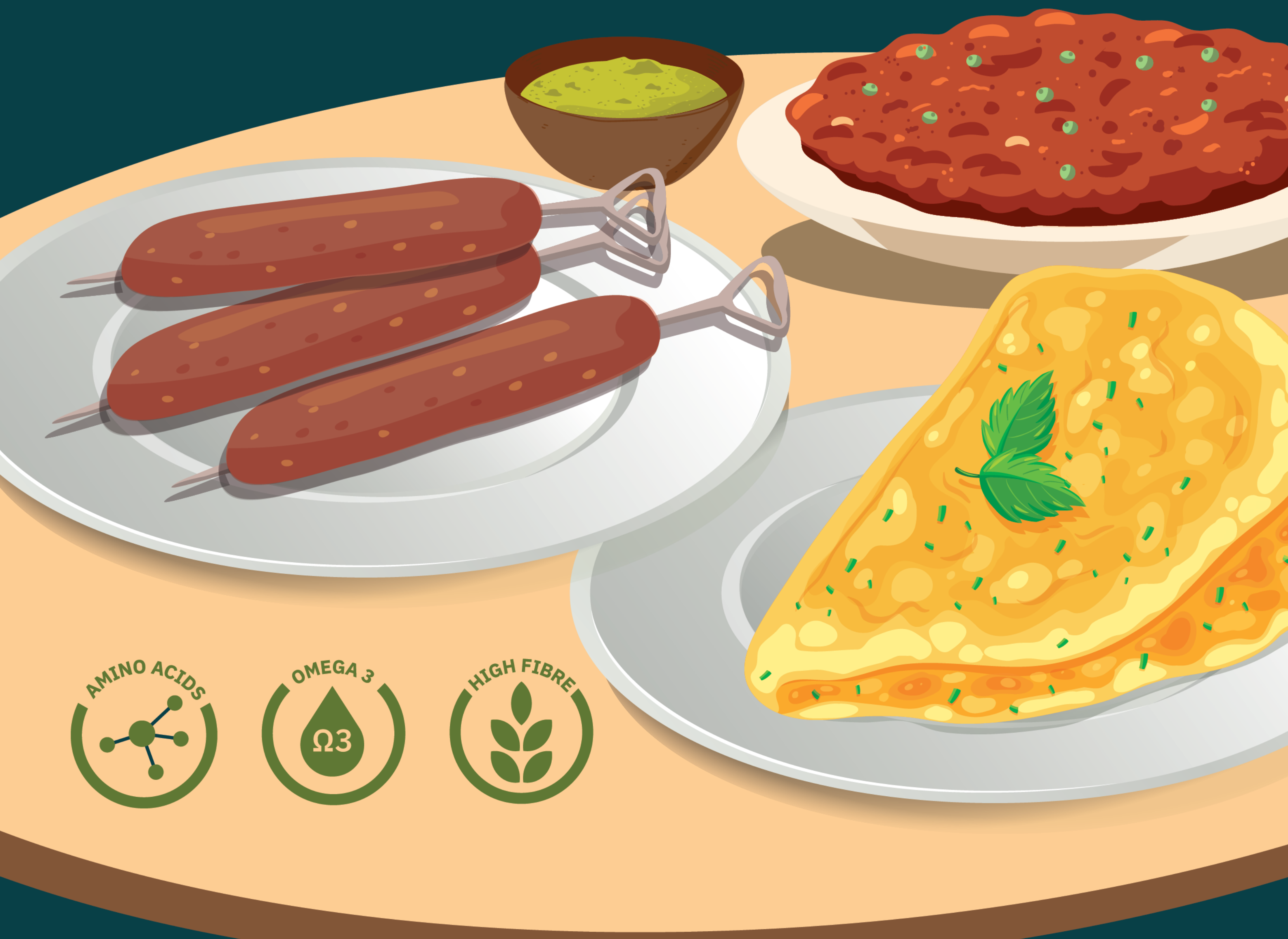
gfi India

# From labels to composition:

## A nutritional analysis of plant-based meat and egg products in India

Padma Ishwarya, S. & Amrutha Girivasan



# From labels to composition: A nutritional analysis of plant-based meat and egg products in India

Published by


Authored by Padma Ishwarya S. & Amrutha Girivasan, 2025

**ISBN - 978-81-985167-1-8**

# Executive summary

India is a burgeoning market for plant-based meat products. While taste drives the consumption of animal-derived meat, factors like protein content, nutrition, and health are the catalysts of plant-based meat consumption among Indian consumers. Though the Indian plant-based egg sector is still evolving, its application range and market opportunities are promising. Globally, plant-based egg products have demonstrated the potential to provide equal or greater amounts of protein and calcium, as well as lesser saturated fat, compared to conventional egg products. The nutritional quality of a food is determined by the amount of macronutrients and micronutrients it contains and their ability to meet consumers' dietary requirements. The growing consumer interest in plant-based meat products necessitates a deeper understanding of their nutritional content and health benefits vis-à-vis their animal-derived counterparts. Several early adopters of plant-based meat rate these products higher on health and nutrition compared to traditional products. However, a comprehensive dataset is not yet available on the nutritional composition and quality of plant-based meat and egg products in the Indian market. Scientific data is essential to instill confidence among consumers around the nutritional and health aspects of these products. Additionally, a comparative dataset would help identify areas for improving the nutritional parity between plant-based and conventional meat and egg products.

The findings presented in this book are based on a comprehensive technical analysis conducted in two phases:

- Phase 1: Compilation and comparison of the nutrition labels and ingredient lists of 112 plant-based meat and 8 plant-based egg products available in the Indian market *versus* the corresponding animal-derived products.
- Phase 2: Quantification of the amino acid and fatty acid composition of the selected plant-based meat (n=22) and plant-based egg (n=4) products to determine their nutritional quality and establish correlations with their protein and fat sources, respectively.

The conditions of Indian and international regulatory bodies have been considered to assess the position of these products with respect to different nutrition claims.

