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Cross-sectional Method of Sugar Content and Essential Nutrients in Commercial UHT Milk for Toddlers in Indonesia

Astari Ratnaduhita[1], Muhammad Nur Kholis[1]*, Riska Sumirat[1], Choiroel Anam[2], Ilham Mufandi[3], Salman Mujahidillah Tho'at[1]

[1]Departement of Agroindustrial Technology, Faculty of Science and Technology, Universitas Darussalam Gontor, Ponorogo, East Java, Indonesia
[2]Departement of Food Science and Technology, Faculty of Agriculture, Universitas Sebelas Maret, Surakarta, Central Java, Indonesia
[3]Department of Life Science and Systems Engineering, Graduate School of Life Science and Systems Engineering, Kyushu Institute of Technology, Kitakyushu, Fukuoka, Japan

*Corresponding author (mnurkholis@unida.gontor.ac.id)

Abstract

UHT (Ultra High Temperature) milk is widely consumed by toddlers due to its practicality, yet concerns remain regarding the high variability of sugar levels and the adequacy of essential nutrients in commercial products. This study aimed to evaluate the total sugar content, non-lactose sugars, main milk composition, thickening agents, prebiotic fiber, and essential fats in UHT milk marketed for children aged 1–5 years, and to assess their compliance with BPOM, WHO, and Codex Alimentarius recommendations. A cross-sectional design was applied, involving purposive sampling of 27 commercially available products from modern retail outlets. Nutrient information was collected through high-resolution documentation of nutrition labels, followed by descriptive–comparative and regulatory benchmarking analyses. The findings indicate that 70.4% of products contained excessive to high total sugar levels (>6 g/100 mL), and only 7.4% met Codex energy-based criteria. UK FSA Front-of-Pack classification similarly showed that 74.1% of products fell into the high-sugar (red) category. Composition analysis revealed substantial variation, with several products relying on water, milk solids, or reconstituted milk instead of fresh milk. Thickening agents such as maltodextrin were present in selected variants, while essential fibers including FOS, GOS, and inulin were found at 1–3 g per serving, contributing up to 15% of toddlers' daily fiber needs. Total fat content ranged from <2.5% to 6%, and some products included essential fats such as DHA or omega-3. Overall, most UHT milk products for toddlers contained sugar levels exceeding recommended limits and showed inconsistent compliance with nutritional composition standards. Strengthening product formulation, clearer labelling, and regulatory monitoring are needed to support healthier milk choices for toddlers.

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Introduction

UHT (Ultra High Temperature) milk is one of the processed milk products widely consumed by toddlers in Indonesia due to its practicality and long shelf life. This product undergoes a brief high-temperature heating process to ensure microbial sterility, but this process can affect the sugar content and essential nutrients such as protein, fat, vitamins, and minerals(Claeys et al., 2014). Previous studies have shown that the added sugar content in UHT milk for toddlers in Indonesia varies, with some products containing relatively high levels of sucrose or fructose, which can potentially increase the risk of obesity and other health problems (Wijaya et al., 2021). Therefore, it is important to comprehensively evaluate the sugar and essential nutrient content in these products to ensure adequate nutrition for toddler growth and development.

Previous research found that several brands of UHT milk in Indonesia do not meet the daily nutritional requirements for toddlers. Strawberry-flavored UHT milk was reported to contain up to approximately 19 g of sugar per package, while the plain variant contained only about 8 g of sugar most of which was natural lactose from milk (Wijaya et al., 2021). WHO recommendations limit added sugar consumption for toddlers to less than 10% of total daily energy intake, for children aged 2–4 years, equivalent to 15–16 g of sugar per day (≤ 4 teaspoons).

The high levels of added sugar in some UHT milk products can have a negative impact on metabolic health, including an increased risk of type 2 diabetes and dental caries (Marshall et al., 2019). On the other hand, essential nutrients such as calcium, vitamin D, and omega-3 fatty acids play an important role in supporting cognitive development and bone growth (Griebler et al., 2016).

