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SMOOTHIES: INGREDIENTS, MANUFACTURING TECHNIQUES, AND QUALITY EVALUATION

Smoothies are popular non-alcoholic beverages prepared at home or produced in enterprises from a variety of types of raw materials. The technique for smoothie production depends on the ingredients used, particularly on their preparation methods. To ensure a uniform consistency, the mixture of ingredients is homogenized. To extend shelf life, smoothies are pasteurized or subjected to alternative processing methods, such as high-pressure treatment. The primary ingredients in smoothies are fresh or processed fruits, vegetables, and berries. Additionally, smoothies may contain milk, yogurt, plant-based milk, mineral water, and various functional and technological additives. The aim of this study was to categorize smoothie ingredients by origin, degree of processing, and functional characteristics, analyze the manufacturing techniques, and develop a comprehensive index for evaluating smoothie quality. All raw ingredients can be grouped into the following categories: plant-based ingredients, liquid ingredients, concentrated and dry ingredients, sources of fat and protein, flavour and aromatic ingredients, and functional and technological additives. Such categorization enables the identification of the functional role of each ingredient in the beverage. The scientific novelty of this research lies in the systematic grouping of smoothie ingredients according to origin, processing level, and functional purpose. The proposed equation for determining the comprehensive quality index of a smoothie also holds theoretical significance. Practically, the comprehensive quality index facilitates an objective evaluation and comparison of smoothies prepared from different raw materials and processed using various techniques, while accounting for the relative importance of their properties for consumers. The weighting coefficients of smoothie properties may vary depending on the functional purpose of the beverage. More important properties are assigned higher weighting coefficients, determined through expert surveys. The quality index is also based on how closely the actual values of the smoothie's properties correspond to their optimal levels. The smoothie quality index is particularly useful during the development of new smoothies, supporting their evaluation and comparison with products already available on the market.

Keywords: *smoothie, beverage, beverage raw materials, smoothie ingredients, beverage technology, beverage quality.*

Statement of the problem and its relevance. Smoothies are a popular breakfast option and are commonly prepared using fruit, milk, oils, and sugar [23]. According to S.G. Nieva et al. [30], the consumption of fruit- and vegetable-based smoothies has increased worldwide. Smoothies provide a convenient means to consume nutrients and bioactive compounds [3]. They are a rich source of anthocyanins, flavonols, phenolic acids, flavan-3-ols, iridoids, dietary fibre, and vitamin C, which provide numerous health benefits [44]. Smoothies are typically semi-liquid with a thick consistency [20].

In most cases, a smoothie is a 100% blend of fruits without added sugars, additives, or concentrates. Its nutritional profile is therefore closer to that of whole fruits, as it contains crushed fruit components such as flesh and pulp [1]. Milk-based smoothies consist of blended cow's milk combined with other ingredients (e.g., sugar, dahi, pectin, banana, carrot juice extract) [32]. Cereals are also used as ingredients in smoothies. R. Rani et al. [36] noted that combining sorghum flour with milk and vegetable or fruit juice enables the development of a functional breakfast beverage. A novel, dried, easy-to-prepare form of smoothie has been developed using freeze-drying, which extends shelf life and preserves the nutritional integrity of the ingredients [34].

A promising direction is the development of smoothies enriched with powdered plant-based ingredients, as well as the production of powdered smoothies. Such products offer several advantages, including extended shelf life, simplified transportation and storage, and the possibility of combining diverse ingredients to create novel flavours and enhanced nutritional profiles. In addition, powdered smoothies can be consumed year-round, regardless of the seasonal availability of fruits, vegetables, berries, nuts and grains. It is important to classify smoothie ingredients according to their functional properties, analyse

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processing techniques in relation to the ingredients used, and develop a comprehensive index for assessing smoothie quality.