Plant-based meat and egg products have a comparable or higher protein content than their animal-derived counterparts. These products comply with the *'source of protein'* claims of the Food Safety and Standards Authority of India (FSSAI) and the Food and Drug Administration (FDA). Indeed, 7 out of the 11 plant-based meat formats and all the plant-based egg products meet the *'high-protein'* claim. Both the plant-based meat and egg product formats are *'rich in dietary fibre'*, giving them an edge over animal-derived products. The essential amino acid composition of certain plant-based egg products exceeds FAO's recommendation on the amino acid requirements for adults. Some plant-based egg products also qualify for the claim *'source of omega-3 fatty acids'.* However, there is scope for improving the content of sulphur-containing amino acids, monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), and micronutrients. In addition, product reformulation efforts in the future should focus on reducing the saturated fat and sodium content of the plant-based meat and egg products.

Based on the above findings, this book puts forth a set of recommendations to Indian smart protein companies to improve the nutritional composition and quality of plant-based meat and egg products. The importance of ingredient diversification, functionalisation, and scientifically-based product formulation has been emphasised as the way forward in achieving nutritional parity between plant-based meat and egg products and their conventional counterparts.

# Table of contents


Executive summary 3

Introduction 6

Methodology 9

- Compilation of nutrition label information and list of ingredients 9
- Quantification of amino acid composition 9
- Estimation of fatty acid composition 9
- Statistical analysis 10

Findings and inferences 11

- Classification of plant-based meat and egg products 11
- Comparison of macronutrient and micronutrient content between plant-based and animal-derived products 15
  - Protein 15
  - Amino acid composition 20
  - Dietary fibre 23
  - Fat 24
  - Fatty acid composition 28
  - Sugar 32
  - Energy 34
  - Sodium 37
  - Micronutrients 39

Conclusions and recommendations to the plant-based meat and eggs industry 44

References 45

About the Authors 52

Appendix 54

# 1. Introduction

The contribution of plant-based foods such as whole grains, fruits, and vegetables towards nutrition, health, and wellness has been demonstrated by various studies.[1-3] According to the EAT-Lancet Commission report,[4] diets rich in plant-based foods and low in animal-based foods (especially red and processed meats) are associated with a lower risk of chronic diseases such as cardiovascular ailments, diabetes, and certain types of cancer. Despite the apprehensions associated with meat consumption, the global meat demand shows no sign of slowing down, which is expected to rise 70% by 2050. This growing demand for meat is particularly driven by emerging economies such as India, China, and Southeast Asia. 77% of India's population attest themselves as non-vegetarians, and their meat consumption is currently driven by taste, indulgence, and aspiration more than health.[5-6]

The world population is envisaged to hit the 10 billion mark by 2050, of which 1/6$^{th}$ would be in India. A 56% food production gap has to be closed by 2050 globally.[7-9] India is not immune to this challenge, as the country's demand for protein-rich food is increasing rapidly. Moreover, India has to improve on the share of calories from protein sources, which is only 6–8% currently compared to the 29% recommended in the reference diet of EAT-Lancet.[10] Though animal proteins have a complete amino acid composition and high digestibility, industrialised animal agriculture is responsible for 14.5% of greenhouse gas emissions.[11] While livestock accounts for 77% of global farming land, it only meets 18% of the world's requirement for calories and 37% of total protein needs.[12] Farm sizes in India are already declining due to population growth and competition for land.[13] Therefore, rethinking animal protein and finding sustainable sources of protein are imperative to tackle this challenge in India and globally. Alternative proteins have been proposed as one of the solutions to meet future global protein demand while maintaining the production and consumption patterns within planetary boundaries.[14]

Alternative proteins are proteins produced from plants, animal cells, or by the fermentation route. Plant-based meat, eggs, dairy, and seafood biomimic the taste, texture, and nutrition of conventionally produced animal products, using plant-derived ingredients as building blocks. Recent studies have shown that switching to plant-based meat could cut down global greenhouse gas emissions caused by conventional animal agriculture by 80–90%.[15] GFI India's survey[16] reveals that 47% of Indians are driven to eat plant-based meat because of its protein content, while 33% and 30% of respondents are drawn to its convenience and ease of cooking and cleaning, respectively. Another recent study on the comparative experience of plant-based and animal-derived meat products in India shows that consumers of plant-based chicken kebabs, mutton samosa, and nuggets checked the nutritional information (about protein content and cholesterol) and list of ingredients.[17] Nutrition, health, and protein content are the key reasons mentioned by 64%, 60%, and 60% of consumers for the repeat purchase of plant-based meat products, respectively.[17] **All of these studies indicate that while meat consumption is mainly driven by taste, nutrition and health are significant catalysts for the purchase of plant-based meat products.**

A nutritious food is 'one that provides beneficial nutrients (e.g., protein, vitamins, minerals, essential amino acids, essential fatty acids, dietary fibre) and minimises potentially harmful elements (e.g., anti-nutrients, quantities of sodium, saturated fats, sugars)'.[18-20] Though early adopters of plant-based meat rate these products higher on health and nutrition compared to animal-derived products, researchers and consumers around the world are often raising questions about their nutritional quality and health aspects. Owing to the rapid growth of this product category, the recent focus is on its nutritional content and health benefits. Hence, it's important to ask the question: How nutritious is plant-based meat compared to the animal products that it substitutes?

To achieve clarity, several studies have looked at the nutritional profiles of plant-based meat products specific to different regions of the world. These analyses are often based on the data from nutritional labels of products from multiple nations, especially from more developed nations known for having higher per capita meat consumption.[21-26] Some common observations from different studies on the comparative analysis between plant-based meat and conventional meat are shown in Fig. 1. Against this background, an India-specific study on the nutritional aspects of plant-based alternatives to animal-derived products is relevant but not available yet. Though several studies have focused on the nutritional aspects of plant-based meat and dairy, information on the nutritional composition and quality of plant-based egg products is scarce.

