A Comparative Analysis of the 2017 Indian Food Composition Database vs the 1989 Indian Food Composition Database.

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Abstract:

Aim: To assess the differences between the old and new Indian food composition databases and to evaluate the impact of the expansion of new food composition information on the existing dietetic practices.

Methods: In the comparative analysis of the two food databases, a total of 117 foods were compared for differences in their composition by calculating the percentage change in values of food constituents in the new database as compared to the old database. Prior to the assessment of the differences between the two databases, the nutritive values for all the foods were computed for 100% dry part to bring about uniformity and overcome the differences in moisture content of these foods between the databases.

Results: The updated database differs extensively from the preceding version. Not only is the new database more representative of the various foods consumed across India, but also all the data reported are based on laboratory analysis carried out by the National Institute of Nutrition laboratories. Also, the new database reports values for added micronutrients as well as for bioactive components in Indian foods. Considerable difference in macro and micronutrient content of foods is noted in the new database when compared to the old database.

Conclusions: The updated Indian Food Composition Database with accurate and nationally representative data on nutritive and non-nutritive composition of Indian foods will greatly assist food and nutrition professionals in India with improving their estimates of dietary intakes and in turn improving their advice to patients, clients and consumers.

Keywords: Food Composition Database, Indian, Nutritional Composition

Introduction:

Indian cuisine is a rich amalgamation of foods from diverse cultures and regions, and is characterized by the use of different grains, vegetables, fruits, animal source foods, and a variety of spices and condiments.[1] Considering the wide-variety of food ingredients used in day-to-day Indian food preparation, having accurate food composition data is critical for estimation of nutrient intakes, informing food-based dietary guidelines, and for nutrition and epidemiological research.[2]

Food Composition Databases are repositories of data on energy, nutrient and bio-active components of foods that are commonly consumed by a population.[3] The National Institute of Nutrition (ICMR) is responsible for developing and updating the Indian Food Composition database[4]. The new Indian Food Composition Tables (IFCT) 2017[4] generated by the National Institute of Nutrition (ICMR), Hyderabad is the most recent, updated, and major source of data on nutrient composition of raw foods in India.

The new database differs from the earlier available 1989 database[5] in several aspects, namely the use of nationally representative food sample collection, updated laboratory methods for estimation of all nutrients and other food constituents such as polyphenols, carotenoids, etc, number of food constituents estimated, and inclusion of several new foods. This may possibly impact the calculated nutritive value of meals.

In this study we have attempted to present a comparative analysis of the values of constituents in foods between the New Database and the Old Database, and to highlight the distinct features of the New Database which make it a more suitable tool for use by Indian dieticians and nutritionists. Therefore, the objectives of the present study were to assess the differences between the old and new databases and to describe the impact of the expansion of new food composition information on the existing dietetic practices.

Methods:

The latest updated nutrient database i.e. the Indian Food Composite Table (IFCT) 2017 (New Database [ND])[4] was compared with the Old Food Composition Table 1989 (Old Database [OD])[5]. The entire database of 528 food ingredients from the ND and 592 from the OD were scrutinized for possible estimation of the differences between the two databases. The ND is more representative of the food varieties available throughout India and it provides the nutritive value for most of the varieties of individual food components. For example, in the ND, nutritive values have been provided for 21 varieties of brinjal, while, in the OD nutritive values have been provided only for a single variety of brinjal. Thus, to enable accurate comparison, wherever values have been provided for multiple varieties in the ND, the mean and standard deviation for each nutrient were calculated, and if the SD were found to be more than 10% of the means for

any of the nutrients, those foods were not considered for the analysis. As a result, a total of 117 foods were matched between the two databases and used for further comparative analysis.

The data in the OD were classified into 10 food groups "Cereal Grains and Products (C)", Pulses and Legumes (PL), Green Leafy Vegetables (GLV), Other Vegetables (OV), Fruits (F), Roots and Tubers (RT), Condiments and Spices (CS), Nuts and Oilseeds (NO), Milk and Milk Products (M), Meat and Poultry (MP), Fishes and Other Sea-products (FS). The sugar and beverages groups were not considered because a suitable match for them was not found in the ND. With the exception of energy values, which have been expressed in Kilojoule (KJ) in the ND, and in kilocalories (kcal) in the OD, the rest of the measurement units for the nutrient components were the same in both the databases. Hence, for uniform expression of energy, the values in the ND were converted into kcal by applying the conversion factor of 0.239.

