

Development of Saudi Food Composition Database (SFCD)

Ghadir Fallata

gafallata@sfda.gov.sa

Saudi Food and Drug Authority <https://orcid.org/0000-0002-9270-6638>

Omar Alhumaidan

Saudi Food and Drug Authority, Riyadh, Saudi Arabia

Mojca Korošec

University of Ljubljana

Mohamad Sibai

Saudi Food and Drug Authority, Riyadh, Saudi Arabia

Rawan Alobaid

Saudi Food and Drug Authority, Riyadh, Saudi Arabia

Mohammed Alsaif

Saudi Food and Drug Authority, Riyadh, Saudi Arabia

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Article

Development of Saudi Food Composition Database (SFCD)

Ghadir Fallata^{ab*}, Omar Alhumaidan^{ab}, Mojca Korošec^c, Mohamad Sibai^a, Rawan Alobaid^a, Mohammed Alsaif^{ad}

^a Saudi Food and Drug Authority, Riyadh, Saudi Arabia.

^b National Nutrition Committee, Riyadh, Saudi Arabia.

^c Biotechnical Faculty, University of Ljubljana, Ljubljana, Slovenia.

^d King Saud university, Riyadh, Saudi Arabia

* Corresponding author. Tel.: +966544310712.

E-mail addresses: gafallata@sfda.gov.sa (G. Fallata), oahumaidan@sfda.gov.sa (O. Alhumaidan), Mojca.Korosec@bf.uni-lj.si (M. Korošec), msibai79@gmail.com (M. Sibai), raobaid@sfda.gov.sa (R. Alobaid), msaif.c@sfda.gov.sa (M. Alsaif)

Abstract

Food composition databases are essential for dietary assessment, nutrition research, clinical practice, food regulation, and public health policymaking. However, Saudi Arabia has historically depended on international databases that include foods that do not represent local consumption, traditional dishes, and national fortification practices. This study developed a structured computational framework for the Saudi Food

Composition Database (SFCD) to facilitate access to national food composition data. Food data were compiled from local and international sources, reviewed, standardized, matched, and classified according to an established food-group hierarchy. The developed bilingual web-based platform provides structured access to 2,818 food items covering 322 nutrients. Foods in the SCFD were systemized into 18 main groups, 226 subgroups, and 44 sub-subgroups. The framework includes functions such as food and nutrient searching, food comparison, and systematic data management, in addition to support for efficient updating, scalability, and reliable access for users and administrators. The SFCD provides a centralized national resource that improves the accessibility and usability of food composition information in Saudi Arabia. It strengthens dietary and nutrient intake assessment, epidemiological and clinical research, nutrition labelling, dietary guideline development, and evidence-based food and nutrition policy development. Continuous expansion of the database using locally generated data and integration with other national health and food systems will further strengthen the representation of the national sources and public health value.

Keywords

Saudi Food composition database, SFCD, national food composition database, food composition database, FCDB, Saudi Arabic database, Food Composition Table, FCT.

1. Introduction

Historically, food composition research was initiated to identify and characterize the chemical components in foods that influence human health. Over time, these studies have developed from simple chemical analyses to standardized national food composition databases that support dietary assessment, epidemiological research, clinical nutrition, food regulation, and public health policy (Greenfield and Southgate, 2003; FAO/INFOODS, 2012).

In 1949, the Food and Agriculture Organization (FAO) established a milestone by publishing the International Food Composition Tables (Chatfield, 1949). These tables support the assessment of food availability at the global level, including the calculation of energy, protein, and fat availability, when used in conjunction with Food Balance Sheets. Although the United Kingdom (UK) has been widely regarded as a leader in the field of food composition databases, the first UK databases were developed after some had already been developed by Germany and the United States (US) (Widdowson, 1967, 1974; Church, 2006).

Food composition tables (FCTs) were originally presented in a printed format for many years. While printed tables are still available in many countries, electronic formats (computerized databases) have become increasingly important because of their ability to contain large amounts of data, which allow easy access and leveraging from the data. The electronic formats of food composition ranged from ASCII plain-

61 text files to spreadsheet formats stored on discs, CD-ROMs, and online access
62 databases. In 1978, the UK FCT were the first tables computerized on readable tape,
63 followed by the US, where their FCT became available online in 1996 (Church, 2006).
64 Computerized databases overcome several limitations of printed tables by facilitating
65 updates, calculations, and the management of comprehensive compositional data and
66 associated metadata (Greenfield and Southgate, 2003).

67 Food composition databases (FCDBs) contain detailed information on the nutritional
68 composition of foods and other compounds, such as polyphenols and phytic acid.
69 Today, the most popular FCDBs are comprehensive open-access online datasets and
70 resources with interface applications that provide responses to simple queries or
71 enable the downloading of large datasets. Up-to-date food composition data are
72 essential for assessments in nutrition and public health, as well as for various
73 estimations and applications in food science, engineering, agrobiodiversity, plant
74 breeding, and food regulatory aspects (Delgado et al., 2021).

75 Currently, the FCDBs include different typologies of foods, such as simple, processed,
76 traditional or “innovative,” certified and local, as well as foods that originate from
77 other countries and are currently considered to be novel to the community. Most
78 commonly, the availability of data generation or data compilation mainly depends on
79 economic resources. Considering the growing globalization of the food market,
80 national food composition databases are striving to produce, collect, and present data

in a standardized format to “speak a common language” that enables data comparison (Marconi et al., 2018).

Following the evolution of nutritional science in recent years, the study of the potential beneficial role of diet is one of the most topical and controversial issues. In addition to the concept of a balanced diet, which has also been enriched by functional diet, health status and the risk of certain diseases have been closely related to diet (Nishida et al., 2004). Research on interactions between single food components and/or the various ingredients of a composite dish has a significant role and amplifies the meaning of “food synergy,” which is defined as a concept for understanding the relationship between nutrition and health (Jacobs and Tapsell, 2007; Marconi et al., 2018).

FCDBs serve as essential tools for converting dietary consumption data into precise nutrient intakes to evaluate these nutritional complexities (Merchant and Dehghan, 2006). Beyond individual dietary assessments and clinical research, FCDBs are extensively utilized in investigating diet-disease relationships, formulating public health policies, and guiding agricultural interventions (Marconi et al., 2018; Md Noh et al., 2020). Furthermore, these databases provide the foundational data required by the food industry for regulatory nutrition labeling and product development (Marconi et al., 2018; Md Noh et al., 2020).

100 FCDBs have been used extensively in many areas, including for nutritional analysis or
101 assessment of nutrient intakes, prescription of therapeutic diets, nutrition labelling,
102 diet-disease relationship research, national food and nutrition policy, nutritional
103 regulation of food supply, and nutrition intervention programs (Md Noh et al., 2020).
104 While many countries maintain FCDBs, despite the broad variation of capacity and
105 adequacy, the majority of countries have incomplete, outdated, and/or unreliable or
106 even no FCDBs. In these cases, data have to be borrowed from other sources;
107 therefore, the international FCDBs are extremely important. The international FCDBs
108 usually comprise lists of software tools for nutrient intake estimation and diet
109 planning, in addition to specific software tools for labelling or calculation of food
110 supply and availability (Delgado et al., 2021; FAO, 2022).

111 Relevant information on food composition can be retrieved from the FAO, European
112 Food Information Resource (EuroFIR), United States Department of Agriculture
113 (USDA), and other sources. Some national FCDBs comply with international
114 standards and can be accessed online in English. Moreover, on the one hand, as
115 databases achieve outstanding dimensions, features such as documented updates, ease
116 of use, and official recognition as national references become critical determinants of
117 their utility, as demonstrated by the French FCDB (CIQUAL) and Danish FCDB
118 (Frida Food Data). On the other hand, national food databases that have limited scope
119 are considered valuable sources of information on specific/ethnic foods, are freely

accessible online, and are related to the health and environmental impacts of diets (Delgado et al., 2021).

Researchers in the Gulf Cooperation Council countries have long relied on FCDBs developed for other populations, such as the USDA database. However, these databases may not adequately represent local foods, recipes, products, fortification practices, and consumption patterns. This limitation has highlighted the need for a representative regional and national FCDB (Bawajeesh et al., 2021). Despite the availability of food composition data from individual studies and selected national resources, Saudi Arabia lacks a comprehensive, regularly updated, and nationally representative FCDB. Thus, Saudi researchers have often depended on international sources, in particular the USDA and the UK FCDB, which mostly fail to reflect the composition of Saudi foods, traditional dishes, recipes, preparation methods, branded products, and fortification practices. Therefore, establishing and maintaining a national Saudi FCDB is essential to improve the accuracy of dietary and nutrient intake assessments, support clinical and epidemiological research, report evidence-based nutrition policies and dietary guidelines, facilitate accurate nutrition labelling, and monitor diet-related public health risks in the Saudi population (Bawajeesh et al., 2021).

This work presents the development of a structured computational framework for a Saudi FCDB that supports, organizes, and facilitates operations on the released web

content. This framework will help to illustrate the systematic approach to web food data management and services in a controlled and optimized manner, in addition to ensuring efficiency, scalability, and reliability for users and administrators.