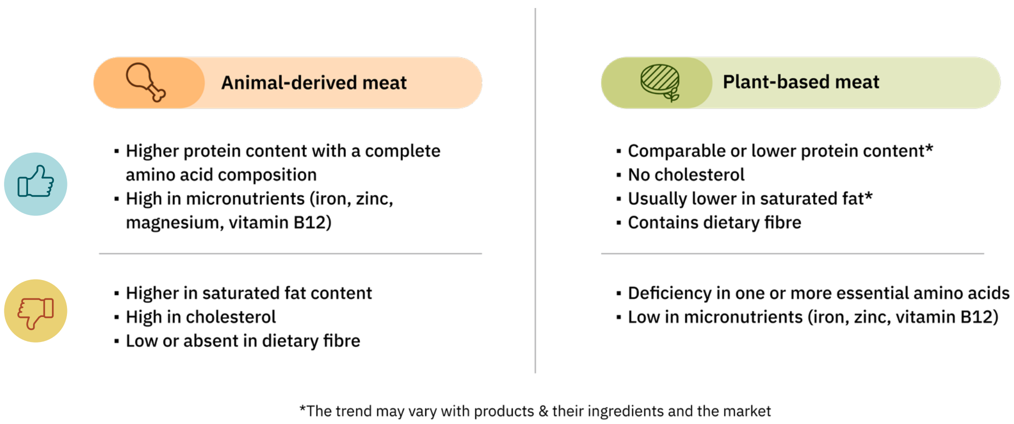



*Figure 1. General observations from previous studies on the nutritional aspects of plant-based meat versus conventional meat products*

Phase I of this study compares the nutritional label information of plant-based meat and egg products sold in the Indian market with that of their animal-derived counterparts (Fig. 2). This information has been assessed with reference to the conditions specified by the Indian and international regulations for nutritional claims. Accordingly, the nutritional information declared on the labels of 112 plant-based meat products and 8 plant-based egg products has been evaluated with reference to the recommendations of the Food Safety and Standards (Advertising and Claims) Regulations of the Food Safety and Standards Authority of India,[27] the Food Labelling Guide of the United States Food and Drug Administration[28] and the FAO/WHO[29], as applicable. Further, the amino acid and fatty acid compositions of selected plant-based meat (n = 22) and plant-based egg (n = 4) products have been quantified in Phase II of this technical analysis (Fig. 2). This is to evaluate the nutritional completeness of plant-based meat and plant-based egg products as a function of the protein and fat sources in their ingredient lists.

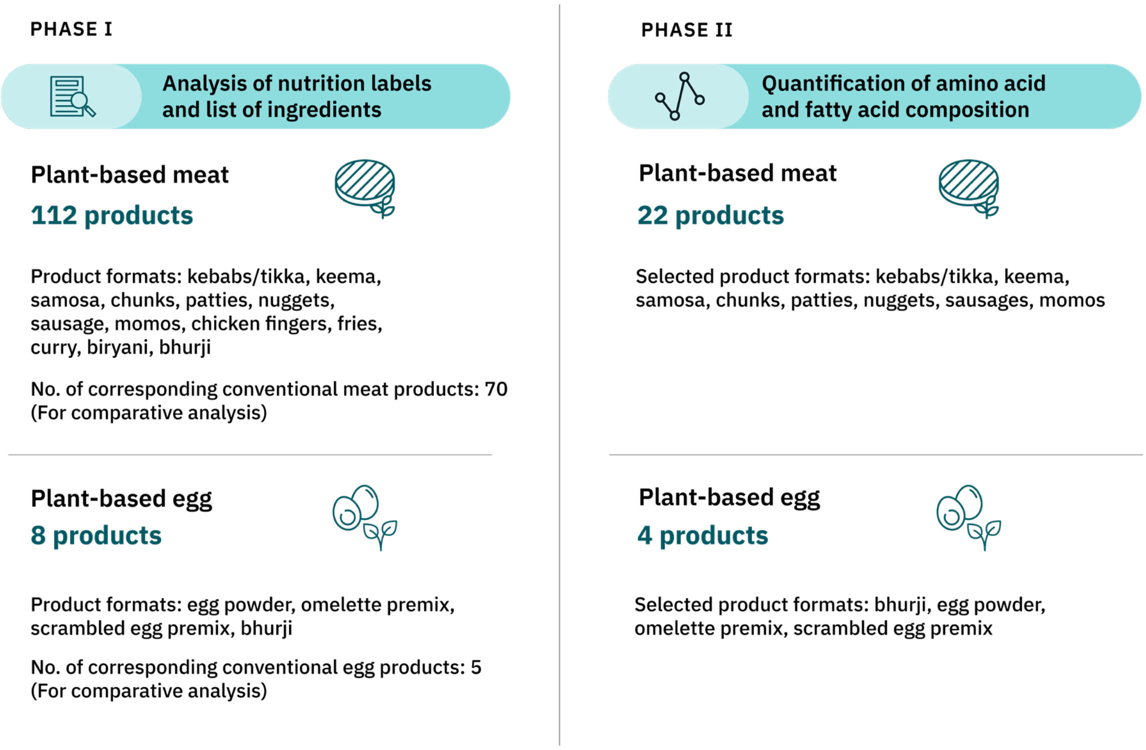



*Figure 2. Phases and research plan of the technical analysis*

# 2. Methodology

## 2.1. Compilation of information from the nutrition labels and ingredient lists

The information on nutritional composition and ingredients of plant-based meat and egg products sold in India is gathered from the images of back-of-pack labels available on the manufacturer's website or e-commerce websites. The data is collected in the period between November 2023 and April 2024. 100 g of the product is the basis for all the nutritional information considered in this study (for labels that showed data based on 'per serving', the values have been converted to 'per 100 g'). The average and standard deviation of the products' nutritional parameters, including energy value (kcal), carbohydrates (g), proteins (g), total fat (g), saturated fats (g), total sugar (g), dietary fibre (g), and sodium (mg) have been calculated. The amounts of micronutrients (µg or mg) such as vitamins and minerals have also been recorded.