The differences in food composition between the two databases were computed by calculating the percentage change in values of components in the new database as compared to the old database.Prior to the assessment of the differences between the two databases, the nutritive values for all the foods were computed for 100% dry part to bring about uniformity and overcome the differences in moisture content of these foods between the OD and the ND. Differences were assessed for the following common nutrients: energy, protein, fat, dietary fibre, iron, zinc, calcium, phosphorus, manganese, magnesium, sodium, potassium, copper, β-carotene, riboflavin, thiamine, ascorbic acid, folic acid, and oxalate.

Results:

The differences between the two databases have been presented in Table 1 and the different methods used for estimation of nutrients have been presented in Table 2. In the ND, data for 195 distinct food constituents have been reported, which is about three times more than that reported in the OD (64 food constituents). The percentage of data reported for different nutrient groups in each database has been illustrated in Figure 1. The ND and OD report values of all macronutrients. However, micronutrients have been reported for almost all foods in ND but for very less percent of foods in OD. Additionally, values of Pantothenic acid (B5), Biotin (B7), vitamin D2 as well as D3 and vitamin E and K have been reported in the ND. The ND also provides data on Aluminium, Arsenic, Cadmium, Cobalt, Lead, Lithium, Nickel, Mercury, and Selenium content, in addition to that of common minerals and trace elements in OD. Furthermore, the content of all fatty acids, amino acids (both essential and non-essential), simple sugars, oligosaccharides, organic acids, and polyphenols have also been reported in the ND.

Percentage change in macronutrient and micronutrient content of raw foods in the ND vs the OD have been illustrated in Figures 2a

2d. Negative differences imply lower nutritive value of foods in the ND, while positive differences indicate higher nutritive values. The maximum negative difference in energy values was reported for foods in the green leafy vegetables group while the maximum positive differences were noted for foods in the meat and poultry category. Considerable differences in values of other nutrients have been noted in all the other food groups.

Discussion:

In this descriptive study, we have presented a comparison of the recently updated Indian food composition database released in 2017 (New Database ND) with the earlier available database which was developed in 1989 (Old Database OD). We have also reported extensive differences in the nutritive value of foods in the ND as compared to the OD. To our knowledge, this is the first study that presents a comparative analysis of the updated Indian food composition database with the preceding database, which was developed more than 25 years ago. This study not only highlights the differences between the two databases but also highlights the unique features of the updated database which will prove especially useful to Indian dietetic practitioners.

The ND is a comprehensive database providing the nutrient composition as well as bioactive compounds, such as carotenoids and polyphenols, of 528 Indian foods sampled systematically to represent the food consumed nationally. All the data presented in the ND have been estimated in the laboratories of the National Institute of Nutrition and no data have been borrowed or derived from any other sources.

Additionally, for the first time, data is available on bioactive compounds in, and on vitamin D2 and D3 content of Indian foods. There is a growing body of evidence supporting the beneficial role of polyphenols[6] and carotenoids[7] in non-communicable diseases such as cancer, diabetes mellitus, and obesity. With NCDs contributing to nearly 60% of all deaths among Indians,[8] the availability of data on bioactive constituents of Indian foods will go a long way not only in assisting dieticians with clinical dietary modifications, but also in informing the revision of dietary guidelines to guide increased consumption of foods rich in such compounds. Moreover, this could pave the way for research and development of polyphenol and carotenoid rich foods products in the Indian Food Industry. Furthermore, availability of vitamin D content of plant foods will be immensely helpful to guide dietary planning and to update population-based dietary guidelines towards overcoming vitamin D deficiency in the light of its extensive prevalence among Indians.[9]

Indian dieticians and nutritionists follow the practice of drawing up lists of locally available foods rich in specific micronutrients to support diet counselling and micronutrient-rich food product development. Considerable differences noted in the nutritional composition, especially the micronutrient content, of foods in the ND as compared to the OD will significantly impact the food