2. Methods

2.1. Study Design Overview

This study involved the development of the Saudi Food Composition Database (SFCD), intended to support the collection, storage, management, and utilization of food composition data. The SFCD was developed with three main functionalities: to search for food items by name, to search for specific nutrients in foods, and to compare the nutritional composition of different food items (see Figure 1 for the structure of the SFCD).

Figures 3 and 4 clarify the user interface of the SFCD. The system enables the recovery or recall of and search for food composition data through multiple approaches, including food- and nutrient-based requests. Food items are organized into predefined food groups to support systematic navigation and data access (see Supplementary Material 1 for more details about the SFCD food groups, sub-group, and sub-sub-group). In addition, the database allows the viewing of detailed nutrient composition data and the comparison of the nutritional profiles of different food items to support dietary assessment, nutritional research, and evidence-based decision making.

As presented in Figure 1, the system includes a knowledge base containing food composition data compiled from multiple sources, a user interface that assist data recovery and user interaction, and a rules engine responsible for query processing and system operations. In addition, in the database, the nutrient composition data has been filed and summarized according to food groups, enabling searches by food name or nutrient content in two languages (Arabic and English) and comparison of up to three items; this structure also sorts the nutritional data to standardized portions per 100 grams, which enables users to recover or recall nutritional information at both individual food levels and in food groups (Figures 2 and 3).

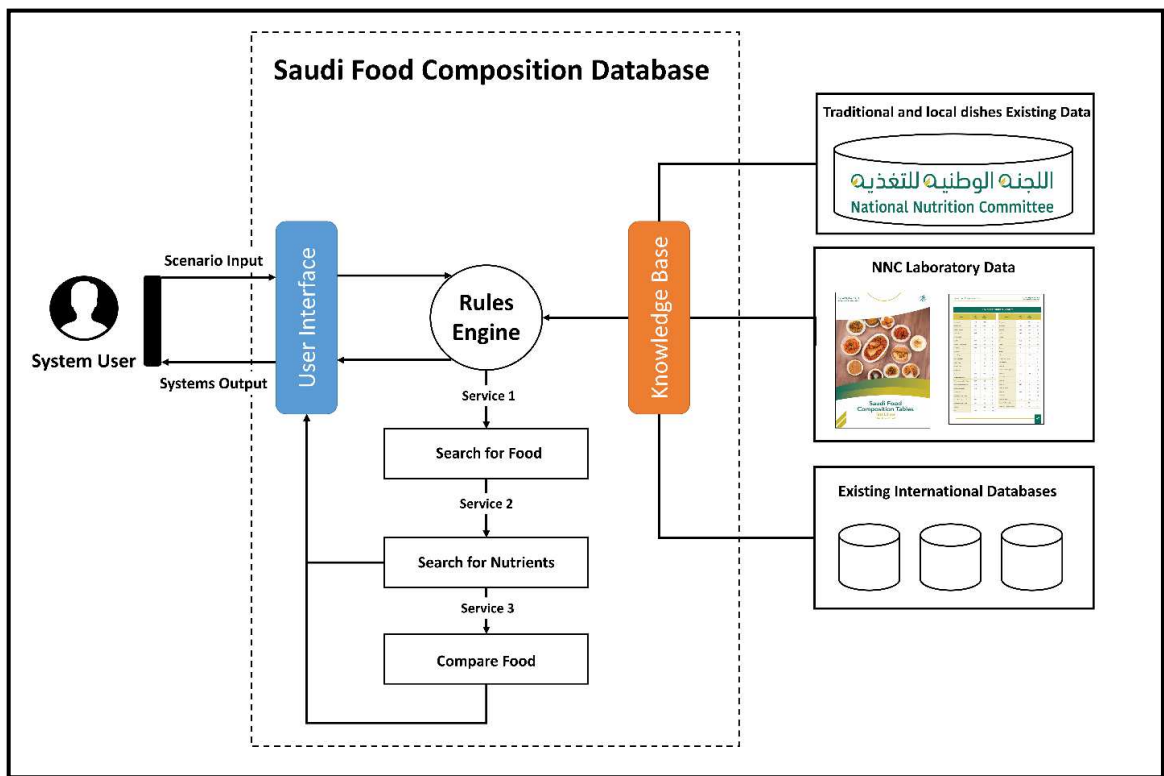


Figure 1: Saudi Food Composition Database Structure.

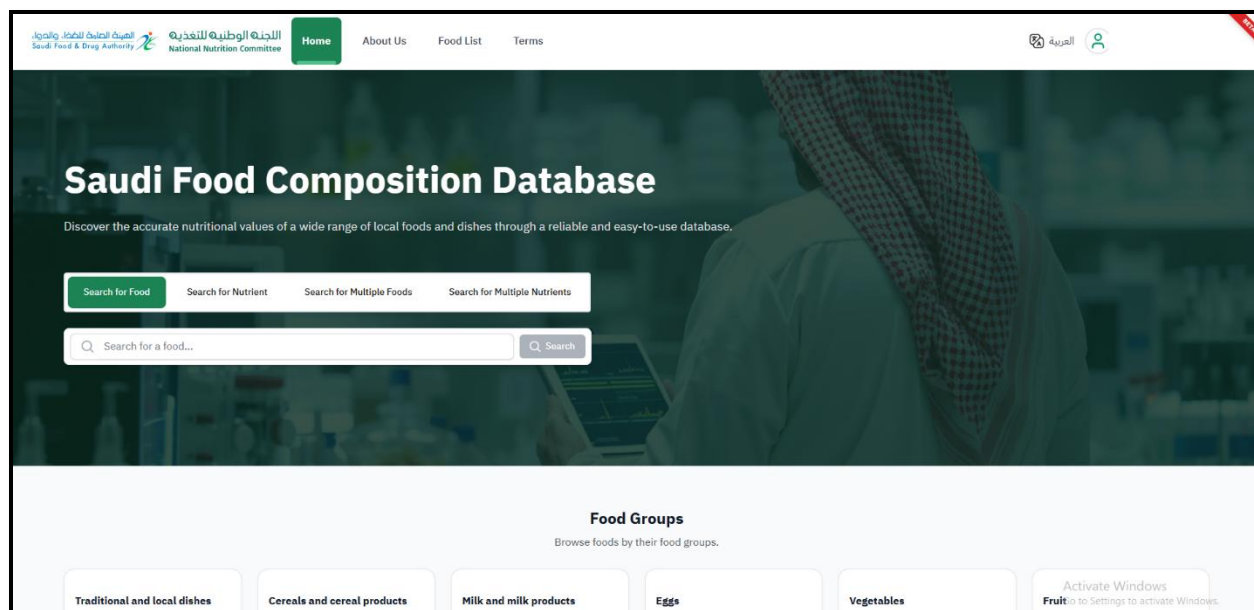


Figure 2: Main user interface of the online Saudi Food Composition Database.

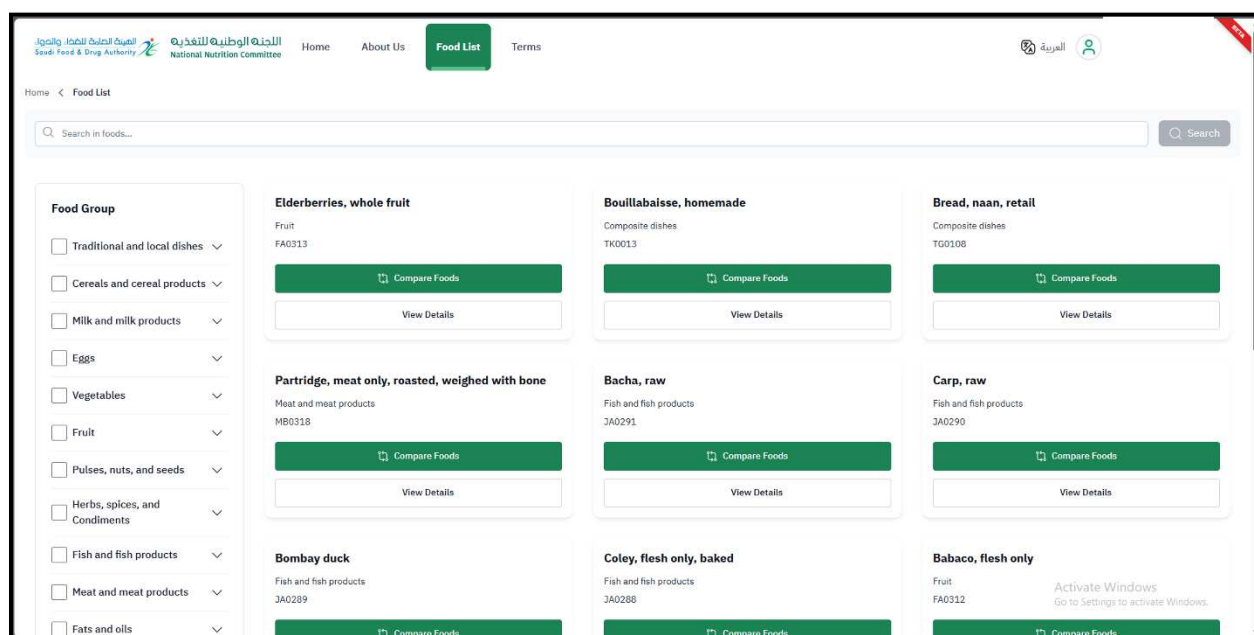


Figure 3: Food browsing and nutrient comparison interface of the Saudi Food Composition Database.