## 2.2. Quantification of amino acid composition

100 mg of the samples is digested using phenolic hydrochloric acid (HCl) for the complete hydrolysis of the protein fraction. The hydrolysed protein fraction is derivatised using Waters amino acid reagent (AccQ•Fluor™, Waters Corporation, USA). After derivatisation, the sample is prepared for injection into the High-Performance Liquid Chromatography (HPLC) system equipped with a C18 reverse phase column and a fluorescence detector (Thermo Fisher Scientific, San José, CA, USA). The amino acids are identified and quantified by comparing the retention times and peak areas with those of pristine amino acid standards.

## 2.3. Estimation of fatty acid composition

The fatty acid profile of plant-based meat and egg samples has been identified and quantified using a Gas Chromatography (GC) system (Agilent 8890 GC system, Agilent Technologies, Santa Clara, CA) equipped with a Flame Ionisation Detector (FID). The fat is extracted from the samples based on the AOAC official method (AOAC 996.06, 2012). 2 g of the sample is taken in a *Mojonnier* fat extraction flask, and 100 mg of pyrogallic acid is added. Subsequently, 2 mL of ethanol and 10 mL of 8.3 M HCL are added to the above contents and mixed well. This mixture is maintained in a water bath at 80°C for 40 min and then cooled to attain ambient temperature (~25°C). Then, 25 mL of diethyl ether/petroleum ether is added to the mixture and shaken well for 10 min. The resultant upper layer is collected in a round bottom flask. The previous steps are repeated three times, followed by the evaporation of ether using a rotary evaporator. The residue in the round bottom flask contained the extracted fat. Further, the derivatisation procedure is carried out according to the methodology specified in ISO 12966–Part 2. 0.1 g of the extracted test sample is accurately weighed in a vial, and 2 mL of isooctane is added and vortexed for 1 min. 100 µL of 2 M methanolic KOH is added, and the mixture is again vortexed for 1 min. Then, 2 mL of 4% sodium chloride (NaCl) is added and vortexed for 1 min. The upper layer (isooctane) is collected into a sample vial. 1 g of sodium hydrogen sulphate is added and vortexed for 1 min. The gas chromatograph's parameters are set as follows: (i) Injection temperature: 250°C; (ii) Detector temperature: 250°C; (iii) Oven temperature: 120°C to 240°C at 4°C/min, held for 7 min at 240°C; (iv) Carrier gas: Hydrogen; (v) Column head pressure: 220 kPa; (vi) Flow rate: ~1.0 mL/min; (vii) Split ratio: 1:100; (viii) Injection volume: 1 µL.

The composition of fatty acid methyl esters is calculated based on the area fraction of the individual fatty acid methyl esters (FAME; expressed in percentage). For most fats and oils, the area fraction of fatty acid methyl esters is equal to the area fraction of triacylglycerols (TAG) in grams per 100 g. According to the AOCS Official Method Ce 1h-05, factors for the conversion of FAMEs to TAG equivalents are between 0.9114 (C8:0) and 0.9965 (C24:1) and are therefore negligible. If the chromatography follows these factors, it can be assumed that the ratio of the peak areas of the FAMEs is identical to the ratio of the mass fractions.

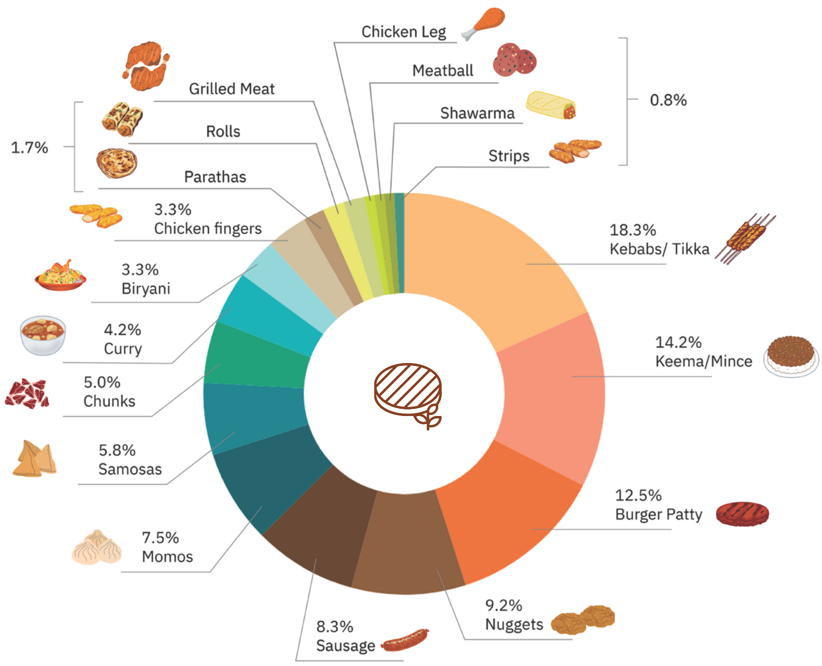
## 2.4. Statistical analysis

To test the null hypothesis for the difference in nutritional content between plant-based and animal-derived meat and egg products, a two-way analysis of variance (ANOVA) (Microsoft Office Excel, 2013; Microsoft Corporation, Redmond, WA) is carried out with significance levels set at a *P-value* of <0.05.