recommendations by practitioners. For example, while garden-cress seeds and niger seeds continue to be among the first ten foods with highest iron content, the total amount of iron in these foods is substantially lower in the ND versus the OD (Garden-cress Seeds: 17.2 mg in ND vs 100 mg in OD; Niger Seeds: 18.9 mg in ND vs. 56.7 mg in OD). Rice flakes, another food that dieticians encourage their clients to consume as a part of an iron-rich diet, has an iron content of 4.46 mg/100 gm according to the ND as compared to 20 mg/100 gm in the OD. The differences noted in the iron content of these foods, between the two databases, could be due to varietal or soil differences (as in the case of garden cress seeds)[10], and due to difference in the paddy or the technology used for flaking in the case of flaked rice[11]. Moreover, the use of updated methods for laboratory estimation of food constituents, stages of ripeness of the foods tested, changes in agricultural practices over the years, and different crop varieties may be some additional reasons for the variations observed in the nutritional composition of foods.[12] Thus, the extensive differences in the nutrient values of foods in ND as compared to the OD strongly support the use of the ND for dietary planning, dietary guideline development and the revision of nutrition labelling for Indian food products.

With differences noted in the nutritional composition of raw foods between the two databases, further studies are required to assess how these differences translate into medical nutrition therapy for different disease conditions. Furthermore, a revision in portion sizes of Indian foods based on the updated food composition database is also required.

Food composition databases are a crucial tool in the field of nutrition science, food science, food biotechnology and public health nutrition. With a diverse range of applications in dietary assessment, food labelling, nutrition research and developing food-based policies and guidelines, having a relevant and representative food database becomes critical.[13] Furthermore, the changing scenario of nutritional deficiency disorders in India demands for detailed information about all macro and micronutrients, and essential non-nutrient components present in the foods that are part of the Indian diet.

Conclusion:

Nationally representative samples of food, updated laboratory techniques, and novel information about nutrient and bioactive components are the key features of the new Indian Food Composition Database. This updated database with accurate data on nutritive and non-nutritive composition of Indian foods will greatly assist food and nutrition professionals in India with improving their estimates of dietary intakes and in turn improving their advice to patients, clients and consumers.

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Table 1: Differences between the Old (1989) and New (2017) food databases

Factors	Old Database	New Database
Data source	• Major part of the data reported is based on analysis of foods performed at the National Institute of Nutrition (NIN). • To achieve a wider coverage of foods and nutrients, data from various other institutes, laboratories, and results of analysis of Indian foods published in various scientific journals have been reported	• All the data reported is based on analysis of foods performed at the NIN.
Data collection regions in India	• No documentation available for sampling procedure and source of the data • The food sampling was limited to locations around NIN, Hyderabad	• A comprehensive, country-wide food sampling was carried out to present data on food varieties available across India • The food sampling covered the six regions of India: North, East, South, West, Central, and North-east.
Raw food data or cooked food data	• Except for white and brown bread, the rest of the data presented is for raw foods	• Except for egg-based recipes (i.e. boiled egg and omelette), the rest of the data presented is for raw foods
Data coding	• Each food item has been arranged food group-wise and coded numerically and continuously • For example, the first food group is Cereal Grains and Products, which has 27 food groups included under it, arranged alphabetically, and numbered 1 to 27. The next category is Pulses and Legumes wherein the first entry is numbered 28.	• An alpha-numeric coding system has been used to code each food item • The alphabetic character represents the food category, and the numeric character represents the record position of the individual food within a food category. Within food categories, foods are arranged alphabetically. • For example, Cereals and Millets is category 'A' and the first entry is the food Amaranth seed, black, so this food is coded A001
Food Identification	• The common English names, botanical names as well as the names of the foods in common Indian languages has been provided	• In addition to common English names, botanical names, and names in common Indian languages, photographs of all foods have been included to aid in ease of identification
Total No. of food items	592 (451 common food, 141 less familiar)	528
Distinct Food Constituents	64	195