Analysis of recent research and publications. Smoothies are non-alcoholic liquid refreshment beverages that can be made from fresh or frozen fruits or vegetables. A. Srivastava et al. [39] noted that they can be blended with crushed ice, ice cream, lemonade, tea, spices, or condiments. Various smoothie formulations incorporate ingredients such as carrot, orange, figs, cherries, tomatoes, kiwi, fennel, spinach, aloe vera, beetroot, cucumber, broccoli, coconut milk, ginger, pepper, psyllium husk, nuts, sorghum flour, chickpea flour, animal milk, skim milk, cream, and plant-based milk [39]. Smoothies may also be based on fruits and berries such as apples, pears, strawberries, blackberries, raspberries, chokeberries, bilberries, cranberries, blackcurrants, and honeysuckle berries [44]. In addition, pulps from exotic fruits, such as mango, papaya, sapota, and banana, as well as pineapple juice, are frequently used as smoothie ingredients [4].

Smoothies, consisting mainly of fresh fruit, vegetable, berries, and juices, are part of a growing trend towards health-promoting nutrition [44]. D. McCartney et al. [25] highlighted that smoothies are popular breakfast foods, particularly among younger age groups [22], and can help increase fruit and vegetable intake in individual diets [26]. Based on their nutrient profile, smoothies can be considered so-called superfoods [31].

In smoothies, fruits and vegetables are the primary dietary sources of carotenoids, which can act as antioxidants and contribute to skin protection against the damaging effects of UV light [40]. N.H. Alsubhi et al. [2] emphasised that certain smoothie ingredients, such as pomegranate pomace, are rich sources of polyphenols and dietary fibre. As noted by M.V. Fernandez et al. [11], vegetable by-products represent promising sources of high-value compounds, including fibre, antioxidants, and essential fatty acids, which can be used in extract form as functional ingredients in smoothies (e.g., beet leaf extract can enhance the phenolic content of smoothies). Incorporating dietary fibre derived from post-harvest vegetable processing by-products into fruit smoothie formulations may enhance the retention of bioactive compounds during processing and storage [10]. Additionally, soybean and mung bean milk have been proposed as innovative ingredients for smoothie production [27].

The aim of this study is to categorize smoothie ingredients, evaluate their manufacturing techniques, and develop a comprehensive index for assessing smoothie quality.

Materials and methods. The study employed methods of analysis and synthesis of scientific information to develop a categorization of smoothie ingredients and examine manufacturing techniques depending on the raw materials used. A hierarchical approach was applied to establish a classification of smoothie properties. Qualimetry methods were used to develop an equation for determining the comprehensive quality index of smoothies.

Summary of the main research material. According to processing techniques and formulation, smoothies differ in textural characteristics, which can be smooth and fluffy, sticky and slimy, or grainy and coarse [21]. The physicochemical properties of fresh smoothies formulated with plant-based ingredients are presented in Table 1. Smoothie properties vary as follows: total soluble solids, 2.7–19.0 ºBrix; acidity, 0.30–0.74%; pH, 3.35–4.57; total sugars, 8.3–15.8%; total carotenoids, 0.05–1.29 mg/100 g; density, 1048–1054 kg/m3 [28]; omega-6, 0.02–0.56 g/kg, and omega-3, 0.01–0.40 g/kg [23]; vitamin C, 41.6–95.4 mg/100 g; and total phenolics, 51.4–213.3 mg GAE/100 g [29]. Therefore, the properties of plant-based smoothies depend on the composition and proportion of their ingredients.

The categorization of smoothies based on the ingredients used is presented in Table 2. All smoothie ingredients can be grouped into the following categories: plant-based ingredients, liquid ingredients, concentrated and dry ingredients, sources of fat and protein, flavour and aromatic ingredients, and functional and technological additives. Each of these categories contains subgroups. Ingredients within these subgroups exhibit distinct functional characteristics, including the provision of flavour, colour, texture, and nutritional value; enhancement of sweetness; acting as a solvent; contributing to fortification with minerals, vitamins, and other bioactive compounds; supplying protein, fat, dietary fibre, and probiotics; supporting gut microbiota; extending shelf life; and improving consistency and stability.

Smoothies can be prepared at home from fresh, unprocessed fruits and vegetables or produced industrially, undergoing processing steps such as homogenization, thermal treatment, and the addition of preservatives to enhance beverage stability [17]. Smoothies are typically consumed fresh or stored for short periods (1–3 weeks) under refrigeration, which can affect their colour and polyphenolic composition [5].