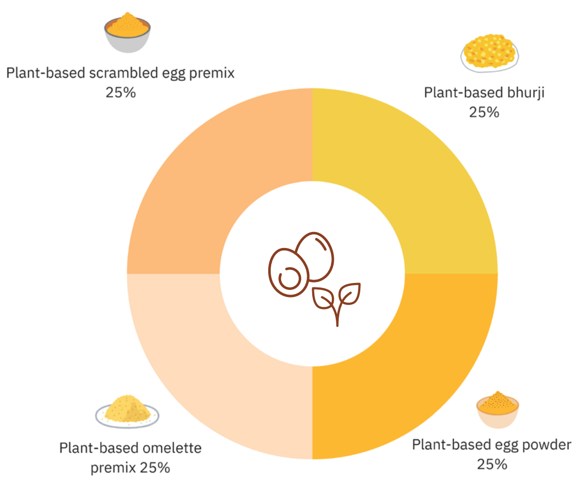
# 3. Findings and inferences

## 3.1. Classification of plant-based meat and egg products

Plant-based meat and egg products in the Indian market can be classified according to their sales category or format. There are 18 major formats of plant-based meat products (Fig. 3[a]) comprising both Indian and western categories. 18.3% of plant-based meat products are sold in the format of *kebabs* or *tikkas* (plant-based chunks that are marinated, skewered, and grilled or baked), followed by *keema* (14.2%) (a minced meat alternative cooked with a variety of spices), burger patties (12.5%), nuggets (9.2%), and others as indicated in Fig. 3[a]. Plant-based egg products are available in 4 formats (Fig. 3[b]).




(a)




(b)

*Figure 3. Different formats of (a) plant-based meat and (b) plant-based egg products in the Indian market*

Only those formats having more than 5 products have been considered for the comparative analysis of nutritional profiles with the corresponding animal-derived products. Accordingly, the nutritional label information of 11 plant-based meat formats comprising 112 products and all of the 4 plant-based egg formats including 8 products have been considered in this study. The nutritional composition data (consisting of macronutrients and sodium content) of these plant-based meat and egg products is presented in Table 1 (a & b). 70 animal-derived meat products and 5 conventional egg products corresponding to the different plant-based meat and egg product formats are considered for the comparative analysis of nutritional label information. A detailed comparative assessment of macro and micronutrients in the plant-based meat and egg products with their conventional counterparts is presented in the subsequent sections.

**Table 1. Compilation of nutritional label information**

(a) Plant-based meat products

| Category | N | Classification | Nutritional composition (per 100 g) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Energy (kcal) | Protein (g) | Total sugar (g) | Total fat (g) | Saturated fat (g) | Dietary fibre (g) | Sodium (mg) |
| Kebabs /Tikka | 22 | Plant-based | 204.46 (113.64, 345) | 15.69 (4.29, 22.68) | 0.6 (0, 4.90) | 11.94 (1.16, 26.70) | 4.96 (0.22, 16.30) | 6.25 (0, 25.09) | 613.38 (50.13, 1165.05) |
| | 16 | Conventional | 190.47 (147.6, 296.62) | 15.44 (10.9, 20.58) | 0.37 (0, 2.5) | 10.66 (3.2, 18.46) | 3.4 (0.8, 6.95) | 1 (0.99, 2.06) | 597.5 (58, 1186.41) |
| Keema /Mince | 17 | Plant-based | 207 (24, 488) | 13.20 (1, 29) | 2.28 (0, 12) | 11.62 (0.28, 29) | 3.64 (0.03, 12.20) | 9.38 (2.49, 30.90) | 366.92 (8.53, 1825.40) |
| | 2^ | Conventional | 169.03 (148.06, 190) | 10.45 (7.5, 13.39) | 1.78 (0.96, 2.6) | 11.39 (11.35, 11.42) | 3.39 (1.88, 4.9) | ND | ND |
| Burger patty | 15 | Plant-based | 221 (157, 288.50) | 12.05 (6.01, 21.20) | 1.85 (0, 12.90) | 10.50 (2.61, 15) | 4.05 (0.35, 9.30) | 10.49 (2, 18.60) | 630.60 (268.42, 900) |
| | 8 | Conventional | 213.04 (170.7, 274) | 12.53 (9.53, 18.2) | 0.1 (0, 1.2) | 11.19 (7.9, 16.9) | 4.14 (1.06, 7) | 1 (0.84, 1.27) | 640.24 (542.57, 830) |
| Nuggets | 11 | Plant-based | 256.02 (217, 297.08) | 9.60 (5.30, 12.20) | 0.6 (0, 8) | 13.20 (9.70, 19) | 4.99 (1.45, 7.14) | 14.60 (6.80, 18.60) | 621.30 (460, 736) |
| | 8 | Conventional | 229.58 (219,286) | 14.04 (10.1, 17.4) | 1.40 (0, 2.6) | 11.60 (10.12, 16.9) | 5.30 (3.4, 5.9) | 1.08 | 496.20 (492, 702.97) |
| Sausages | 10 | Plant-based | 161.92 (139.87, 260) | 10.23 (5.70, 13.09) | 0 (0, 1.80) | 8.05 (5.39, 14.68) | 1.47 (0.88, 10.80) | 5.20 (3.14, 20.32) | 537.83 (239.10, 872) |
| | 9 | Conventional | 152.4 (130.1, 220) | 11.9 (9.41, 15.14) | 0 (0, 0.8) | 8 (5.7, 17.45) | 3.8 (1.77, 7.7) | 1.6 (0, 3.2) | 882 (395, 1369) |