176 The SFCD system has been designed with high performance and reliability features; it
177 provides a secure, transparent, and user-friendly platform that is compatible with
178 mobile phones, desktops, and tablets and with major browsers, including Chrome,
179 Edge, Firefox, and Safari. In addition, the SFCD system includes features such as auto
180 complete search, dropdown filters for food groups, page load times not exceeding two
181 seconds under normal conditions, high security ensured by two-factor authentication,
182 and automatic session termination after 15 minutes of inactivity with full acquiescence
183 with the General Data Protection Regulation (GDPR) and national cybersecurity
184 regulations.

185 The database will be updated periodically and when new food data become available.
186 Foods in the database may be replaced with new data updates, or new foods and their
187 data may be added. For food replacement, a confidence score system adopted from an
188 analytical tool (Fallata et al., 2026) is used to compare the previous food data source
189 with the new one. The confidence score system assigns a score to the food data
190 confidence, and the data with the highest confidence score are included in the
191 database. For instance, the new food data may have an average or poor- confidence
192 score compared to the previous data, so, in this case, the previous entry with high data
193 confidence will not be replaced by the new data (scored as average or poor
194 confidence) (see Supplementary Material 2 for more details about the confidence
195 score system of food in SFCD).

2.2. Data Sources

Food composition data were obtained from two primary sources. The first source was the basis of the SFCD and included general food items obtained from international food composition databases used as reference sources when corresponding data were not available from national sources. The UK Composition of Foods Integrated Dataset (CoFID), known as the McCance and Widdowson's database (MWD), was selected because it is considered to be one of the primary, comprehensive, and standardized references of internationally recognized food composition systems (Public Health England, 2021). The MWD is a suitable reference for the development of a national food composition database due to the comprehensive documentation, harmonious food descriptions and classification, clear definitions of nutrients, and compliance with to international food composition standards, which facilitated the identification, matching, and standardization of foods during the development of SFCD.

The second source consisted of 130 laboratory analyses for traditional Saudi foods that had previously been compiled and published in the Saudi Food Composition Tables (Alkhunein et al., 2026). Relevant studies were identified through a systematic review of the available literature, and composition data for 130 foods were extracted and incorporated into the database. Overall, all data from the two sources were reviewed, standardized, harmonized, and integrated into the database structure to ensure consistency and facilitate data retrieval and comparison.

2.3. Food Composition Data Model

Each food is assigned to a specific food group and a subgroup associated with multiple nutrients at multiple levels, including food category, subcategory, specific nutrient, and nutrient form. Figure 4 illustrates the design of the food composition data structure, which reflects a hierarchical "one-to-many" relationship between categories, to ensure accuracy and gradation in the descriptions of nutritional data (the structure includes foods, food groups and subgroups, and nutrient levels).

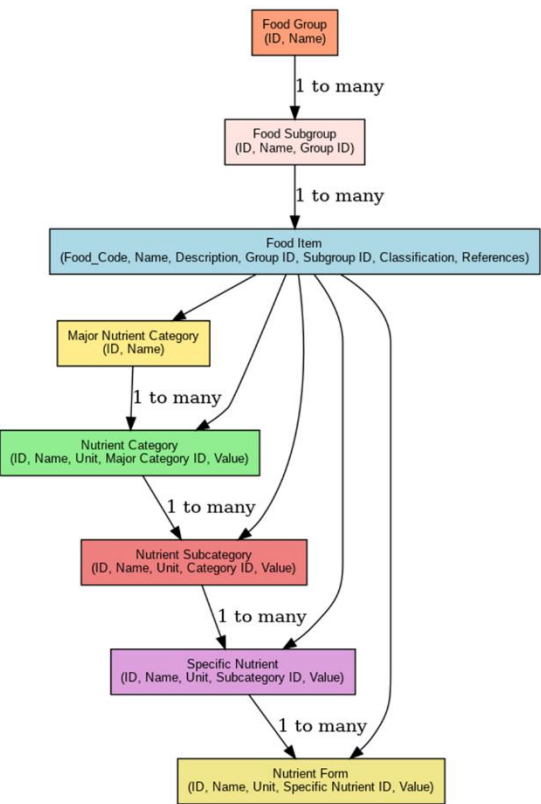


Figure 4: Data Food Composition Data Model.

2.4. System Development

The national FCDB was developed as a web-based platform using multi-tier architecture, including presentation, application, and data management layers. Angular was used to develop the user interface, while ASP.NET Core was used to implement both application services and business logic. The Microsoft SQL Server was used as the primary relational database management system associated with metadata for storing and managing the food composition data. The platform was designed to support functional data entry, storage, recovery, search, report, and future interoperability with external applications through application programming interfaces (APIs). The overall architecture was developed to ensure scalability, maintainability, extensibility, and reliable management of the SFCD.

2.5. Food Definition and Inclusion Criteria

To ensure consistency and relevance to Saudi food supply, food definition and inclusion criteria were established before compiling the database. Information about foods included in the SFCD are available in two languages, English and Arabic, in both versions of the database. In addition, foods such as pork and alcohol, or any foods containing these, were excluded because their production, sale, and consumption are prohibited in Saudi Arabia due to religious and regulatory restrictions. Consequently, these items are not part of the local food supply chain. Food items with company or brand names were also excluded in accordance with regulatory guidelines that prevent the inclusion of branded products in the database.

2.6. Data Entry Sheet Structure

The data entry sheet was developed for the compilation of the SFCD and is comprised of eight standardized sections: (1) Food Code in WMD, (2) Food Name, (3) Food Type, (4) Description, (5) Group, (6) Main Data References, (7) Data Reference Classification, and (8) Footnote. Each section was designed to capture specific information required for the management of the database (See Figure 5).

Food Code in M&W	رمز الغذاء في قاعدة بيانات بريطانيا	Food Name	اسم الغذاء	FoodType	نوع الغذاء	Description	الوصف	Group	المجموعة الغذائية	Main data references	المراجع الأساسية للبيانات	Data reference classification	تصنيف المرجع	Footnote	معلومات إضافية
13-146	13-146	Agar, dried	أجار، مجفف	Food	غذاء	Literature sources	مصادر أدبية	DB	خضروات أخرى	McCance and Widdowson's Composition of Foods Integrated Dataset (CoFID).	McCance and Widdowson's Composition of Foods Integrated Dataset (CoFID).	From another database	من قاعدة بيانات أخرى	It is a natural gelatinous substance extracted from certain types of marine algae (especially red algae).	هي مادة هلامية طبيعية تُستخرج من أنواع معينة من الطحالب البحرية (خاصة الحمراء).
13-147	13-147	Agar, dried, soaked and drained	أجار، مجفف، منقوع ومصفى	Food	غذاء	Literature sources	مصادر أدبية	DB	خضروات أخرى	McCance and Widdowson's Composition of Foods Integrated Dataset (CoFID).	McCance and Widdowson's Composition of Foods Integrated Dataset (CoFID).	From another database	من قاعدة بيانات أخرى	It is a natural gelatinous substance extracted from certain types of marine algae (especially red algae).	هي مادة هلامية طبيعية تُستخرج من أنواع معينة من الطحالب البحرية (خاصة الحمراء).
13-148	13-148	Alfalfa sprouts, raw	براعم البرسيم، نيئة	Food	غذاء	Analytical and literature sources	تحليل ومصادر أدبية	DB	خضروات أخرى	McCance and Widdowson's Composition of Foods Integrated Dataset (CoFID).	McCance and Widdowson's Composition of Foods Integrated Dataset (CoFID).	From another database	من قاعدة بيانات أخرى		

Figure 5: Template of the Data Entry Sheet used for Saudi Food Composition Data Compilation.

2.6.1. Food Code in MWD

The original food code was documented for food items adopted from the MWD. In addition, a new food code was assigned for all food in the SFCD. The original codes were documented to maintain traceability to the sourced database. This approach facilitates data verification, cross referencing, quality control, and future database

270 updates while ensuring consistency between the SFCD and international food
271 composition resources such as the MWD. Retention of the original coding also
272 supports interoperability and enables efficient integration of additional data from
273 external food composition databases.