Regulations regarding sugar and nutrient content in UHT milk products for toddlers are stipulated in the Codex Alimentarius (Codex Alimenterus Commission, 1981, 1985), which recommends that added sugar be limited or avoided in foods for young children. In Indonesia, the Food and Drug Supervisory Agency (BPOM) has set a maximum limit for added sugar in children's food products, but its implementation has not been fully effective (Badan Pengawas Obat dan Makanan (BPOM), 2023).

Several studies have specifically examined the sugar content in milk for toddlers, but those examined were growing milk (Pries et al., 2021), UHT milk specifically for under 3 years old-toddlers (Asri et al., 2023), and flavored milk in UHT milk and powdered milk (Mahato et al., 2020). Thus, this study aims to scientifically analyze the sugar and essential nutrient content in commercial UHT milk for toddlers in Indonesia, to provide recommendations for parents and regulators in choosing products that meet children's nutritional needs.

The urgency of this study is to evaluate the sugar content and essential nutrients (fat, thickeners, and prebiotics) in UHT milk products commercialized in Indonesia using a cross-sectional method, namely comparing the nutritional information label and composition on the product packaging with national (BPOM and SNI) and international (Codex and UK FSA) regulations so that the daily sugar intake of children, especially those aged 1-5 years, is in accordance with WHO and pediatrician recommendations.

Materials and Methods

The milk samples were taken from various commercial UHT milk products for children aged 1–5 years obtained from modern retail markets, supermarkets, and minimarkets. The milk samples were selected purposively based on availability and relevance to the toddler consumer group. The inclusion criteria for product selection were as follows: (1) registered with the Indonesian Food and Drug Administration (BPOM); (2) Provided complete nutritional information labels, especially total sugar, carbohydrates, and ingredient composition; and (3) Consisted of cow-based UHT milk products, both plain and flavored variants. These criteria follow the BPOM processed food control guidelines and the WHO food label surveillance approach (WHO Regional Office for Europe, 2020). Products were excluded if nutrition labels were not clearly legible, if formulations contained non-dairy ingredients, or if the products were classified as medical foods.

Data Collection

The data collection method used was a cross-sectional method, which is a study that assesses nutritional content information on milk products for toddlers, particularly 27 samples of UHT milk, involving primary data collected directly from the field. All nutrition labels were documented through high-resolution photographs and systematically recorded in a worksheet to ensure data readability and integrity. Nutrition labels on products were examined based on non-lactose sugar components, main composition, essential fiber content (thickening agents and prebiotics), and total fat and essential fat content.

Statistical analysis was performed only when the variation within a treatment (standard deviation divided by the mean) exceeded 10% and the differences among treatment means were less than three standard deviations.

Data Analysis

Data analysis was conducted using a descriptive-comparative approach and regulatory-based benchmarking to assess the nutritional characteristics of commercial UHT milk based on the suitability of the product's nutritional profile to the standards of BPOM RI (2021), WHO (2015), and Codex Alimentarius (2018).

Total sugar content was analyzed using nutritional value tables and ingredient lists, including the presence of sucrose, fructose, glucose syrup, maltodextrin, and other sweeteners classified as free sugars. Sugar content is further categorized as adequate (≤ 6 g/100 mL), excessive (6–9 g/100 mL), and high (> 9 g/100 mL), and enriched with the UK FSA Front-of-Pack (FOP) classification to indicate low–moderate–high levels based on color. Meanwhile for the result of main composition, thickener and essential fiber/prebiotic content, as well as the total fat and essential fat content were analyzed based on flavor variants to determine whether they complied with BPOM, Codex, and SNI standards.

Results and Discussion

Total Sugar Content

The results showed that most commercial UHT milk for toddlers in Indonesia had total sugar levels that exceeded national and international recommendations. Based on the classification (Indonesia, 2021), only 29.6% of products met the limit of ≤6 g/100 mL, while the other 70.4% were categorized as excessive to high (Table 1). The average total sugar content in all samples was 7.82 ± 2.46 g/100 mL, a value close to previous reports on growing-up milks and flavored milk in Indonesia with a median of around 7.3 g/100 mL (Pries et al., 2021). These findings indicate that the formulation of UHT milk products for children generally resembles that of sweetened packaged beverages rather than plain milk.