The process of preparing a smoothie depends on the ingredients used (Fig. 1). When fresh fruits, vegetables, berries, parsley, dill, and leafy vegetables are employed, they are first washed under running water. During the pre-processing stage, depending on the type of fruit or vegetable, items are inspected, peeled, and seeds and stems are removed; vegetables (e.g., table beet) may be boiled and chopped into small pieces, whereas berries are generally left whole.

Smoothie preparation involves a breakdown of plant parenchyma, resulting in a dispersed system consisting of a liquid phase (soluble solids) and a solid phase (insoluble solids) [15]. When the beverage is prepared using frozen fruits, vegetables, or berries, the frozen ingredients are defrosted in air at room temperature or by microwave defrosting, and during the pre-processing stage they are chopped into small pieces (except for berries). Bulk ingredients, such as fruit, vegetable, or berry powders, milk powders, plant-based milk powders, seeds, nuts, flakes, and flours, are first cleaned (powders, spices, and flours are

Table 1 – Physicochemical properties of plant-based smoothies

Smoothie ingredients	Total soluble solids (ºBrix)	Acidity (% citric acid)	pH	Total sugars (%)	Total polyphenols (mg/100 g)	Total carotenoids (mg/100 g)
Papaya, mango, and pineapple[1]	15.0	0.33	4.29	13.6	63.3	1.29
Papaya, mango, phalsa, and watermelon[1]	12.9	0.46	3.88	11.2	54.0	1.17
Sapota, pineapple, and watermelon[1]	17.5	0.30	4.57	14.7	88.7	0.73
Sapota, purple grape, and pomegranate[1]	17.9	0.33	4.02	14.4	123.6	0.14
Sapota, pineapple, and pomegranate[1]	18.5	0.31	4.33	15.8	158.3	0.16
Papaya, banana, and pineapple[1]	17.0	0.52	4.18	13.3	78.0	0.87
Papaya, banana, and green grape[1]	19.0	0.57	3.94	15.4	65.6	0.89
Apple, rhubarb, strawberry, and chokeberry[2]	11.9	0.73	n.d.	8.3	347.0	n.d.
Apple, rhubarb, strawberry, chokeberry, and honeysuckle berry[2]	12.0	0.74	n.d.	8.7	426.8	n.d.
Pumpkin and purple carrot[3]	7.9	n.d.	4.37	n.d.	39.2	0.07
Banana and purple carrot[3]	12.7	n.d.	4.35	n.d.	47.4	0.05
Banana, pumpkin, and purple carrot[3]	12.2	n.d.	4.45	n.d.	46.6	0.11
Carrot and water[4]	2.7	2.05*	3.35	n.d.	148.7	n.d.
Apricot, mango, acerola, passion fruit, and cupuaçu[5]	13.5	n.d.	3.59	n.d.	71.7	n.d.
Strawberry, plum, cherry, raspberry, apple, cranberry, and pomegranate[5]	13.8	n.d.	3.56	n.d.	66.4	n.d.
Kiwi, pineapple, lemon, green tea, mint, and chlorophyll[5]	14.1	n.d.	3.45	n.d.	73.5	n.d.
Cucumber, broccoli, and spinach[6]	4.3	0.22*	4.49	n.d.	15.1	n.d.
Orange juice, apples, carrots, beet leaves, and beet stems[7]	10.0	n.d.	3.86	n.d.	68.0	n.d.

Note: n.d.: no data; *g citric acid/100 mL.

Source: prepared on the basis of research data by [1]K. Balaswamy et al. [4], [2]M. Waszkiewicz et al. [44], [3]M. Kidoń & P.A. Uwineza [20], [4]A.S. Formica-Oliveira et al. [14], [5]S.C.S.R.D. Moura et al. [28], [6]N. Castillejo et al. [8], and [7]M.V. Fernandez et al. [13]