274 **2.6.2. Food Name**

275 The food names appear in both English and Arabic. Arabic food names were selected
276 from three different food specialists to ensure that the most common name is
277 represented in or aligned with national bodies such as the Culinary Arts Commission
278 (CAC), which affiliated with the Ministry of Culture. In Saudi Arabia, CAC plays a
279 central role in standardizing the naming and recognition of traditional dishes to ensure
280 consistency and authenticity across regions that usually consider national
281 representation of naming traditional food, and the naming is conducted by specialized
282 committees under the guidance of the Commission to ensure that the involved
283 region's geography, traditional food culture, and contribution to promoting the local
284 economy is reflected (Culinary Arts Commission, n.d.).

285 **2.6.3. Food Type**

286 Foods in the database are classified by type: (1) Food, (2) Saudi Food, (3) Dish, (4)
287 Saudi Dish, or (5) Packaged Food to account for the significant variations in nutrient
288 composition that occur due to processing, cooking methods, or packaging. This
289 categorization helps researchers to ensure more accurate representation of foods as

consumed, supports reliable dietary assessment, and enhances the applicability of the database in public health nutrition and research.

2.6.4. Food Description

Descriptions of food sources and methods of derivation include the number of samples used, whether the values were obtained through direct analysis or calculation based on proportions of different food components, and the general state or cooking method of the dish (such as without stones or boiling for 20 minutes). Moreover, for newly added Saudi foods, information was added depending on the provided food information (from lab analyses or reports). This information helps to clarify data quality to the extent to which it represents the actual food.

2.6.5. Food group

New food codes were created for food groups, sub-groups, and sub-sub-groups in the SFCD; some of the codes were modified from both the MWD database and FAO/INFOOD (Greenfield and Southgate, 2003; Public Health England, 2021) (see Supplementary Material 1 for more details about the SFCD food groups, sub-group, and sub-sub-group). Moreover, to represent “Saudi” food, the letter S has been added before each food sub-group and sub-sub-group code (such as rice coded as AA in MWD and Saudi rice as SAA)). The S code was only used for national or traditional foods from Saudi references (literature, analysis, or calculation). For the “Group”

column, the code was added, whereas, in the Arabic column, the full name was added for more clarification.

2.6.6. Main Data References & classification

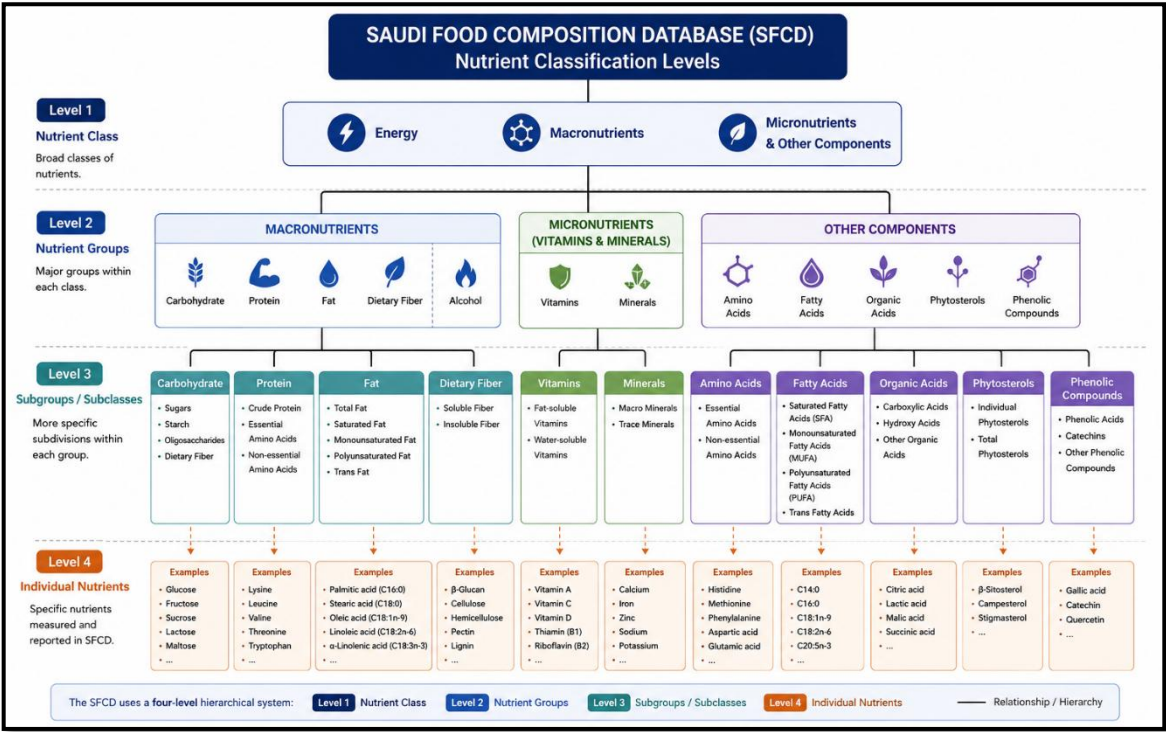
For all foods borrowed from the MWD, the “Main Data Reference” is “McCance and Widdowson's Composition of Foods Integrated Dataset (CoFID), 2021.” Moreover, “data reference classification” comprises five categories to discriminate from: (1) From another database, (2) From laboratory analyses, (3) From studies or reports, (4) From using general model calculations, or (5) from using prescription calculations. “From another database” was chosen for all foods from the MWD database. In addition, for included Saudi foods, the choice depended on the data origin (e.g., From laboratory analyses or From studies or reports).

2.6.7. Footnote

Any additional information regarding food, such as descriptions of the food origin or ingredients or details regarding steps of cooking, was added in the footnote section. Foods from the MWD included in the SFCD retained the original information stated in the “Footnote” in the MWD database. For newly added Saudi food items, the information added depended on the additional food information provided in the literature or in lab analyses or report sheets.

2.6.8. Nutrients description

328 A total of 322 nutrients were included in the SFCD. The nutrients were divided into
329 four levels: Level 1 contains energy and main macro and micro nutrients (total of 43),
330 Level 2 includes sub groups of some macronutrients such as carbohydrates, sugars,
331 fibers, total fatty acids, total amino acids, vitamins, minerals, and phenols (total of 53),
332 Level 3 includes sub groups of total fatty acids, phytosterols, total essential and non-
333 essential amino acids, phenols, and other forms of vitamins and minerals (total of 205),
334 and Level 4 includes sub-sub groups of total essential and non-essential amino acids
335 (total of 21). Figure 6 shows how the levels are presented in the database. Usually, all
336 nutrients in the first level are visible to the platform user on the platform, whereas
337 Levels 2, 3, and 4 are provided in dropdown lists for the platform user.



338 **Figure 6:** Conceptual Hierarchy of Nutrient Classification in the Saudi Food
339 Composition Database (SFCD).

3. Results

3.1. Distribution of Foods Across Food Groups

A total of 2,818 food items have been included in the SFCD, distributed through 14 main food groups, classified according to five different food types: (1) Food, (2) Saudi Food, (3) Dish, (4) Saudi Dish, or (5) Packaged food. The largest food group represented was Vegetables, including 671 items (23.8%), followed by Meat and meat products with 508 items (18.0%), and Cereals and cereal products with 368 items (13.1%). In addition, Fish and fish products include 284 items (10.1%), while Fruits and Milk and milk products include 228 items (8.1%) and 180 items (6.4%), respectively. Moreover, Traditional and local dishes represent 4.6% (130 items), followed by Sauces and soups with 4.47% (126 items). The smallest number of entries observed was for Beverages; Sweets and sugars; Herbs, spices, and condiments; Pulses, nuts, and seeds; Fats and oils; and Eggs (74 items (2.6%), 69 items (2.5%), 61 items (2.2%), 50 items (1.8%), 36 items (1.3%), and 33 items (1.2%), respectively) (Figure 7).

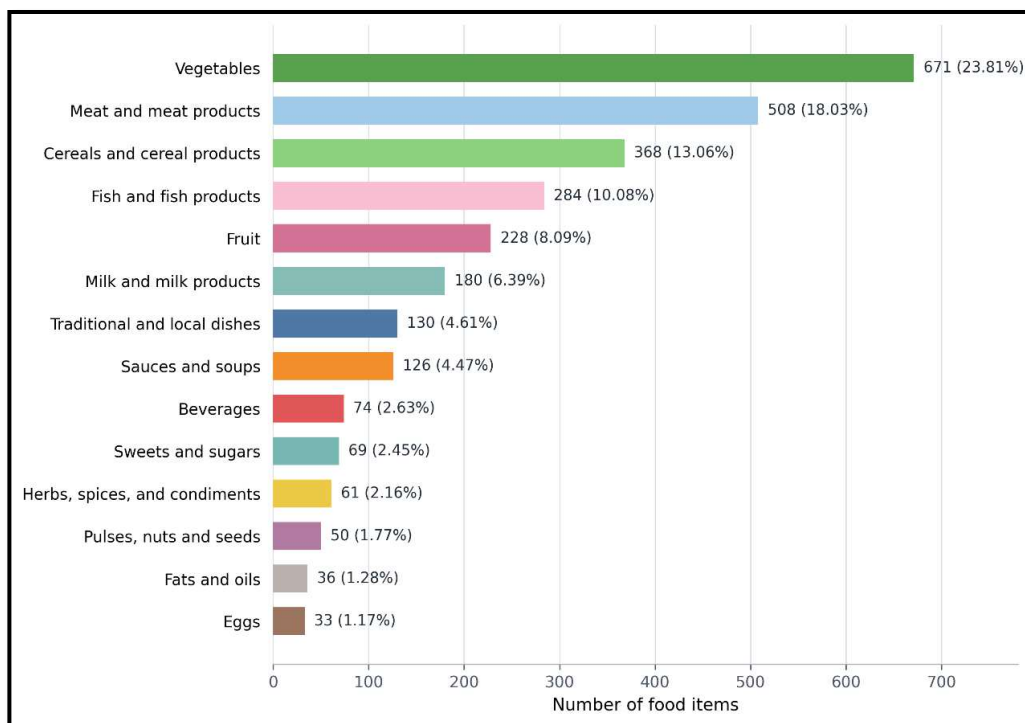


Figure 7: Distribution of Foods across the Main Food Groups in the Saudi Food Composition Database (N=2,818).