Food Groups	Similar food groups in both version: "Cereals and millets", "Grain legumes", "Green leafy vegetables", "Other vegetables", "Roots and tubers", "Fruits", "Condiments and spices", "Nuts and oil seeds" , "Milk and milk products", and "Fats and edible oils"	
	• Total Food Groups: 12 • "Condiments and Spices"– Fresh and dry spices not categorized separately • Seafoods have been grouped under the category 'Fishes and Other Seafoods' • "Meat and poultry" category comprise nutritive values for all the varieties of eggs, poultry, and animal meat. • Sugar and Beverages: Nutritive values have been provided for a variety of sugar products as well as some alcoholic and non-alcoholic beverages	• Total food groups: 20 • "Condiments and Spices"- Fresh and dry spices categorized separately • Different fish varieties have been mentioned separately under following headings: - Marine fish - Marine shellfish - Marine Molluscs - Freshwater Fish and Shellfish • Nutritive values for "egg and egg products", "poultry" and "animal meats" are categorized separately • Sugar and Beverages: Nutritive value of sugar products have not been provided and beverages are not classified under beverages but under a category labelled 'Miscellaneous'
Nutrients Reported	**Table 1. PROXIMATE PRINCIPLES AND DIETARY FIBRE** (In both databases: Energy, Moisture, Protein, Carbohydrate, Fat, Dietary fiber)	
	• Unit for energy is Kilocalorie (kcal) • Additional Data: Mineral (gm) and Crude fibres (gm)	• Unit for Energy is Kilojoules • Additional Data: Ash (gm)
	Table 2. WATER SOLUBLE VITAMINS (In both databases: Thiamine, Riboflavin, Niacin, Total B6, Folic Acid, Vitamin C)	
	• Additional Data: Choline (mg) and Vitamin B12 (µg)	• Additional Data: Pantothenic Acid (mg) and Biotin (µg)
	Table 3. **FAT SOLUBLE VITAMINS**	
	• Except for retinol, fat-soluble vitamin values have not been reported	• Complete fat-soluble vitamin profile including vitamin D2 and D3 content has been presented
	Table 4. **CAROTENOIDS** (In both databases: Total carotene and beta-carotene)	
	• Only Total carotene and β-carotene values have been provided for 29 selected food items provided and retinol values have been provided for animal source foods	• Along with Total carotenoids, values for other carotenoids like, Lutein (µg), Zeaxanthin (µg), Lycopene (µg), β-Cryptoxanthin (µg), γ-Carotene (µg), α-Carotene (µg), β-Carotene (µg) have been provided
	Table 5. **MINERALS AND TRACE ELEMENTS** (In both databases: Calcium, Chromium, Copper, Iron, Magnesium, Manganese, Molybdenum, Phosphorus, Potassium, Sodium, Zinc)	
	• Additional Data: Sulphur (mg) and Chloride (mg)	• Additional Data: Aluminium(mg), Arsenic (µg), Cadmium (mg), Cobalt (mg), Lead (mg), Lithium (mg), Mercury (µg), Nickel (mg), and Selenium (µg)
	Table 6. STARCH AND INDIVIDUAL SU GARS	
	• Content of individual sugars not reported	• Additional Data: Total starch, Fructose, Glucose, Sucrose, Maltose, Total free sugar
	Table 7. **FATTY ACID PROFILE** (In both databases: Palmitic, Stearic, Arachidic, Behenic, Lignoceric, Palmitoleic, Oleic, Linoleic, A-Linolenic, Total SFA, Total MUFA and Total PUFA)	

• Data presented for limited fatty acids	• Content of all fatty acids have been reported
Table 8. AMINO ACID PROFILE (In both databases: Histidine, Isoleucine, Leucine, Lysine, Methionine, Cystine, Phenylalanine, Threonine, Tryptophan, Valine, Arginine, And Tyrosine)	
• Only the essential amino acid profile has been reported.	• Along with essential amino acid values, some non-essential amino acids like Alanine, Aspartic Acid, Glutamic Acid, Glycine values have been reported
Table 9. ORGANIC ACIDS (In both databases: Oxalic acid)	
• Only Total Oxalic acid values have been reported • Values for Soluble and Insoluble oxalates have not been reported separately	• Along with Total oxalic acid, soluble and insoluble oxalate values are specified. • Additionally, content of 7 more organic acids have been reported
Table 10. Polyphenols	
• Values not reported	• Values for 37 polyphenolic components along with total polyphenols have been reported
Table 11. Oligosaccharides, Phytosterols, Phytates and Saponins (In both databases: Total Phytin)	
• Total phytin phosphorus (mg) and phytin phosphorus as a percent of total P have been reported	• Along with phytate (mg) content, content of oligosaccharides, phytosterols and total saponin have been reported
Table 12. Fatty Acid Profile of Edible Oils and Fats	
• Total SFA, Total MUFA, Total PUFA and 9 individual fatty acids have been reported	• In addition to Total SFA, MUFA and PUFA, content of all the 19 fatty acids have been reported

Table 2: Differences in methods used for estimation of nutrients between the Old (1989) and New (2017) food database