Table 2 – Categorization of smoothie ingredients

Group	Subgroup	Ingredients	Functional characteristics
1	2	3	4
Plant-based ingredients	Natural plant-based ingredients	Fruits, vegetables, and berries in fresh, frozen, dried, or cooked forms; parsley, dill, leaf vegetable in fresh or dried forms	Provide flavour, colour, texture, and nutritional value
	Processed plant-based ingredients	Purees, juices, and syrups	Enhance flavour, texture, and sweetness
Liquid ingredients	Water-based	Purified drinking water	Acts as a solvent
		Carbonated or non-carbonated mineral water	Acts as a solvent, provides hydration, and contributes to fortification with minerals and salts
	Dairy	Milk, kefir, yogurt	Provide protein, fat, and probiotics
	Plant-based beverages	Plant-based milk formulated with oat, soybean, coconut, hazelnut, almond, and others	Provide protein, fat, texture, and an alternative to dairy products
	Other beverages	Tea, coffee, lemonade, and others	Contribute flavour and functional properties
Concentrated and dry ingredients	Powders	Fruits, vegetables, and berries powders	Thickening; provide concentrated source of nutrients
	Dry milk and milk substitute products	Dry dairy or plant-based milk	Thickening; provide concentrated nutrients, protein, and texture enhancement
	Grain products	Flakes, flake powder	Thickening; provide carbohydrates and fiber
	Flour	Rice, almond, and others	Enhance texture and nutritional content
Sources of fat and protein	Seeds	Whole, ground (powder)	Provide fat, protein, and fiber
	Nuts	Almonds, walnuts, cashews, and others	Provide fat, protein, and fiber; contribute flavour and texture
	Fats	Vegetable oils	Provide fat and enhance texture and energy value
	Combined products	Ice cream, frozen desserts	Contribute fat, flavour, texture, and sweetness

The end table 2

1	2	3	4
Flavour and aromatic ingredients	Flavouring agents and aromatic ingredients	Spices and herbs	Contribute flavour and aroma
	Sweeteners	Sugar, sugar substitutes, honey, and others	Provide sweetness and caloric value
Functional additives	Bioactive compounds	Vitamins, minerals, pectin, fiber, and others	Provide additional nutrients
	Probiotics	Lactobacilli	Support gut microbiota
Technological additives	Preservatives	Citric acid, ascorbic acid, lemon juice, rosemary extract, and others	Extend shelf life
	Stabilizers	Pectin, xanthan gum, guar gum, carrageenan, and others	Improve consistency and stability

Source: developed by the authors

sieved; and nuts are shelled). During pre-processing stage, nuts, seeds, and flakes are crushed. Dried ingredients, including herbs, fruits, vegetables, berries, parsley, and dill, are first sorted to remove damaged material and then crushed. Pre-processing generates waste, including peel, shells, and husks.

The next stage of smoothie production is the mixing of ingredients according to the formulation. To the pre-processed ingredients, additional components may be added, if specified, including water, mineral water, milk, kefir, yogurt, puree, juice, syrup, plant-based milk, tea, coffee, lemonade, ice cream, frozen dessert, vegetable oil, sugar, sweetener, and bioactive compounds. In smoothies formulated with milk and plant-based ingredients, a milk content exceeding 30% can result in protein coagulation and the separation of a watery layer [35]. The smoothie mixture is then homogenized, resulting in a more fluid and homogeneous beverage.