3.2. Distribution of Nutrients Components Across Food Groups

3.2.1. Energy Distribution Across Food Groups

Energy values per 100 g of food vary across different food groups, as shown in Figure 8, with the majority clustering around the median value of 158.0 kcal/100g. Highly energy-dense foods such as edible oils, nuts, seeds, and sweets and desserts marked a limited number of 555.5 kcal/100g, which exceeds the 97.5th percentile. On the contrary, beverages and high moisture foods, including vegetables, were near the 2.5th percentile (13.6 kcal/100g).

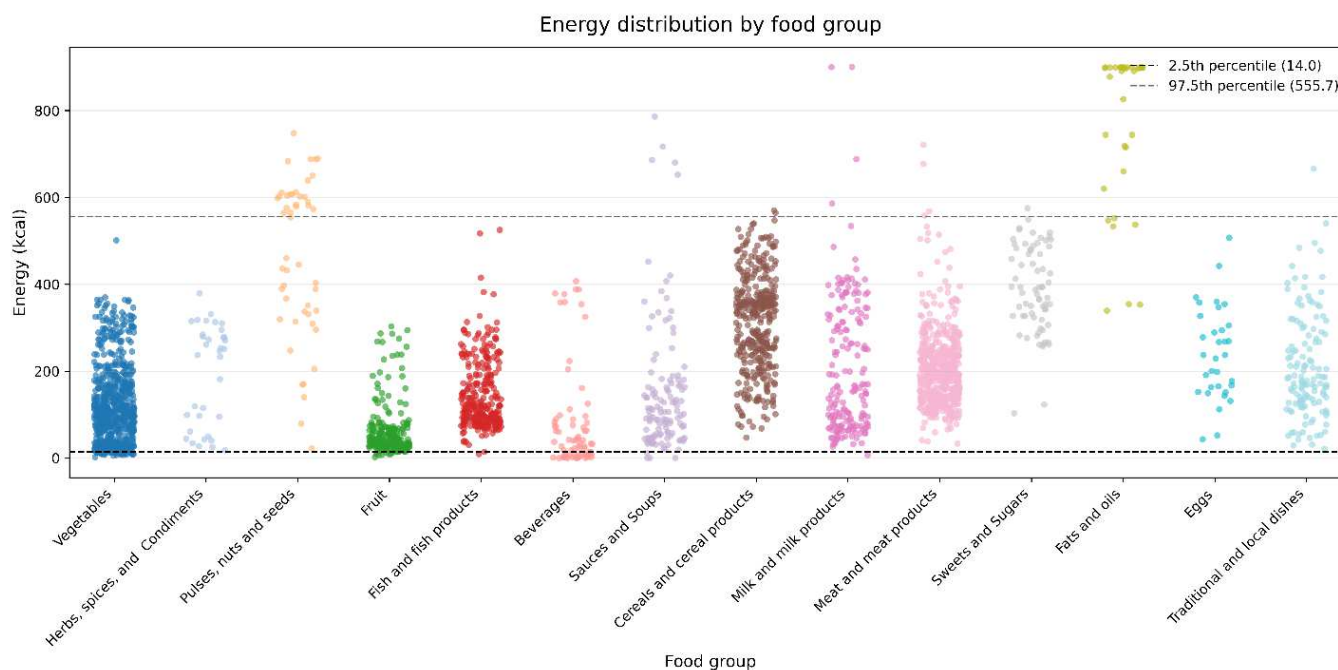


Figure 8: Distribution of Energy Content Across Food Groups in Saudi Food Composition Database.

3.2.2. Carbohydrate Distribution Across Food Groups

Figure 9 illustrates that the distribution of carbohydrate content in foods is largely centered around a median of 8.8 g/100g. Foods extremely high in carbohydrate levels are uncommon, with only a small portion reaching the 97.5th percentile (77.1 g/100g). The high values are mainly linked to cereals, sweets and desserts, and dried fruits.

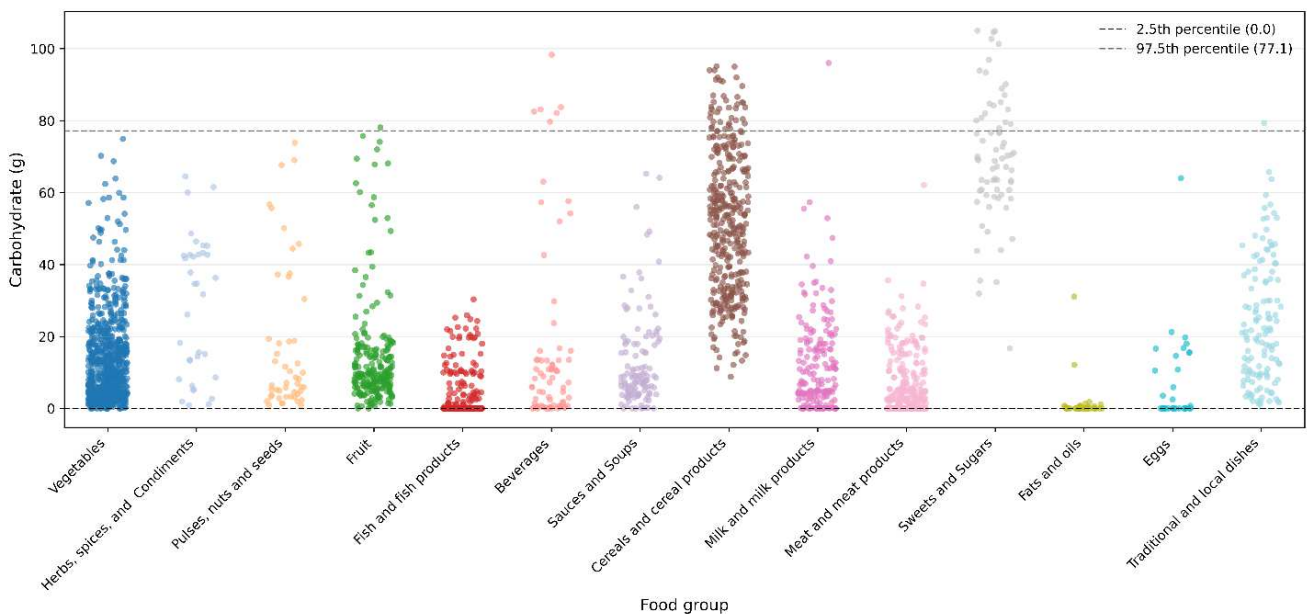


Figure 9: Distribution of carbohydrate content across food groups in the Saudi Food Composition Database.

3.2.3. Protein Distribution Across Food Groups

Protein content was widespread among the food groups, reflecting differences in food composition (Figure 10). Nevertheless, the protein content of the majority of foods remained close to the median (6.2 g/100g). Meat, poultry, fish, legumes, and other protein-rich foods reached values at the 97.5th percentile (29.8 g/100g). In contrast, beverages, fruits, edible oils, and other foods naturally low in protein were close to the 2.5th percentile (0.1 g/100g).