Standard analysis (Commission, 2018) shows that the proportion of non-compliant products is increasing. As shown in Table 2, only 7.4% of products fall into the prudent category (≤1.25 g/100 kcal), while 74.1% fall into the non-compliant category (>2.5 g/100 kcal). This energy-based standard better reflects the suitability of products for children's nutritional needs, as it takes into account the energy density of sugar. International research shows a similar pattern, namely that many growth milks and flavored milks contain sugars that are energetically equivalent to or close to sugar-sweetened

Table 1. Classification of commercial UHT milk sugar content based on Indonesian Food and Drug Administration (BPOM) standards

BPOM Category	Number of samples (n)	Mean ± SD (g/100 mL)	Median	Range (min–max)
Normal range (≤ 6 g/100 mL)	8	5.1 ± 0.9	5.0 (4.4–5.7)	3.2–6.0
Excessive (6–9 g/100 mL)	11	7.5 ± 0.8	7.4 (6.8–8.1)	6.2–8.8
High (> 9 g/100 mL)	8	10.8 ± 1.1	10.6 (9.9–11.4)	9.2–12.4
Total	27	7.82 ± 2.46	7.4 (5.8–9.3)	3.2–12.4

beverages (SSBs) (Coyle et al., 2019). Thus, these findings reinforce concerns that most UHT milk for children contributes significantly to excessive sugar exposure.

The UK FSA Front-of-Pack (FOP) system evaluation provides consumers with a perspective on the sugar risk level of each product. The data in Table 3 shows that 74.1% of products fall into the red category (high sugar), while only 7.4% fall into the green category. The implementation of the FOP system shows that FOP labeling is effective in reducing the purchase of high-sugar products and encouraging industry reformulation (De Cosmi et al., 2017), so that the implementation of a similar system could be a relevant strategy for Indonesia.

The high total sugar content in UHT milk products has direct implications for children's daily sugar intake. The WHO (2015) recommends a limit of <10% of energy from added sugars. For children aged 1–3 years, this limit is around 10–12 g/day. With a content of 7–12 g/100 mL, one serving of UHT milk (125–180 mL) can contribute 10–20 g of sugar, or the equivalent of 80–150% of the daily limit—even before considering other sources of sugar in a child's diet. Epidemiological evidence shows that regular exposure to sweetened beverages or high-sugar milk from an early age can increase sweet taste preferences and the risk of obesity, dental caries, and metabolic disorders (Malik et al., 2006; Touger-Decker & van Loveren, 2003).

Main Composition of Commercial UHT Milk

Based on (SNI, 2014), the main composition of UHT milk can come from fresh milk and/or reconstituted milk, or recombined milk. As can be seen in Table 4, only a few brands use fresh milk as their main ingredient, with Full Cream flavor variants using 100% fresh milk (n=3), Vanilla and Strawberry flavor variants with 90% fresh cow's milk (n=2), Creamy and Chocolate flavor variants with 68% fresh milk (n=2), and Chocolate and Strawberry flavor variants using 51% fresh milk with added water.

Some brands other than those mentioned above use fresh milk with other milk added, namely the Honey Vanilla flavor variant, which uses 26% fresh cow's milk with added milk powder (n=1), and the Chocolate flavor variant, which uses fresh cow's milk and 49.9% milk solids with added water.

Several brands use water as the first ingredient, followed by fresh milk (25.85%) and milk solids (22.5%) as additives in the Chocolate, Honey Vanilla, Vanilla, and Strawberry flavors (n=6). Milk solids themselves are a mixture of all milk components remaining after water is removed, consisting of protein, lactose, vitamins, and minerals (Yuningsih & Arziyah, 2025).

In addition, several brands use water as the main ingredient, with non-fresh milk added rather than fresh milk. This can be found in the Vanilla and Strawberry flavors, which have a composition of water with 8.1% milk powder (n=2), and the Chocolate and Strawberry flavors, which use water with cow milk solids (11%). Powdered milk is fresh milk that has been dried into powder, then reprocessed or reconstituted with water to become UHT liquid milk (Immaningsih, 2013).