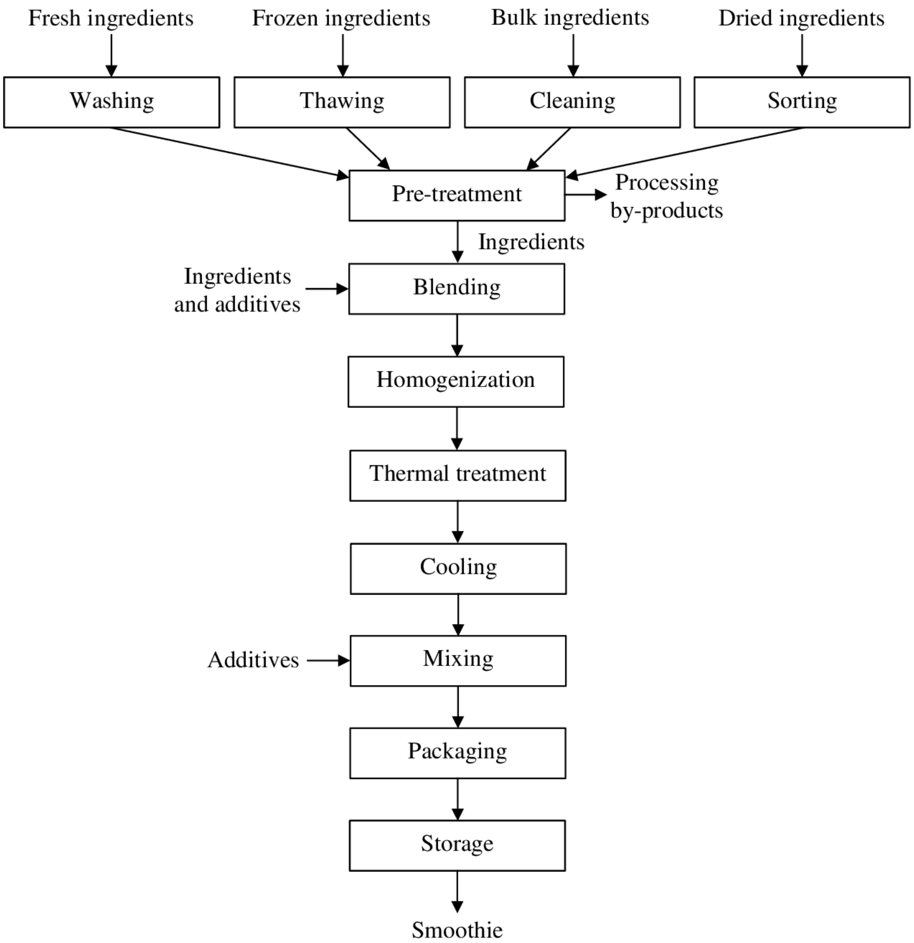

Figure 1 – Production of smoothies

Source: prepared on the basis of flowchart by U. Tiwari [41]

Smoothies without specific preservation treatment have a short shelf life due to microbial spoilage. Thermal treatment of fresh vegetable smoothies (3 min at 80ºC) inactivated polyphenoloxidase, peroxidase, and pectinmethylesterase, whose activities remained minimal during subsequent storage at either 5ºC or 20ºC [37]. Pasteurization at 90ºC for 35 s negatively affects smoothie colour, although it preserves the bioactive compounds such as flavonoids and phenolic acids [9]. Compared with batch pasteurization, flow pasteurization requires only a few seconds to inactivate enzymes and eliminate microorganisms and appears superior for preserving heat-sensitive compounds [24].

To meet safety requirements, various minimal processing methods, such as high-pressure processing (HPP), pulsed electric field [43], and ultrasound, have been applied to foods with fresh-like properties. Among these, the combination of HPP and low-temperature storage is most effective for preserving the sensory attributes of smoothies [38]. HPP (627.5 MPa/6.4 min) reduces the activity of pectinmethylesterase, peroxidase, and polyphenol oxidase, increases antioxidant capacity, and maintains colour [12]. During storage, mildly heated smoothies (80ºC for 7 min) exhibited more stable colour, whereas HPP-treated beverages (350 MPa for 5 min) showed a lower browning index and reduced viscosity [33]. Additionally, HPP-treated smoothies exhibited superior sensory properties and higher nutritional quality compared with their mildly heated counterparts. After pasteurization (80ºC for 3 min) or HPP-treatment (450 MPa for 3 min at 20ºC) and subsequent storage, soluble sugars (glucose and fructose), organic acids (citric, malic, tartaric, oxalic and quinic), and minerals (sodium, potassium, calcium, magnesium, iron, copper, zinc and manganese) showed no significant changes [3].

Mild thermal treatment (3 min at 80ºC) combined with low-temperature storage (5ºC) extended the shelf life of smoothies up to 58 days and reduced the degradation of total vitamin C and colour compared with storage at 20ºC [7]. Pasteurization at 85ºC for 7 min effectively inactivated oxidase and pectic enzymes but resulted in a cooked-fruit flavour and the loss of vitamin C [16]. Thermal pasteurization is therefore not considered optimal for preserving healthy smoothies, as it can degrade heat-labile nutrients, including vitamins and bioactive compounds [13]. To prolong the shelf life and stability of mixed fruit and vegetable smoothies, ultrasound treatments in combination with green tea extract, nisin, or natamycin have been applied [6, 30]. The naturally low pH of fruits (≤ 4.5) also acts as an intrinsic preservation factor against most spoilage microorganisms [18].