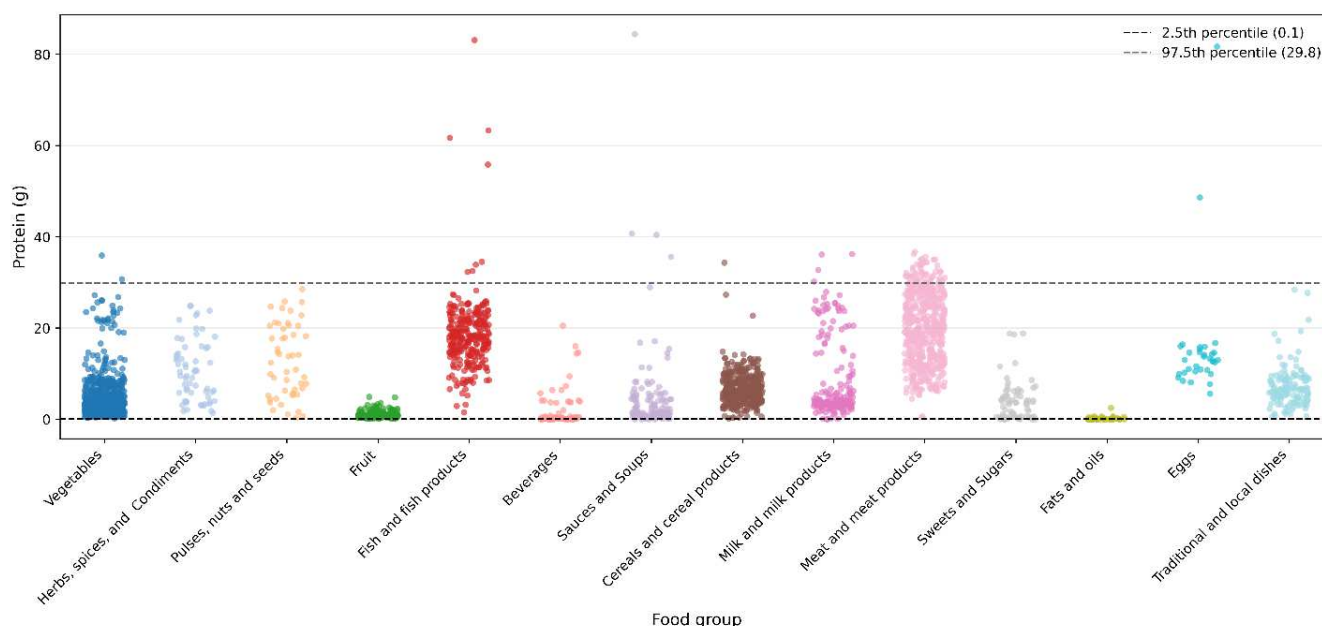


Figure 10: Distribution of Protein Content Across Food Groups in the Saudi Food Composition Database.

3.2.4. Fat Distribution Across Food Groups

As shown in Figure 11, the distribution of fat content was skewed with the majority of foods that contained comparatively low to moderate amounts of fat clustered around the median (5.4 g/100g). Only a small proportion of foods approached the 97.5th percentile (49.2 g/100g), which included edible oils, nuts, seeds, and high fat products. At the opposite end of the distribution, foods such as fruits, vegetables, beverages, and other foods that are naturally fat free or contain minimal amounts of fat were close to the 2.5th percentile (0.0 g/100g).

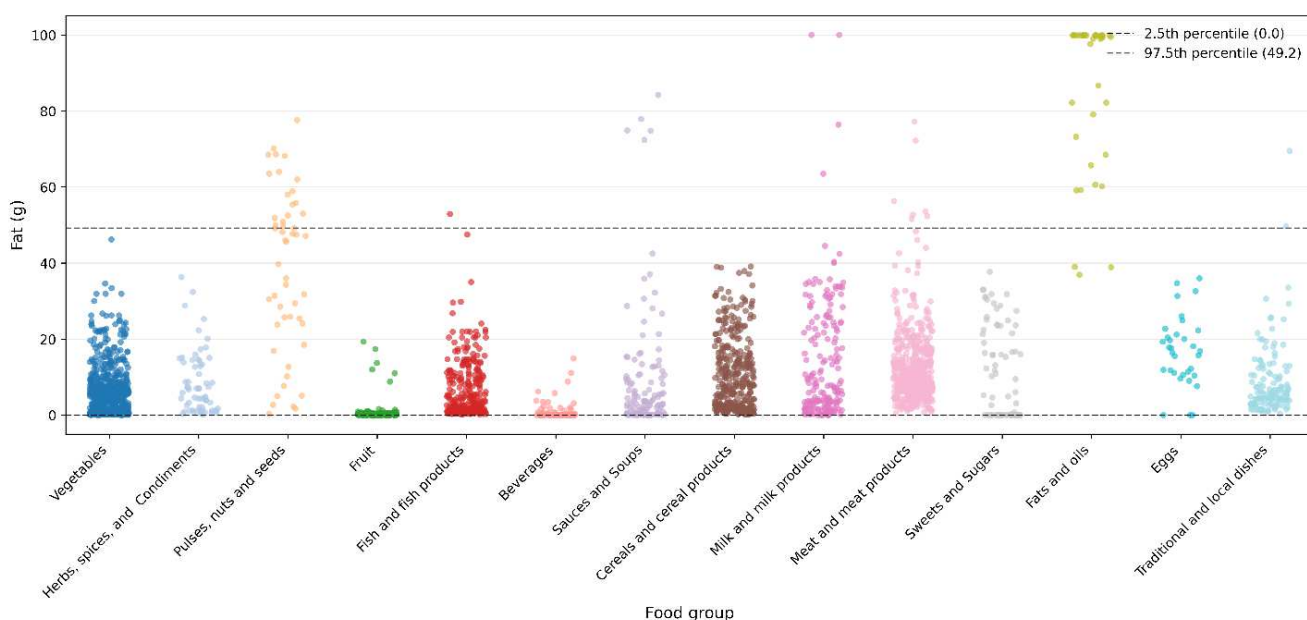


Figure 11: Distribution of Fat Content Across Food Groups in Saudi Food Composition Database.

3.2.5. Distribution of minerals and vitamins

Figures 12 and 13 illustrate the distribution of minerals and vitamins across the food groups. Minerals, including potassium, phosphorus, chloride, sodium, and calcium, presented the highest concentrations, with median values of 236, 110, 93, 70, and 58 mg/100g, respectively. Their distributions were markedly right-skewed, reaching the 97.5th percentiles (1,082, 485.8, 1,220, 906.6, and 577.4 mg/100g, respectively), which indicates that a limited number of foods contained exceptionally high concentrations. In contrast, other minerals, such as iron, zinc, copper, manganese, selenium, and iodine, were consistently detected at lower concentrations, in addition to the absence of several trace minerals from a considerable proportion of foods.

Regarding vitamins, the distribution showed a similarly heterogeneous pattern. On the one hand, at the 97.5th percentile, the broadest distribution was for β -Carotene (3,905 μ g/100g), followed by retinol (344 μ g/100g), vitamin K1 (237.2 μ g/100g), folate (145 μ g/100g), and vitamin C (53 mg/100g). On the other hand, data for both Vitamins D and B12 were absent for many foods, and B vitamins, such as niacin equivalent, pantothenate, thiamin, riboflavin, and vitamin B6, as well as vitamin E were at low concentration despite their variability across food groups.

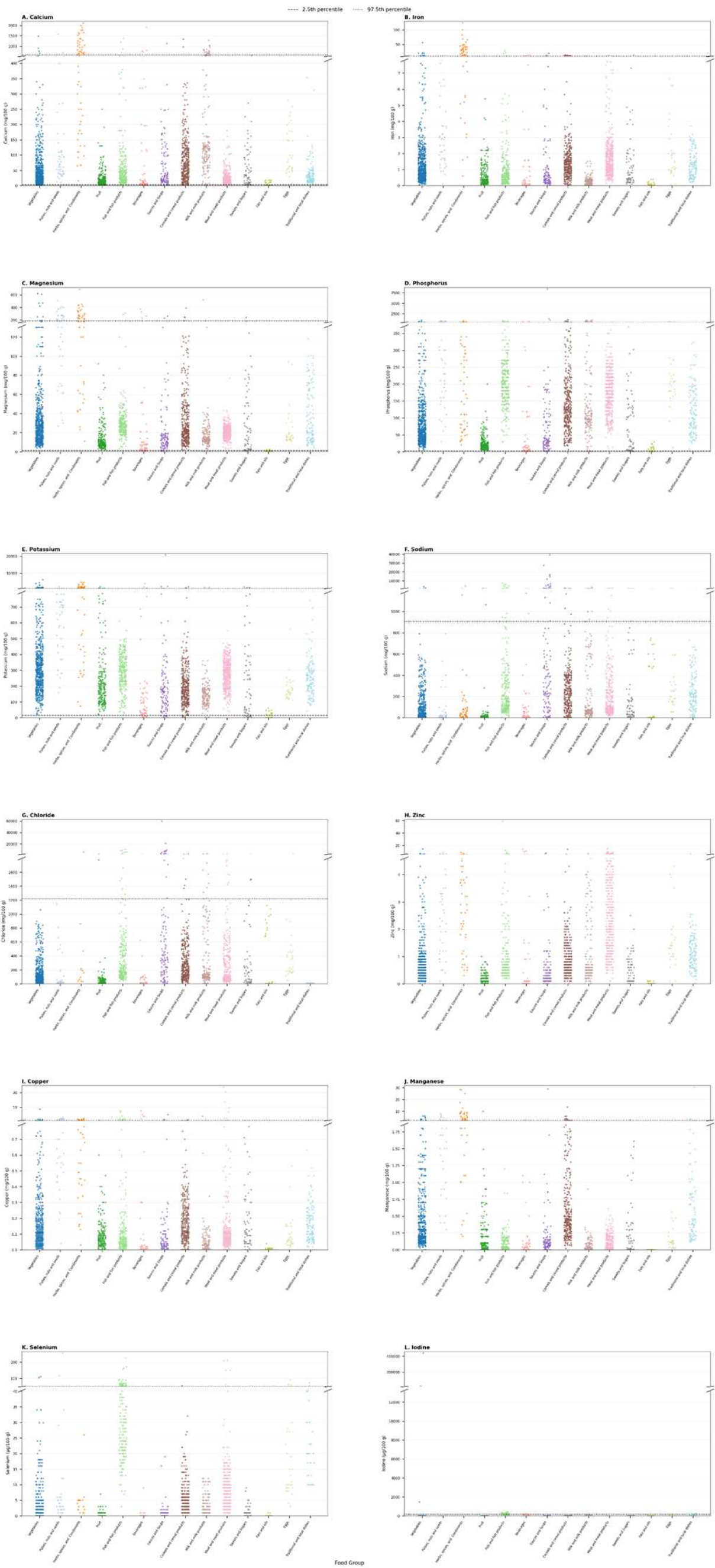


Figure 12: Distribution of minerals across food groups.