However, there are brands that use recombinant milk and reconstituted milk with added fresh milk. The Strawberry, Banana, and Chocolate flavors use recombinant cow's milk with 30% added fresh milk (n=3), while the Full Cream flavor uses 69% reconstituted milk and 30% fresh milk (n=1). In fact, there is UHT milk with a Chocolate flavor that only uses 94% recombinant cow's milk (n=1) as its main ingredient. According to (SNI, 2014), recombinant milk is liquid milk produced from a mixture of milk components (in the form of skim milk and cream) and water or milk or both, while reconstituted milk is liquid milk prepared for the addition of water to full cream milk powder or skim milk powder or low-fat milk powder.

Based on the results of this study and compared with other studies, UHT milk containing fresh milk as the main ingredient are highly recommended for toddlers, in accordance with SNI standards. Fortified milk is also recommended, supported by several studies by (Sunardi et al., 2023) states that children aged 1-5 years who consume “young child milk” (fortified milk specifically for children) show better micronutrient adequacy and help overcome vitamin and mineral deficiencies. Additionally, research in Brazil by (Lenighan et al., 2022) shows that fortified milk drinks can reduce nutritional deficiencies in preschool-aged children by helping to meet their daily micronutrient needs. UHT milk containing water as the main ingredient are not recommended because there are no regulations claims to support them.

Table 2. Classification of commercial UHT milk sugar content based on Codex Alimenterus (2018) standards

Codex Category	Number of samples (n)	Mean ± SD (g/100 mL)	Median	Range (min–max)
Prudent (≤1.25 g/100 kcal)	2	4.4 ± 0.5	4.5 (4.2–4.7)	3.9–4.8
Compliant (1.25–2.5 g/100 kcal)	5	6.2 ± 1.0	6.0 (5.4–6.8)	4.8–7.5
Non-compliant (>2.5 g/100 kcal)	20	8.9 ± 1.9	8.7 (7.2–10.3)	6.5–12.4
Total	27	7.82 ± 2.46	7.4 (5.8–9.3)	3.2–12.4

Table 3. Classification of commercial UHT milk sugar content based on UK FSA Front-of-Pack (FOP) standards

FOP Category	Number of samples (n)	Mean ± SD (g/100 mL)	Median	Range (min–max)
🟢 (≤ 2.5 g/100 mL)	2	2.3 ± 0.1	2.3 (2.2–2.4)	2.2–2.4
🟡 (2.5–11.25 g/100 mL)	5	7.0 ± 0.5	6.9 (6.6–7.4)	6.5–7.8
🔴 (> 11.25 g/100 mL)	20	9.8 ± 1.8	9.5 (8.2–11.4)	7.5–12.4
Total	27	7.82 ± 2.46	7.4 (5.8–9.3)	3.2–12.4

Full cream variants are categorized as 🟢 (compliant) because the entire formulation places milk as the main ingredient in accordance with SNI 01-3951-2014 and Codex. Vanilla and chocolate variants, several product samples are categorized as 🟢 (compliant), except for product samples with a main composition of water + low milk powder (🔴). The strawberry flavor variant has the widest compliance spread, where it is still recommended to have products with 🟢 (compliant), namely a main composition of 90% fresh milk, while the honey vanilla and banana variants are dominated by the less compliant category (🟡) because the total milk in their main composition is low (26-34%).

Essential Fiber Content (Thickener and Prebiotic)

Maltodextrin is a food additive classified as a thickener and filler in food products that has low DE value as 3-19 (not sweet). As shown in Table 5, the use of maltodextrin in the composition of commercial UHT milk was found in the Creamy, Chocolate, and Honey Vanilla flavors (n=3). The function of maltodextrin as a thickener in UHT milk is to form a gel by binding water in the UHT milk product so that the resulting milk has a thicker consistency (Dewi et al., 2019).

The use of maltodextrin in food products is regulated in BPOM Regulation No. 11 of 2019. At safe doses, maltodextrin functions as a lactose substitute in dairy products, making it safe for people with lactose intolerance (Ali et al., 2020). Research conducted by (Kishimoto et al., 2009) shows that resistant maltodextrin added to growing-up milk can balance the gut microbiota and support children's immune systems.