Smoothies can be sonicated at different amplitude levels (24.4–61.0 μm) for 3–10 min. The greatest reductions in total antioxidant capacity and total phenolic content were observed at the maximum amplitude (61.0 μm). Sonication also reduced colour and rheological properties and decreased particle size compared with fresh or thermally treated smoothies [19].

After heat treatment, the smoothies are immediately cooled. Functional additives (e.g., vitamins and probiotics) and technological additives (e.g., stabilizers and preservatives) are then added to the cooled smoothie, if required by the formulation. The smoothies are subsequently packaged and stored at a temperature of 5ºC.

For the production of fermented fruit smoothies fortified with whey protein derived from ewe's milk, the fruit blend is heated at 80ºC for 10 min and cooled to 25ºC prior to fortification. Starter cultures, including *Lactiplantibacillus plantarum, Leuconostoc holzapfelii, Lactococcus lactis*, and A. *kunkeei*, are then added, and fermentation is carried out at 30ºC for 72 h [42].

The quality and safety of a smoothie are determined by a combination of nutritional, chemical, physical, sensory, functional, and microbiological properties (Fig. 2). These properties are influenced by the quality of the ingredients, the formulation, and the processing technique. Nutritional indicators are particularly important for consumers, especially the content of protein, fat, and carbohydrates, which determine the caloric value of the beverage. Chemical indicators, including total soluble solids, total sugar content, pH, and acidity, affect the taste and aroma of the smoothie, its consistency (primarily via soluble solids), caloric value (mainly sugars), shelf life, and stability (primarily sugar content, acidity, and pH). Physical properties, including density, viscosity, pulp content, sediment content, and mineral impurities, determine the beverage's consistency and stability, contribute to its nutritional value (pulp), and affect its safety (mineral impurities).

Consumer evaluation of smoothie quality is primarily based on the sensory attributes, including appearance, taste, aroma, consistency, and colour. In addition to sensory characteristics, functional properties are increasingly valued by consumers, particularly the content of bioactive compounds such as vitamins, minerals, dietary fibre, polyphenols, pectins, carotenes, omega-3 and omega-6 fatty acids, and amino acids. Smoothie safety is determined by its microbiological profile, which depends on the quality of raw materials, the processing method employed, as well as storage conditions and shelf life. Collectively, these properties constitute a hierarchical classification that should be considered when determining the comprehensive quality index of the smoothie.

The comprehensive quality index of a smoothie can be calculated using the following equation:

$$Q = m_1 \sum_{i=1}^{3} m_{1i} q_{1i} + m_2 \sum_{j=1}^{4} m_{2i} q_{2i} + m_3 \sum_{k=1}^{5} m_{3k} q_{3k} +$$
$$+ m_4 \sum_{l=1}^{5} m_{4l} q_{4l} + m_5 \sum_{t=1}^{8} m_{5t} q_{5t} + m_6 q_6$$

where Q is the comprehensive quality index of a smoothie; m_1, m_2, m_3, m_4, m_5, m_6 are the weighting coefficients for the groups of indicators: nutritional, chemical, physical, sensory, functional, and microbiological indicators, respectively; m_{1i}, m_{2j}, m_{3k}, m_{4l}, m_{5t} are the weighting coefficients of individual indicators within each groups; q_{1i}, q_{2j}, q_{3k}, q_{4l}, q_{5t}, q_6 are the relative quality indicators of a smoothie.