N: Number of products

| Category | N | Classification | Nutritional composition (per 100 g) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Energy (kcal) | Protein (g) | Total sugar (g) | Total fat (g) | Saturated fat (g) | Dietary fibre (g) | Sodium (mg) |
| **Momos** | 9 | Plant-based | 203.60 (197, 300.11) | 9.1 (6.55, 12.57) | 2.29 (0, 3.90) | 6.24 (5.38, 18.55) | 2.60 (2.04, 3.51) | 9.20 (2.02, 15) | 598.50 (199.30, 3000) |
| | 1 | Conventional | NA | | | | | | |
| **Samosa** | 7 | Plant-based | 351 (284.37, 416.20) | 10.04 (6.10, 21.95) | 3.14 (1.60, 5.03) | 18.21 (15.28, 36.17) | 3.37 (2.90, 11.76) | 16 (16, 16) | 512 (168.50, 610.58) |
| | 4 | Conventional | 230.74 (94, 290.50) | 12.59 (5.2, 25.19) | 1.17 (0.01, 4.05) | 10.56 (3.6, 14.50) | ND | ND | 153.8 |
| **Chunks** | 6 | Plant-based | 150 (110.19, 311.52) | 22.97 (5.74, 28.47) | 1.99 (0, 4.83) | 3.27 (1.20, 12.68) | 1.94 (0.57, 5.18) | 4.55 (3.90, 8.57) | 447.53 (265.80, 527.62) |
| | 3 | Conventional | 171.88 (152, 202) | 12.4 (3.02, 13.87) | 1.43 (0, 1.9) | 11.1 (5.12, 14.52) | 4.13 (3.1, 5.16) | 0.2 | 292.15 (190, 394.3) |
| **Curry** | 5 | Plant-based | 196.51 (112.97, 268.01) | 15.02 (5.96, 24.5) | 1.48 (0, 5.75) | 12.85 (2.77, 13.87) | 2.12 (0.73, 4.37) | 6.68 (4.52, 10.5) | 454.85 (318, 1270.44) |
| | 5 | Conventional | 177 (133, 485) | 14.76 (7.50, 33.30) | 2.05 (0.96, 3.40) | 11.42 (8, 34.90) | 4 (1.88, 12.40) | 1.95 (1, 2.90) | 455 (171.50, 487) |
| **Biryani** | 4 | Plant-based | 215.25 (169.14, 384.32) | 6.4 (5.62, 13.26) | 2.87 (2.07, 4.24) | 7.57 (6.18, 11.09) | 2.65 (1.5, 4.4) | 5.45 | 596.12 (371.17, 689.01) |
| | 5 | Conventional | 165.44 (131.43, 278) | 8 (4.49, 12.96) | 0.75 (0, 2.20) | 3.9 (2.94, 9.52) | 1.55 (0.17, 3.60) | 2.82 (1.98, 3) | 447.29 (344.58, 550) |
| **Chicken fingers** | 4 | Plant-based | 242.5 (120, 297.08) | 11.15 (9.6, 13) | 1.4 (0.8, 2) | 12.15 (1.5, 19) | 2.93 (0.4, 7.1) | 8.8 (3, 14.6) | 575 (260, 780) |
| | 8 | Conventional | 224 (207, 256.4) | 13.15 (9, 19.21) | 0.31 (0, 2.7) | 12.85 (9.3, 15.31) | 5.22 (1.8, 6.14) | 2.12 | 528.2 (438.4, 618) |

N: Number of products

Note: Values in each column are expressed in the order of Median (Min, Max); ND: Data not available; NA: Not applicable (only one product under the format); ^Median value is same as mean as there are only two products

(b) Plant-based egg products

| Category | N | Classification | Nutritional composition (per 100 g) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Energy (kcal) | Protein (g) | Total sugar (g) | Total fat (g) | Saturated fat (g) | Dietary fibre (g) | Sodium (mg) |
| ***Bhurji*** | 2 | Plant-based | 268.27 (167.54,369) | 29.23 (8.16,50.3) | 1.045 (0, 2.09) | 3.98 (2.1, 5.86) | 0.98 (0.66, 1.3) | 6.83 (3.16, 10.5) | 847.63 (210.25, 1485) |
| | 1 | Conventional | 82 | 3.75 | 2.49 | 5.02 | 1.22 | ND | 118 |
| **Egg powder** | 2 | Plant-based | 361 (360, 362) | 35 (23, 47) | 5.5 (5, 6) | 9 (6, 12) | 1.2 | 9.5 (8, 11) | 2456 (912, 4000) |
| | 2 | Conventional | 576.33 (540,595) | 46.73 (45.4, 47.4) | ND | 40.87 (40.8, 40.9) | ND | 0.02 | ND |
| **Omelette pre-mix** | 2 | Plant-based | 377.5 (355, 400) | 29.3 (26.6, 32) | 1.65 (0, 3.3) | 4.25 (4, 4.5) | 0.1 | 13.95 (12.9, 15) | 375 |
| | 1 | Conventional | 153 | 10.62 | 0.65 | 12.02 | 3.37 | ND | 161 |
| **Scrambled egg pre-mix** | 2 | Plant-based | 248.54 (104.97, 392.1) | 13.55 (8.19, 18.9) | 5.4 (BDL [DL-1], 5.4) | 3.58 (2.65, 4.5) | ND | 6.43 (1.26, 11.6) | 196.44 |
| | 1 | Conventional | 595 | 47.4 | 1.73 | 40.9 | 3.68 | ND | 523 |

Note: Values in each column are expressed in the order of Mean (Min, Max); BDL: Below detectable limit;
DL: Detectable limit; ND: Data not available

## 3.2. Comparison of macronutrient and micronutrient contents between plant-based and animal-derived products

### 3.2.1. Protein

#### Plant-based meat products

Protein content (%) is prioritised among the macronutrients in plant-based meat products, as this category has emerged to address the increasing demand for alternative sources to animal-derived proteins and the consequent industrial innovations.[30] The average protein content of different plant-based meat formats ranges between 9.1-20.8%, with chunks having the maximum mean protein content (Fig. 4[a]). Soy protein (concentrate and isolate), wheat gluten, and pea protein are the main protein sources of plant-based chunks (Table 2). The mean protein content of plant-based keema and biryani is slightly higher than the corresponding conventional products by 12.23% and 9.1%, respectively. However, the protein content per 100 g of plant-based kebabs, burger patties, sausage, nuggets, momos, samosa, curry, and chicken fingers is lower than their conventional meat counterparts (by 4-33%), with nuggets exhibiting the most difference.