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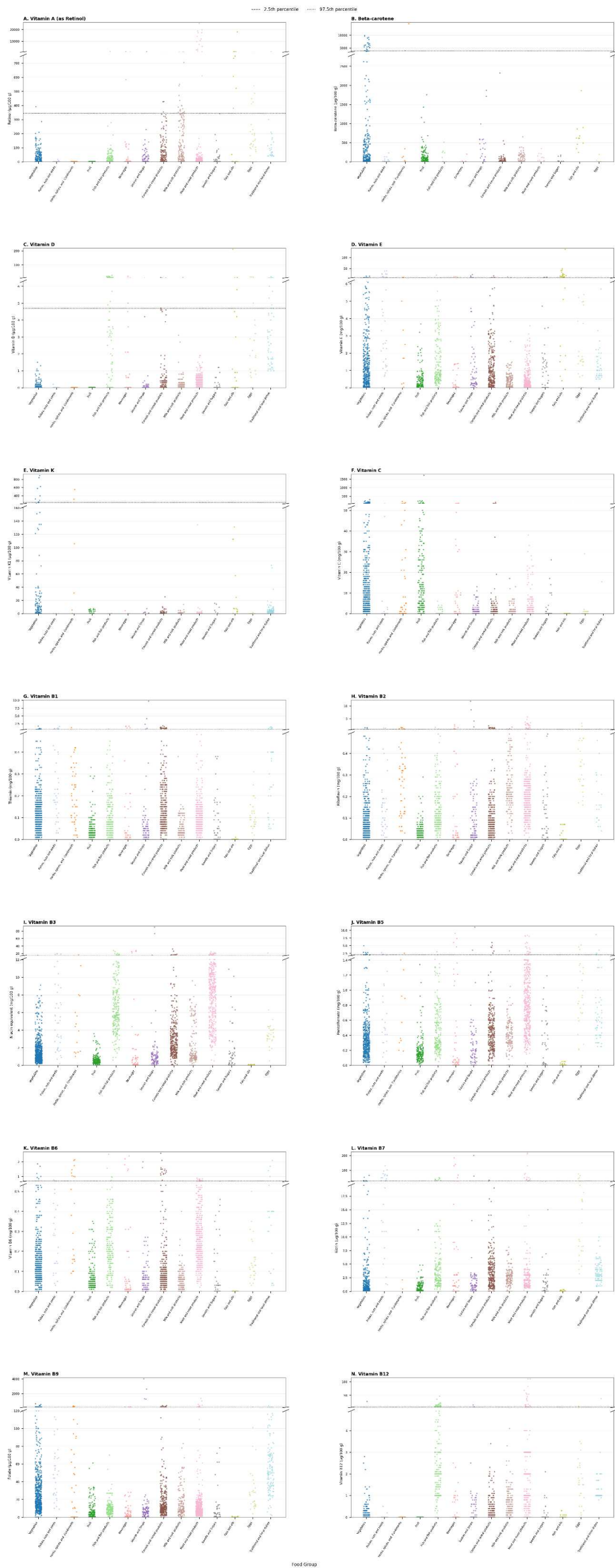
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501 **Figure 13:** Distribution of vitamins across food groups.

3.2.6. Distribution of Total Sugars, Trans Fat, and Cholesterol

Figure 14 shows that Total sugars, Trans fat, and Cholesterol displayed skewed distributions across the food groups in the SFCD. The median concentrations were 1.7, 0, and 2 mg/100g for total sugars, trans-fat, and cholesterol, respectively. The majority of foods were located at the lower end of these distributions, whereas limited numbers of foods had elevated nutrient levels, starting from 2.9, 1.4, and 156.6 mg/100g, respectively, reaching the 97.5th percentiles. For all three nutrients, the 2.5th percentile was 0.0, which indicates that many foods contained low quantities or none of these nutrients. This significant disparity between the lower and upper percentiles confirms the significant variability in nutrient composition across food groups.

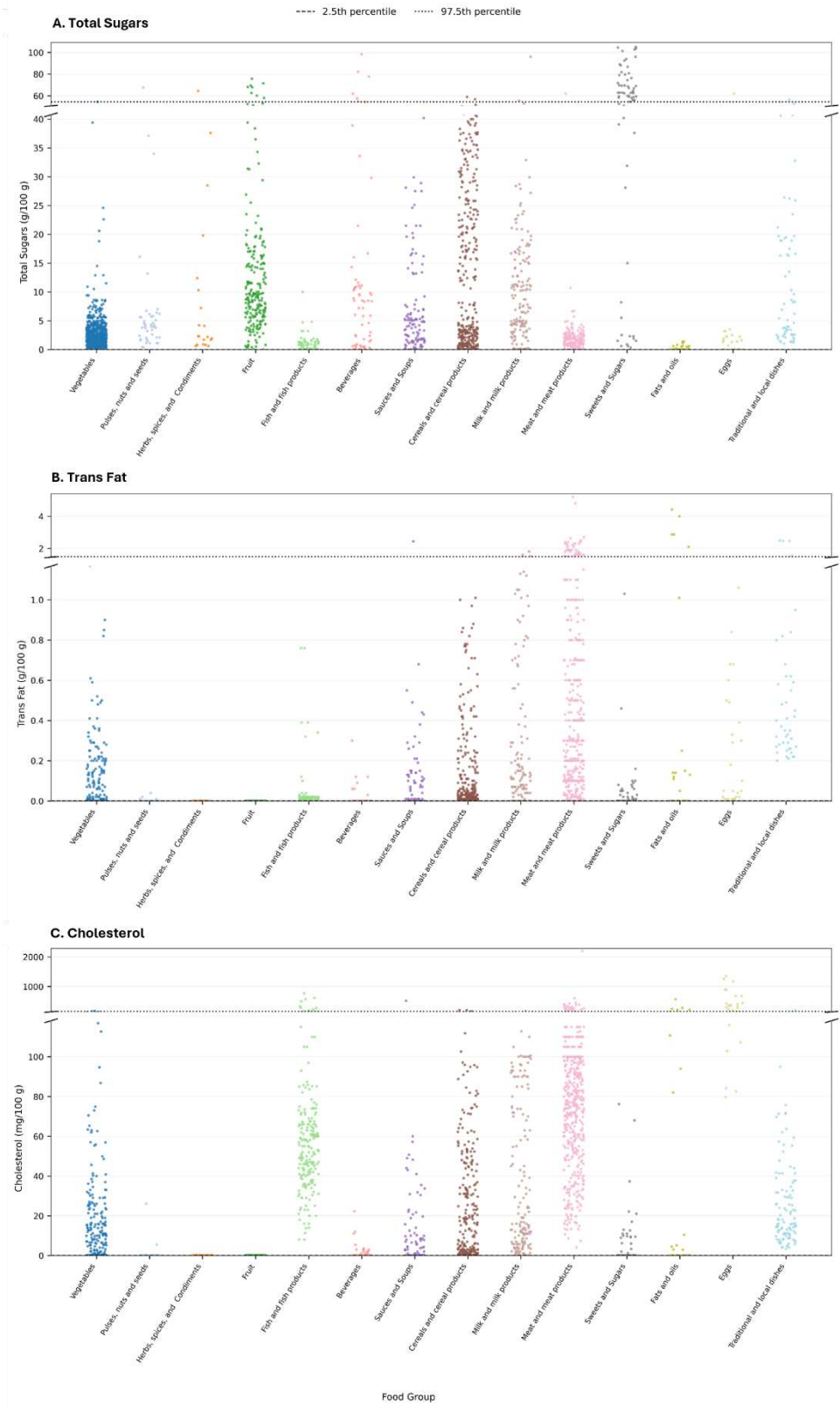


Figure 14: Distribution of total sugars, trans fat, and cholesterol across food groups.

4. Discussion

The SFCD contains the first comprehensive compositional data on both macronutrients and micronutrients in foods available in Saudi Arabia. It is a national integrated electronic portal or platform that enables users to easily access nutritional information regarding their food. A total of 2,818 food items from two primary data sources were included in this database.