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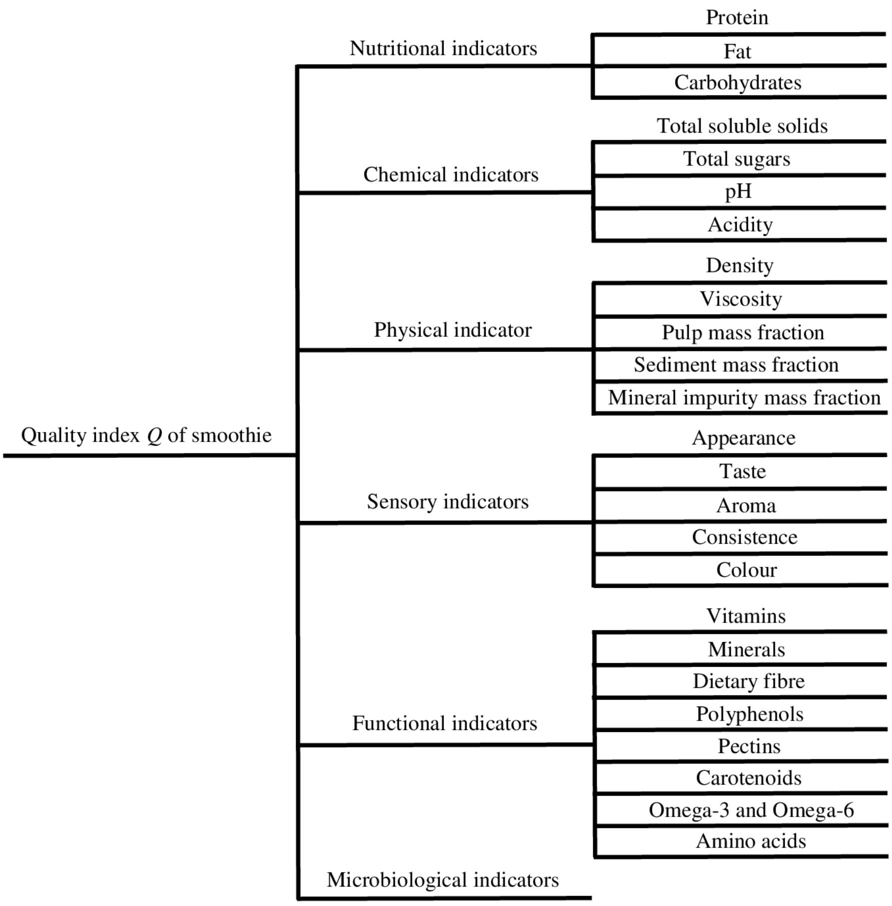

Figure 2 – Hierarchical classification of smoothie properties

Source: developed by the authors

The weighting coefficients of the indicator groups and of each indicator within a group are determined through expert evaluation (reverse ranking of beverage properties). The weighting coefficients of smoothie properties may vary depending on the functional purpose of the beverages. The values of the weighting coefficients range from 0 to 1 ($0 < m < 1$). The greater the value of a weighting coefficient, the stronger the impact of the corresponding property on smoothie quality. The following conditions must be satisfied for the weighting coefficients:

$$m_1 + m_2 + m_3 + m_4 + m_5 + m_6 = 1,$$

$$\sum_{i=1}^{3} m_{1i} = 1, \sum_{j=1}^{4} m_{2i} = 1, \sum_{k=1}^{5} m_{3k} = 1, \sum_{l=1}^{5} m_{4l} = 1, \sum_{t=1}^{8} m_{5t} = 1.$$

Relative quality indicators of a smoothie are calculated using the equations:

$$q^* = \frac{P}{P_{rec}} \quad or \quad q^{**} = \frac{P_{rec}}{P},$$

where P is the measured value of a smoothie indicator;

P_{rec} is the recommended (optimal) value of a smoothie indicator.

The relative quality indicator q^* is calculated when an increase in the value of the indicator P has a positive effect on smoothie quality. For example, if the mass fraction of fruit pulp in the smoothie is $P = 0.75$ and the recommended value is $P_{rec} = 0.85$, then $q^* = 0.75/0.85 = 0.88$. The relative quality indicator q^{**} is calculated when an increase in the value of the indicator P has a negative effect on smoothie quality. For example, if the mass fraction of sediment in a smoothie is $P = 0.25$ and the recommended value is $P_{rec} = 0.15$, then $q^* = 0.15/0.25 = 0.60$. The comprehensive quality index enables comparison of smoothie formulations with different compositions and facilitates the identification of beverages that meet the needs of specific target consumer groups.