The conditions specified by FSSAI[27] for a product to be claimed as a 'source of protein' and 'high-protein or protein-rich' are listed in Table S1 (Appendix). The nutrient requirements for Indians as defined by the Indian Council of Medical Research (ICMR) and National Institute of Nutrition (NIN)[31] specify the RDA for protein intake to be 0.83 g protein/kg body weight/day for healthy Indian adults. This value is in agreement with the RDA for protein recommended by the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO), and the United Nations University (UNU) and translates to a value of 54 g/day for a person weighing 65 kg, irrespective of work category.[31] Therefore, for a product to be considered a source of protein, its average protein content must be at least 5.4 g per 100 g. Similarly, for a product to be considered high in protein, its average protein content should be more than 10.8 g per 100 g. Accordingly, all the formats of plant-based meat products comply with the 'source of protein' claim of FSSAI. Except for nuggets, sausage, momos, and biryani, the average protein content of other plant-based meat formats complies with the requirements for the 'high-protein' claim (Fig. 4[a]).

According to the U.S. Food and Drug Administration's (FDA) guidelines,[28] a food product can be considered healthy if it has at least 10% of Daily Value (DV) for protein as per Reference Amounts Customarily Consumed (RACC). Besides, it can be considered a 'high' or 'good source' of protein if the product contains 20% or more of the DV per RACC and 10-19% of the DV per RACC, respectively.[28] The DV for protein is 50 g.[32] Therefore, the upper limits above which a product can be claimed as 'healthy', 'high', or 'good source' of protein are 5 g, 10 g, and 9.5 g, respectively. Thus, Indian plant-based meat products can be claimed as 'healthy'. Except for nuggets, momos, and biryani, the other plant-based meat formats comply with the FDA's requirement for the 'high protein' claim.

Among the plant-based meat products, 30% employ soy as their source of protein, 20% use a composite blend of soy and wheat protein, and 15.8% contain pea protein (Table 2[a]). Soy protein in concentrated and isolated forms is the preferred protein source in plant-based meat products due to its desirable functional properties such as gelling, emulsification, fat absorption, and water-holding capacities.[33] Plant-based meat products using a combination of soy+wheat and soy+wheat+pea offer a significantly higher protein content (more than 20 g/100 g of the product). Strikingly, a combination of wheat and pea is an established model species mixture,[34-35] as their complementarity caters to many requirements, including high protein content and quality and easing climate change-related challenges.[36] Similarly, a combination of textured wheat and textured pea proteins has been found to play a vital role in plant-based meat products by providing a desirable meat-like texture, clean flavour profile, ease of formulation, and nutritional benefits (i.e., high protein and no cholesterol).[37]

## Plant-based egg products

The plant-based egg *bhurji* and omelette pre-mix products exhibit a higher average protein content than their conventional egg counterparts (Fig. 4[b]; Table 1[b]). Of all the formats, the plant-based egg powder has the highest average protein content. The average protein content of all the plant-based egg formats is higher than the condition specified by FSSAI for the *'high protein'* claim[27] (Table S1; Appendix). However, the variation between different products within the same format is higher for plant-based *bhurji* and egg powder, which can be attributed to differences in their formulation and protein sources. The average protein content for all the formats of plant-based egg products complies with the FDA's requirement for '*high in protein*' and '*healthy*' claims[28], as mentioned in the previous section.

Among the plant-based egg products, 25% use a combination of soy and pea as the protein source (Table 2[b]). Besides soy and pea, plant-based egg products also employ mung bean, black-eyed pea, and chickpea as protein sources. The utilisation of these protein sources is justified by their desirable texture upon coagulation, which is vital in mimicking the functionality of conventional eggs, mainly gelation and foaming. This trend is different from the plant-based meat products that predominantly use soy, wheat gluten, and pea and their combinations thereof as protein sources.

