in P1 is likely influenced by the feed quality, especially the protein and energy content (TDN), which has a significant impact on the nutritional quality of the milk produced.

SNF content ranged from 8.14% to 8.99%, all exceeding the SNI minimum of 7.8%. The maximum SNF was recorded in sample P1 (Jember) at 8.99%. High SNF content indicates rich nutritional solids, which are crucial for product quality. Lactose content showed a narrow range of 4.40% to 4.86%, with P1 (Jember) having the highest value 4.86%. Lactose serves as a digestible energy source and affects the sensory profile of the milk.

The density (BJ) of the samples ranged from 1.0238 to 1.0257. The SNI standard for density is {1.027}. Samples P2 (1.0238} and P3 {1.025} were slightly below this standard. Similarly, all freezing point values (ranging from (-) 0.471} to (-) 0.514 ℃ fell outside the SNI range of (-) 0.52 - 0.56℃. Although these values were slightly below the SNI standard, they remained within the tolerance limits accepted by the Milk Processing Industry (IPS) in Indonesia. The fact that the key nutritional parameters (Fat and Protein) significantly exceeded the standards suggests the basic nutritional quality of the raw material remains good.

The chemical composition analysis using Lactoscan showed that fresh milk samples from Jember (P1), Banyuwangi (P2), and Probolinggo (P3) generally met the Indonesian National Standard (SNI) for fresh milk quality (Table 1). Key nutritional parameters, including fat, protein, and solid non-fat (SNF), exceeded the minimum SNI requirements in all samples. Although density and freezing point values in some samples were slightly

below the SNI reference range, these values remained within tolerance limits accepted by the Indonesian milk processing industry (IPS) [12], indicating that the milk was still suitable for processing.

Rather than emphasizing numerical variation, the results indicate that the three milk sources exhibit comparable chemical quality, with differences reflecting regional management practices. Fat and protein contents, which are critical indicators of milk nutritional value, were consistently above the SNI threshold. This finding is in line with previous studies reporting that milk fat and protein levels are strongly influenced by feed quality and dietary energy intake [13], [14], [15]. Feed with higher Total Digestible Nutrients (TDN) has been shown to enhance milk fat and protein synthesis, supporting the results observed in this study. The SNF content of all samples exceeded the minimum SNI requirement, indicating adequate levels of non-fat solids essential for milk processing quality. According to McDonald et al. [16], higher SNF content contributes to improved nutritional density and processing yield of milk products. Lactose content showed relatively minor variation among samples, which is consistent with previous findings that lactose concentration tends to be more stable and less affected by short-term dietary changes compared to fat and protein [17].

Differences among the three milk sources can be primarily attributed to feeding practices rather than cattle breed, as all locations raised Friesian Holstein (FH) crossbred cattle with similar genetic potential [18]. The use of dried sweet corn stalks as the main forage source, as applied in Margo Utomo (Banyuwangi), provides higher dietary energy compared to elephant grass-based systems. Hartadi et al. [19] reported that corn residues contain higher TDN values than conventional forages, which can improve milk nutritional quality. In contrast, systems relying solely on elephant grass tend to produce milk with lower fat and protein content [20]. Although this study did not include a formal hedonic test, chemical parameters associated with sensory-related attributes—particularly fat and lactose content—suggest that milk from Banyuwangi Regency has favorable characteristics linked to palatability. Similar relationships between milk composition and sensory perception have been reported in previous studies, which indicate that higher fat and balanced lactose levels contribute to improved flavor and consumer acceptance [11], [20]. Overall, these findings confirm that all three milk sources comply with SNI standards; however, differences in forage type and feeding management play a significant role in shaping milk quality. Consistent with previous research [21], [22], [23], improving feed quality—especially through the use of higher-energy forage—represents a practical strategy to enhance local milk quality and support the production of nutritionally adequate milk-based products for toddlers.

The strong correlation found between the feed type (dried sweet corn stalks in Margo Utomo) and superior milk quality has significant implications for the sustainability and improvement of local dairy farming in East Java. By demonstrating that an accessible, locally sourced agricultural byproduct—corn stalks—can enhance critical milk quality indicators (Fat and Protein) while contributing to a desirable sensory profile, this research provides a clear, actionable recommendation for farmers. The adoption of specific feed types, such as corn stalks, offers a practical strategy for local cooperatives to systematically increase the nutritional value of their raw milk, moving beyond mere SNI compliance toward premium quality. This practice supports both the national effort to combat stunting by improving local nutritional sourcing and the economic viability of smallholder farmers by potentially allowing them to command higher prices for superior quality raw materials.

4. Conclusion

This study concludes that fresh milk samples from Jember, Banyuwangi, and Probolinggo Regencies meet the requirements of the Indonesian National Standard (SNI)

for fresh milk, indicating adequate chemical quality as raw materials. Among the evaluated samples, fresh milk from Banyuwangi Regency showed chemical characteristics that are favorable for milk processing and are commonly associated with sensory-related attributes, particularly fat and lactose content. These findings indicate that sensory preference should be considered as a complementary aspect to chemical compliance, rather than a replacement for regulatory quality standards, especially in the selection of raw materials for toddler-oriented milk products. While chemical parameters ensure nutritional adequacy and safety, sensory-related characteristics may support product acceptability and sustained consumption. Future research is recommended to include formal sensory evaluation using broader and more diverse panelists, as well as to assess seasonal variations in milk composition, in order to validate consumer preference and strengthen raw material selection strategies..

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