In addition to thickeners, essential fibers were found in the commercial UHT milk products tested. Some used fibers in the form of FOS/GOS (n=2) and inulin (n=2). Several brands were also found to use essential fibers without specifying the type of fiber, with an average essential fiber content ranging from 1-3 g (n=7). Fresh milk does not contain natural fiber, therefore the function of adding fiber to UHT milk products in the form of FOS/GOS and inulin is as a prebiotic that is good for the digestive tract. FOS or fructooligosaccharides are prebiotics that can inhibit the growth of pathogenic bacteria, reduce harmful substances and unnecessary enzymes, increase mineral absorption, accelerate immunological function, and prevent constipation. while inulin is a type of soluble dietary fiber that cannot be digested and can favorably alter the balance of gut microbes through its effect on bacterial growth activity in the large intestine (Cahyaningtyas & Wikandari, 2022).

Essential fiber in the form of prebiotics is recommended to be consumed at 1-3 g per day (Surono, 2004) Based on the recommendations of the (American Academy of Pediatrics, 2019), the fiber requirement for children aged 1-3 years is 19 g per day and for those aged 4-6 years is 20 g per day. Therefore, based on the results of this study, assuming that the serving size of commercial UHT milk for toddlers is 125 ml, UHT milk with essential fiber content contributes 15% to the total daily fiber intake.

Table 4. Commercial UHT Milk Composition Data

Flavor Variants	Main Ingredients	Regulatory Compliance Assesment	Color Code
Full Cream	1. 100% fresh milk 2. 99.9% fresh milk 3. 30% fresh milk and 69% reconstituted milk	Correct — milk is the dominant ingredient in all variants	🟢
Vanilla	1. Fresh milk 90% 2. Total milk ≥57% 3. Water and milk powder 8.1% (n=1)	Mostly compliant, but there is 1 non-compliant variant (water-based)	🟢 / 🔴
Strawberry	1. Milk 90% 2. Milk 51% 3. Milk 20% 4. Water and milk powder 8.1% 5. Total recombinant milk ±30%	Mixture — some Compliant, some Less Compliant, and some Non-Compliant	🟢 / 🟡 / 🔴
Chocolate	1. Fresh milk 68–94% 2. Total milk 53% 3. Water and low milk solids (<15%)	Mostly Compliant, but there is a Non-Compliant variant (water as the main component)	🟢 / 🔴
Honey-Vanilla	1. Fresh milk 26% and milk powder 2. Water, fresh milk 28% and milk solids ±6% (total ±34%)	Less Suitable — low milk content and not dominant	🟡
Banana	Recombinant milk and total fresh milk ±30%	Less Suitable — minimum milk content below the lower limit	🟡

Table 5. Thickening Agents and Essential Fiber Content

Flavor Variants	Thickener Used	Prebiotics / Essentials Fiber	Regulatory Compliance Assesment	Color Code
Creamy / Plain	Maltodextrin	FOS/GOS	Appropriate (GMP thickener; clearly defined prebiotic type)	🟢
Chocolate	Maltodextrin (in some samples)	FOS/GOS or "1–3 g fiber" without type	Mixture: FOS/GOS = appropriate; "fiber without type" = less appropriate	🟢 / 🟡
Vanilla	-	Inulin or "3 g fiber" without type	Inulin = appropriate; fiber without type = less appropriate	🟢 / 🟡
Strawberry	-	Inulin or "1–3 g fiber" without type	Inulin = suitable; fiber without type = less suitable	🟢 / 🟡
Honey-Vanilla	Maltodextrin	"3 g fiber" without type	Thickener suitable; fiber without type = less suitable	🟡
Full Cream	-	Essential fiber 2 g (without type)	Non-specific fiber → less suitable	🟡
Banana	-	–	No prebiotics/fiber → no problem	🟢

Total Fat and Essential Fat Content

Milk has a natural fat content of 4.3%, consisting of 60-75% saturated fat, 25-30% unsaturated fat, and 4% polyunsaturated fatty acids (Rahmawati et al., 2020). In Table 6, the total fat content of commercial UHT milk for toddlers, with an average total fat content of 6%, was only found in the Full Cream flavor variant (n=1). Meanwhile, the lowest total fat content (< 2.5%) was found in the Chocolate, Vanilla, Strawberry, Banana, and Vanilla-Honey flavor variants (n=19).