Conclusions. Smoothies are non-alcoholic beverages that are gaining widespread popularity due to their functional properties among consumers of different age groups. They are prepared both at home and in food processing enterprises from a wide range of raw materials, which enables them to meet diverse consumer preferences and nutritional needs within the context of functional foods. The primary raw materials for smoothies are fresh and processed fruits, vegetables, and berries in various combinations. In addition, mineral water, milk, plant-based milk, yogurt, and kefir are commonly used as liquid bases. Smoothies are often enriched with bioactive compounds, vitamins, and minerals. To extend shelf life, natural preservatives may be added, while stabilizers are used to ensure stability and prevent phase separation. Taking into account the origin, degree of processing, and functional purpose of smoothie ingredients, their categorization was developed.

The technique for smoothie production depends on the type of raw materials used and whether the beverage is intended for immediate consumption or storage. Prior to use, the raw materials undergo pre-processing, including washing and cleaning. To achieve a uniform consistency, the smoothie mixture is homogenized. To extend shelf life, the beverage is subjected to pasteurization or other processing methods to inactivate spoilage microorganisms.

The quality and safety of a smoothie depend on its nutritional, physicochemical, sensory, functional, and microbiological properties. To assess the quality of such beverages, a comprehensive quality index has been developed, based on comparing the measured properties of the smoothie with their recommended values. This approach to quality evaluation enables an objective and integrated assessment of the beverage and facilitates the comparison of similar products using consistent criteria. Further research on the application of the comprehensive smoothie quality index to support formulation design tailored to the needs of specific consumer groups is considered promising.

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СМУЗІ: ІНГРЕДІЄНТИ, ТЕХНОЛОГІЇ ВИРОБНИЦТВА ТА ОЦІНЮВАННЯ ЯКОСТІ

Смузі є популярним безалкогольним напоєм, що готують в домашніх умовах або виробляють на підприємствах із різних видів сировини. Технологія виготовлення залежить від інгредієнтів напою та способу їх підготовлення до використання. Для забезпечення однорідної консистенції напою суміш інгредієнтів гомогенізують. Для подовження терміну зберігання напою його пастеризують або застосовують інші способи оброблення, зокрема високим тиском. Основою смузі переважно є свіжі або перероблені фрукти, овочі та ягоди. Смузі також може містити молоко, йогурт, «рослинне молоко», мінеральну воду та різні функціональні й технологічні добавки. Метою статті було згрупувати інгредієнти смузі за походженням, ступенем оброблення та призначенням, а також проаналізувати технології виготовлення смузі і розробити комплексний показник для оцінювання їхньої якості. Усі сировинні компоненти смузі можна об'єднати у групи: рослинні інгредієнти, рідкі інгредієнти, концентровані та сухі інгредієнти, джерела жиру та білків, смако-ароматичні інгредієнти, функціональні та технологічні добавки. Таке групування дозволяє визначити функціональне призначення кожного інгредієнта в напої. Наукова новизна проведених досліджень полягає у групуванні інгредієнтів смузі за категоріями залежно від їхнього походження, ступеня оброблення та функціонального призначення. Теоретичне значення має також запропоноване рівняння для визначення комплексного показника якості смузі. Застосування на практиці комплексного показника якості дозволяє об'єктивно оцінити та порівняти смузі з різних видів сировини, що виготовлені за різними технологіями, з урахуванням вагомості властивостей напою для споживачів. Коефіцієнти вагомості властивостей смузі можуть змінюватися залежно від функціонального призначення напою. Більш важливій властивості смузі призначають більший коефіцієнт вагомості, що визначають шляхом опитування експертів. Також показник якості засновано на визначені ступеня досягнення оптимальних значень показників, що характеризують властивості та якість смузі. Комплексний показник якості смузі доцільно використовувати на етапі розроблення нових смузі для їх оцінювання та порівняння з вже представленими на ринку.

Ключові слова: *смузі, безалкогольний напій, сировина для напоїв, інгредієнти смузі, технологія напою, якість напою.*

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