Components	Estimation Method in the Old Database	Estimation Method in the New Database
Energy	Calculation	Atwater conversion factors
Moisture	Thermogravimetry	Gravimetry using vacuum / Hot air oven
Protein	Kjeldahl method (N × 6.25)	Titrimetry by combustion / Kjeldahl / Mixed catalyst
Fat	Ether extractives	Gravimetry; Ether extraction using Soxhlet apparatus
Ash	Thermogravimetry	Gravimetry using Muffle furnace
Carbohydrates	By difference	By difference
Calcium	Association of Official Analytical Chemists (AOAC)	Atomic Absorption Spectrophotometry (AAS)

Phosphorus	Association of Official Analytical Chemists (AOAC)	Colorimetry
Iron, Magnesium	Association of Official Analytical Chemists (AOAC)	Atomic Absorption Spectrophotometry (AAS)
Sodium, Potassium, Copper, Manganese, Zinc	Atomic Absorption Spectrophotometry (AAS)	Atomic Absorption Spectrophotometry (AAS)
Molybdenum, Chromium	Atomic Absorption Spectrophotometry (AAS)	Graphite Furnace Atomic Absorption Spectrophotometry
β-carotene	HPLC	High Performance Liquid Chromatography (HPLC)
Carotenoids	Spectrophotometry	High Performance Liquid Chromatography (HPLC)
Thiamine	Thiochrome method	Fluorometry
Riboflavin, Niacin	Microbiological	Turbidometry - Microbiological assay
Folic acid	Microbiological	Trienzyme procedure and liquid chromatography.
Vitamin C	Chemical (2-6-dichorophenol indophenol and xylene extraction method)	Reserved Phase - High Performance Liquid Chromatography (RP-HPLC)
Fats and fatty acid	Gas chromatography (Partly)	Gas Chromatography with Flame Ionization Detector
Amino acids	Automated amino acid analyser	Amino acid analyser (Ion exchange chromatography)

Figure 1: Percentage of Data Reported for Different Groups of Nutrients in both the food databases (Old 1989 and new 2017)

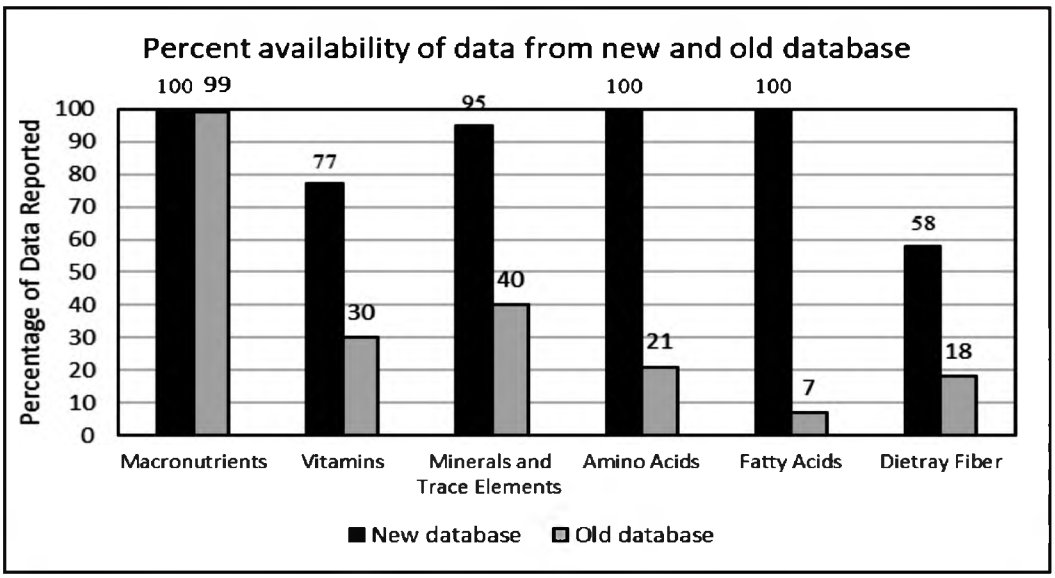


Figure 2a: Percentage Change in Macronutrient Content in the New Database versus the Old Database