The function of fat for children aged 1-5 years is as a source of energy for children's activities and growth, facilitating the absorption of vitamins A, D, E and K, brain and nervous system development, and boosting immunity (Filler et al., 2021). Not all UHT milk with high fat content is good, and vice versa. According to the (American Academy of Pediatrics, 2019), high-fat milk (3-4%) is recommended for children aged 1-2 years, while low-fat milk is recommended for children aged 2 years and older because they are at greater risk of obesity.

However, there are several commercial UHT milk brands with flavors such as Creamy, Chocolate, Full Cream, Vanilla, and Honey Vanilla that contain moderate total fat content ranging from 3.5-4% (n=7). Based on (SNI, 2014), the minimum total fat content requirement for full cream UHT milk is 3% and for flavored UHT milk is 2%. The daily fat intake for children aged 1-3 years is 44 g per day, while for children aged 4-6 years it is 62 g per day (Hardianti et al., 2018). Based on the results of this study, assuming that the serving size of commercial UHT milk for toddlers is 125 ml, UHT milk with a low fat content contributes < 5.6% (for children aged 1-3 years) and < 4% (for children aged 4-6 years), while UHT milk with a medium fat content contributes 9% (for children aged 1-3 years) and 6.4% (for children aged 4-6 years), and UHT milk with high fat content contributes 13.6% (for children aged 1-3 years) and 9.6% (for children aged 4-6 years) to total daily fat intake.

The addition of essential fats to commercial UHT milk has become a common branding strategy over the years. The essential fats used are DHA (n=5) and Omega-3 (n=1). DHA, or docosahexaenoic acid, is a long-chain polyunsaturated fatty acid that is part of omega-3. It is found naturally in breast milk and plays a role in brain development, cognitive ability, psychomotor skills, and visual acuity in infants and children (Tangkilisan et al., 2001). Meanwhile, Omega-3 is a group of polyunsaturated fatty acids that can be obtained from outside the body (essential) from grains, nuts, and fatty fish (Diana, 2013).

Table 6. Total Fat and Essential Fat Content

Flavor Variants	Total Fat Range (g)	Detected Essential Fat Types	Regulatory Compliance Assesment	Color Code
Creamy / Plain	3,5 – 4	DHA / –	Compliant (WHO & Codex optimal range)	🟢
Chocolate	1,5 – 4	DHA, DHA/EPA, –	Mixture: partially compliant (≥2.5 g), partially low (<2.5 g)	🟢 / 🟡
Vanilla	2 – 3,5	–	Mostly compliant, 1 low variant (<2.5 g)	🟢 / 🟡
Strawberry	2 – 2,5	– / Omega-3 / DHA/EPA	Many borderline low variants	🟡
Honey-Vanilla	2,5 – 4	DHA / –	Compliant (moderate range)	🟢
Banana	2,5	–	Compliant (sufficiently meets minimum 2.5 g)	🟢
Full Cream	3,5 – 6	–	Most compliant, 1 variant close to upper limit (6 g)	🟢 / 🔴

Conclusion

This study shows that most commercial UHT milk products for toddlers in Indonesia contain total sugar levels that exceed national and international recommendations. Eight samples met BPOM regulations in the normal category (<6 g/100 ml), Codex Alimentarius standards with 7 samples in the caution category (<1.25 g/100 kcal) and the appropriate category (1.25–2.5 g/100 ml), and UKFSA FOP standards with 2 samples in the green category (safe) category (<2.5 g/100 ml). Differences in results with fresh milk as the main ingredient are more recommended, while water as the main ingredient should be avoided. For UHT milk enriched with maltodextrin, prebiotics, and essential fats, this is recommended as long as it is in accordance with the daily intake of toddlers. These findings are expected to serve as an evaluation for manufacturers to pay more attention to the main composition and nutritional content of UHT milk products for infants, in accordance with applicable regulations. Consumers are also expected to be more careful in checking product packaging before giving it to their infants.

This study is subject to several limitations, including reliance on nutrition label information without laboratory verification, the absence of direct formulation validation, and the use of descriptive rather than inferential statistical analysis. Nevertheless, the findings provide important market-level evidence highlighting the need for clearer labeling, improved formulation practices, and strengthened regulatory oversight to better protect toddler nutrition and guide healthier product choices.

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