Food items adopted from the MWD were reviewed and aligned with the Saudi regulatory requirements and cultural practices. Thus, 199 food items were excluded, including pork, alcoholic beverages, blood-based dishes, and branded food products. Pork, alcohol, and blood-based foods were excluded because they are prohibited under Islamic dietary laws and are not part of the Saudi food supply (see Supplementary Material 3 for the list of excluded food items from SFCD). Branded food products were excluded due to the Saudi Food and Drug Authority (SFDA) policy, which prohibits the inclusion of any trade names in the national food composition database. The development of the SFCD required reviewing internationally recognized food composition databases, including the UK CoFID, the United States FoodData Central, the Danish Food Composition Databank, the Australian AUSNUT, the Canadian Nutrient File, and the Japanese Food Composition Tables. Following the review of the international databases, MWD (CoFID) was chosen as the foundation of the SFCD due to its comprehensiveness and the existence of a clear mechanism for both food and

553 nutrients. Therefore, the SFCD adopted and modified some of standardized framework
554 for food identification and classification and nutrient documentation. In addition,
555 similar to other national resources, quality-controlled data management was developed
556 for the SFCD. The SFCD provides comprehensive nutrient coverage, including
557 proximate, vitamins, minerals, fatty acids, amino acids, and organic acids, compatible
558 with the scope of international food composition databases. Similar to other global
559 reference databases that primarily reflect the dietary patterns and food supply of their
560 respective countries, the SFCD was specifically designed to represent foods commonly
561 consumed in Saudi Arabia (locally produced foods, traditional and regional dishes, or
562 specialties). The integration of bilingual food descriptions, country-specific food
563 classifications, and laboratory-generated nutrient data for selected Saudi foods will
564 promote the database's link to and applicability for national dietary assessment, public
565 health surveillance, and nutrition research. Combining the international accepted
566 standards with local food composition data will help to establish a reliable and
567 interoperable national resource that supports both domestic and international data
568 exchange and applications.

569 The SFCD includes locally produced and traditionally consumed foods that are
570 underrepresented or absent from international food composition databases, which is
571 considered as the main strength of this database. The database combines nutrient data
572 for culturally important foods such as dates, camel milk and its products, traditional

573 Saudi dishes, regional foods, locally consumed fish and fish dishes, and some of
574 domestic herbs and seeds. These foods are of major importance in Saudi diets and
575 contribute substantially to nutrient intake in different regions of Saudi. However, many
576 international food composition databases either do not include these foods or provide
577 nutrient values for similar foods produced under different environmental, agricultural,
578 or processing conditions, which may not accurately reflect the nutritional
579 characteristics of foods consumed in Saudi Arabia. By combining the analytical data
580 for locally consumed foods and beverages in the SFCD, more representative and
581 culturally relevant resources are provided for dietary assessment, nutrition research,
582 and public health initiatives. This national approach promotes the accuracy of nutrient
583 intake estimation and supports the development of evidence-based dietary guidelines
584 and nutrition policies designed for the Saudi population.

585 Moreover, laboratory analyses of 130 locally consumed foods and beverages from the
586 13 primary administrative regions (provinces or manatiq) in Saudi Arabia assist in
587 strengthening the database by including previously unavailable or inadequately
588 represented in international databases nutrient values for specific foods. These analyses
589 improve the reliability of nutrient estimates and reduce reliance on borrowed
590 composition data from other countries.

591 The comprehensive nutrient coverage of the SFCD represents an important progression
592 in the availability of nutrition data for Saudi Arabia. In addition, the database does not

593 only include proximate composition, it also include detailed information on vitamins,
594 minerals, fatty acids, amino acids, and organic acids, information that is required to
595 provide a complete representation of the nutritional composition of foods commonly
596 consumed in Saudi Arabia. Moreover, these data are essential for food labeling,
597 nutrient profiling, food reformulation, and nutrition surveillance. In addition to
598 traditional applications, comprehensive nutrient data provide the foundation for
599 emerging digital health technologies, such as artificial intelligence-driven dietary
600 assessment systems, personalized nutrition platforms, and clinical decision support
601 tools. Today, the evolution of personalized and precision nutrition demands access to
602 detailed nutrient composition data, which is becoming increasingly important for
603 developing individualized dietary recommendations and advancing nutrition research.
604 Thus, a wide coverage of nutrients in the SFCD will enhance the value of national
605 resources for researchers, healthcare professionals, policymakers, and the food
606 industry.

607 One of the special features of SFCD is the adoption and modification of a
608 comprehensive standardization framework that provides nutrient compilation and food
609 identification, classification, and documentation. Bilingual food names (Arabic and
610 English), harmonious food group classification, and a structured data entry template
611 were developed to harmonize information results from multiple national and
612 international sources. This systematic approach helped to minimize the inconsistency

613 in food descriptions, remove the duplication, and improve the accuracy of food
614 identification and data recovery. Furthermore, the standardized framework facilitates
615 interoperability with internationally recognized food composition systems while
616 providing a flexible infrastructure for routine database updates, in addition to adding
617 analyses of new national foods and future integration with digital health applications,
618 artificial intelligence, and dietary assessment tools. This harmonization is important to
619 ensure data consistency, support collaborative research, and maintain a sustainable
620 national food composition database capable of meeting future public health and
621 research needs.

622 The SFCD supports research by providing an effective tool for researchers and
623 specialists to access reliable data on food composition and contributes to the
624 enhancement of scientific studies and the development of food products in accordance
625 with health standards. Moreover, the database helps with the implementation of a
626 governance for the review and approval of research through providing a structured
627 mechanism for the review and approval of research related to food composition to
628 ensure the accuracy and validity of data before publication and to enhance the
629 reliability of nutritional information available to users.

630 A major strength of this database is that it is considered as the first national food
631 composition database in Saudi Arabia. The database is built on a clear and
632 standardized methodology that is also aligned with international databases, in addition

to including both bilingual food descriptions and comprehensive nutrient coverage.

The Saudi foods data were derived from multiple data sources and conducted laboratory analyses and assessed through a quality scoring tool to ensure the highest national data quality.

However, the database has some limitations that need to be taken into consideration for future development, such as that some foods rely on international reference data, not all nutrients are available for every food, some local foods still have to be added and require laboratory analysis, and continuous updates will be necessary as the food supply evolves.

Overall, there are several areas that require attention for the continuous development of the SFCD, such as expanding laboratory analyses for national foods to be added in the database, including branded foods through future regulatory mechanisms; integration with national dietary surveys; development of mobile and web applications; use of artificial intelligence in food matching processes and food image recognition, and the establishment of connections with food purchasing and consumption databases.

5. Conclusions

The Saudi Food Composition Database is the first electronic database of its kind in the Kingdom and the third in the Arabian Gulf region, after the food composition tables of Bahrain and Kuwait. The database is comprised of data regarding local foods in an

electronic format that is easy to use by all segments of society, as well as researchers and entities.

The Saudi Food and Drug Authority (SFDA) played a central role in establishing the SFCD, collaborating closely with the Health Transformation Program to support the Kingdom's Vision 2030. The Authority supervised the standardization and validation of the SFCD, in addition to ensuring accuracy, reliability, and alignment with national public health data. The SFCD will enhance nutritional research, dietary assessment, and evidence-based policymaking in Saudi Arabia.

Future development of database features is needed; for instance, the integration of some of interactive features such as personalized dietary assessments and recipe nutrient calculations will be helpful. In addition, future research should focus on developing the SFCD into a more accessible and practical user-friendly mobile application to keep pace with technological advancements and improve the use of the national food composition data among diverse population groups. Moreover, future studies that evaluate the application's usability, data accuracy, user satisfaction, and effectiveness in improving nutrition knowledge and dietary decision making will be indispensable. This development will facilitate increasing public engagement with the SFCD, support nutrition education and healthier food choices, and expand the database use beyond researchers and healthcare professionals to the public community.

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Data Availability: The detailed datasets generated and/or analyzed during this study are available from the corresponding author upon reasonable request. Food composition data from the Saudi Food Composition Database (SFCD) can be accessed through the official platform at <https://fd.sfda.gov.sa/>. The food composition dataset is also available in CSV format through [datasets SFCD 2026](#).

Disclaimer: “The views expressed in this paper are those of the author(s) and do not necessarily reflect those of the SFDA or its stakeholders. Guaranteeing the accuracy and the validity of the data is a sole responsibility of the research team”.

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750 **Supplementary Materials**

751 Supplementary Material 1: The Saudi Food Composition Database Definition for
752 Food Groups, Sub-group, and Sub-sub-group.

753 Supplementary Material 2: Food Confidence Determination Score System in Saudi
754 Food Composition Database.

755 Supplementary Material 3: List of Excluded Food Items from Saudi Food
756 Composition Database.

Supplementary Files

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- [SupplementaryMaterial1.pdf](#)
- [SupplementaryMaterial2.pdf](#)
- [SupplementaryMaterial3.pdf](#)