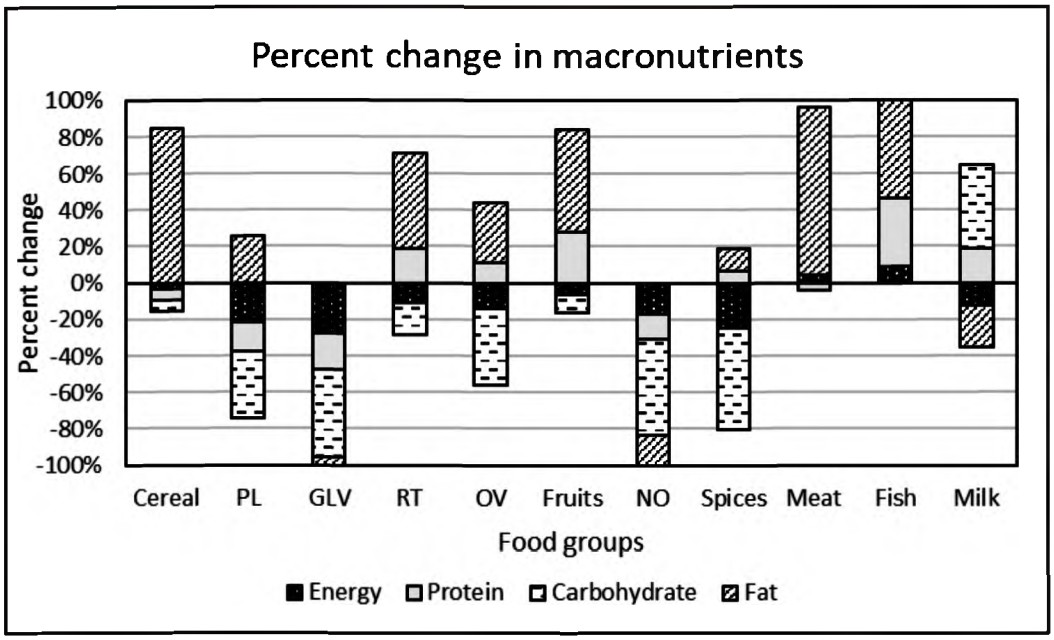


Figure 2b: Percentage Change in Vitamin Content in the New Database versus the Old Database

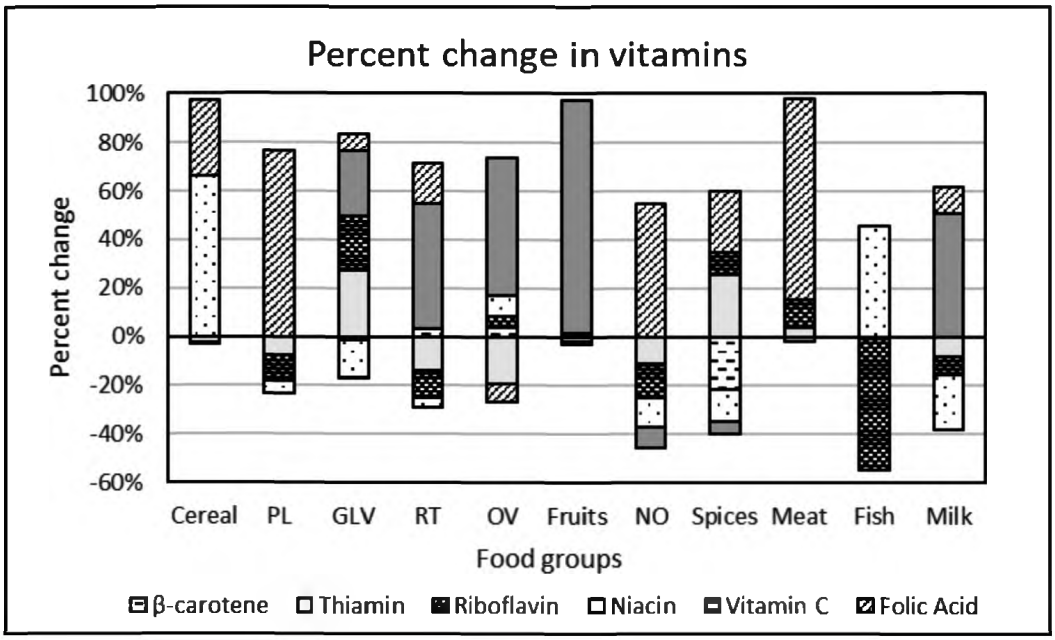


Figure 2c: Percentage Change in Mineral Content in the New Database versus the Old Database

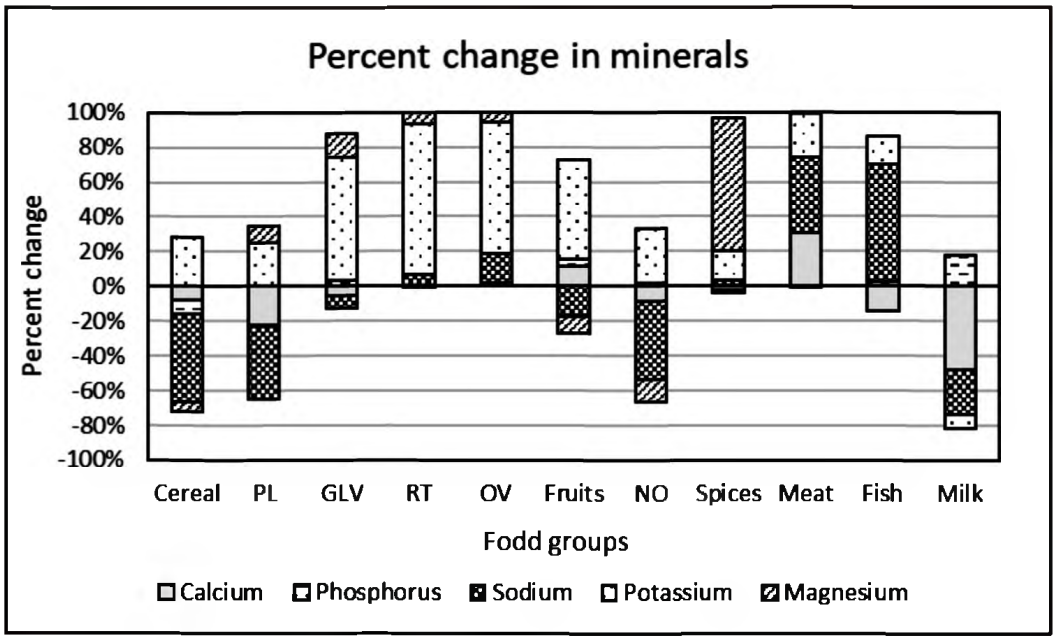
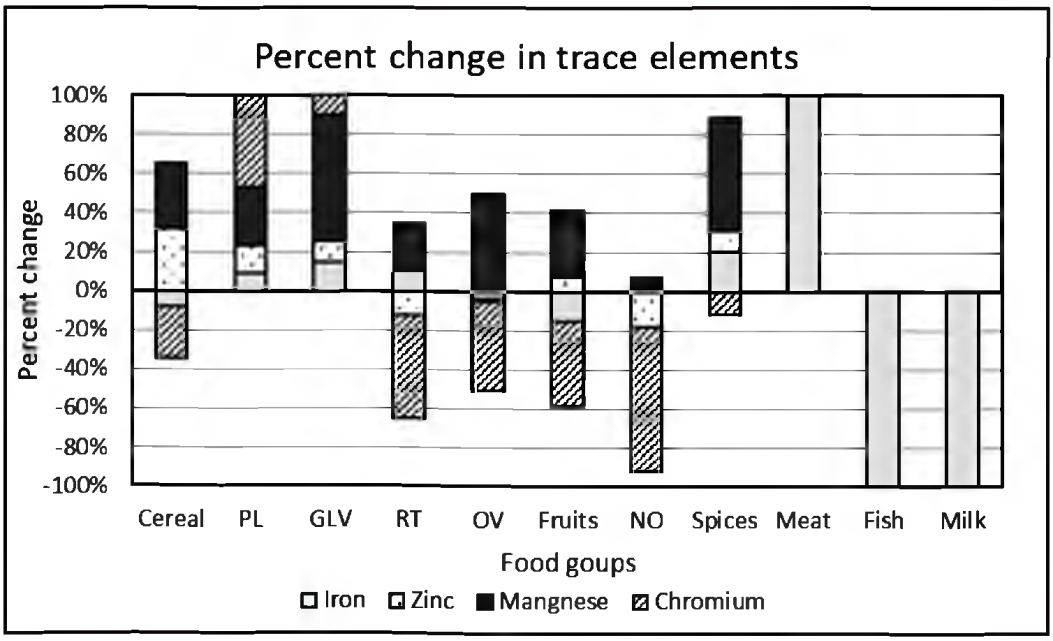


Figure 2d: Percentage Change in Trace Element Content in the New Database versus the Old Database



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