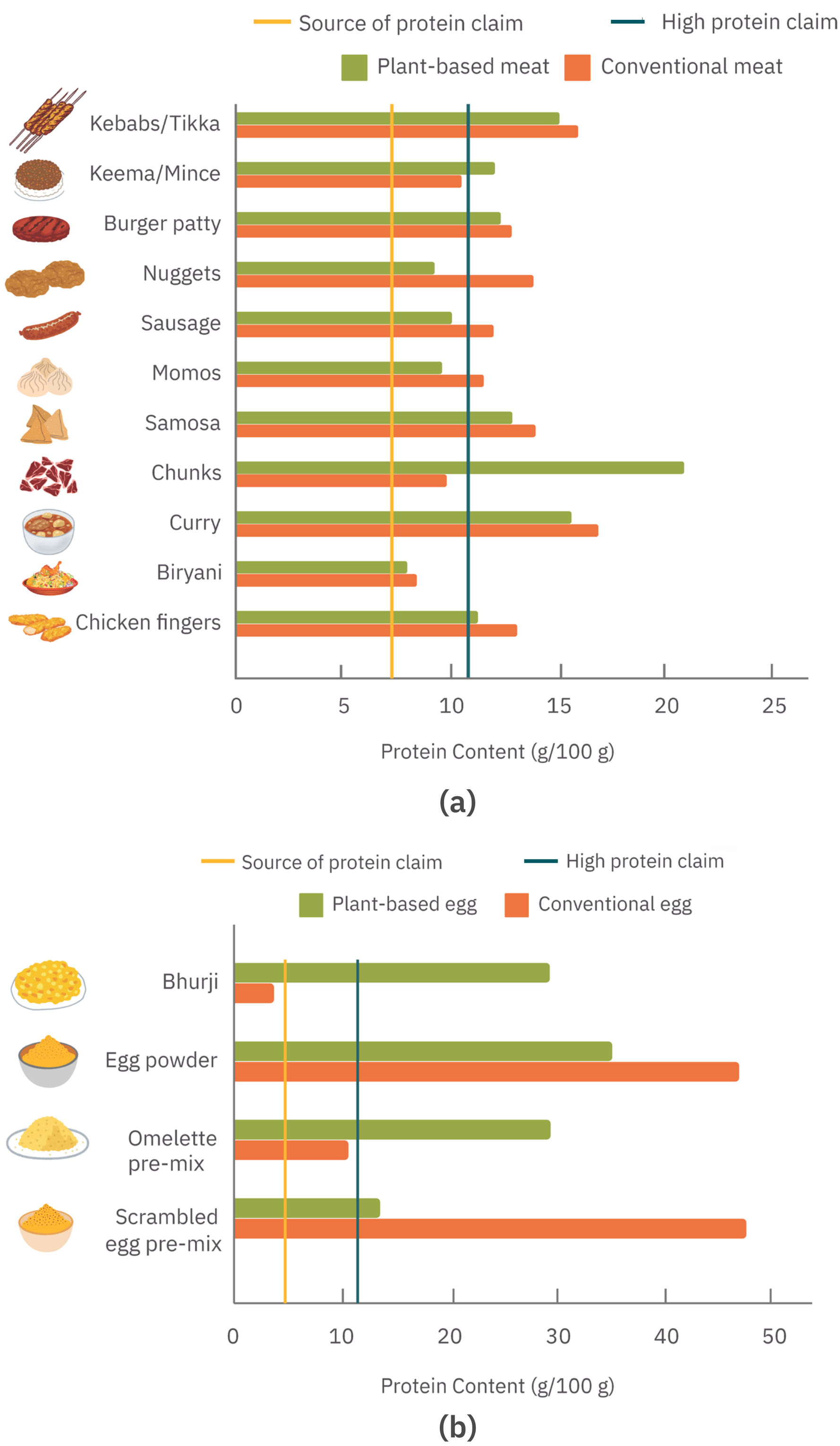
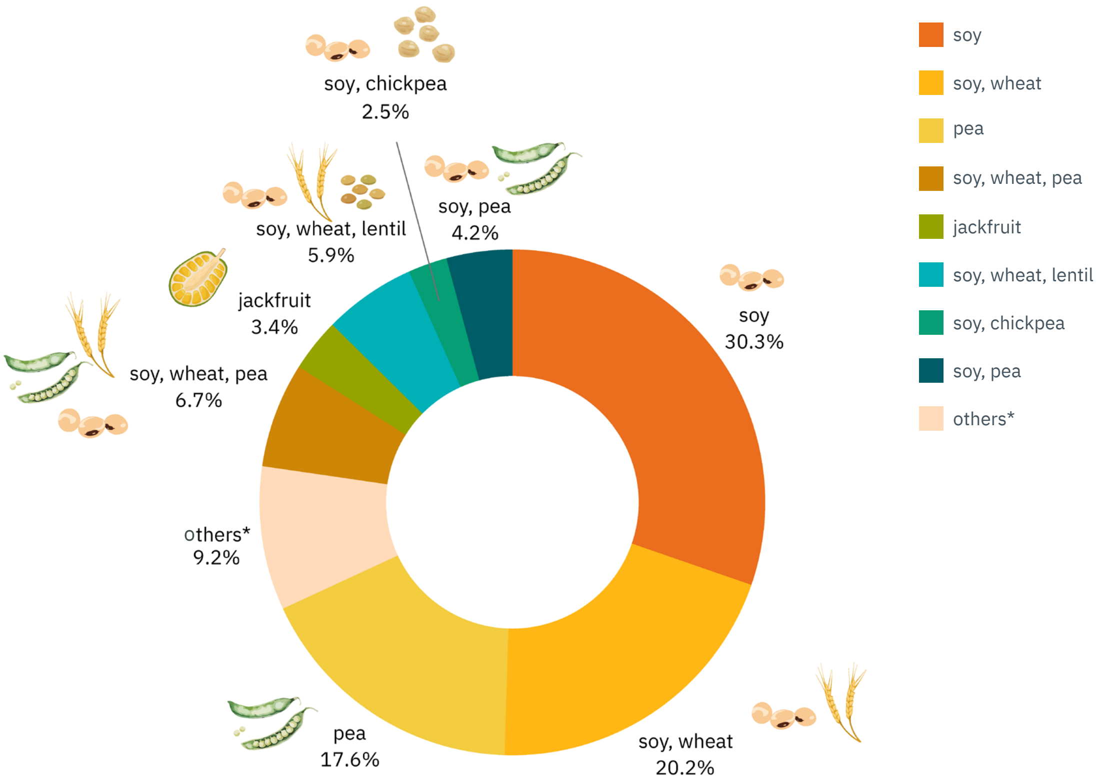



*Figure 4. Comparison of average protein content per 100 g: (a) Plant-based meat versus conventional meat products; (b) Plant-based egg versus conventional egg products (Requirement for 'high protein' claim: 10.8 g per 100 g of product; 'source of protein' claim: 5.4 g per 100 g of product)*

**Table 2. Sources and usage patterns of proteins in plant-based meat and egg products**

| (a) Plant-based meat products | |
|---|---|
| **Category** | **Major protein sources (as identified from the list of ingredients)** |
| **Kebabs/Tikka** | Soy protein (including isolate, concentrate & their textured formats and flour), wheat protein (gluten), pea protein (including textured pea protein), channa *dal* and powder, vegetable protein mix, gram *dal*, chickpea |
| **Keema/Mince** | Soy protein (including isolate, concentrate & their textured formats and flour), pea protein, split roasted chickpeas concentrate, pea protein (including textured pea protein), wheat gluten |
| **Burger patty** | Soy protein (including isolate, concentrate, and their textured formats), wheat protein (gluten), pea protein (including textured pea protein), potato protein, Jackfruit (tender), vegetable protein mix, gram *dal* |
| **Nuggets** | Soy protein (including isolate, concentrate, and their textured formats), chickpea, pea protein (including textured pea protein), potato protein, vegetable protein mix, wheat gluten |
| **Sausage** | Soy protein (including isolate and its textured format), pea protein (including textured pea protein), wheat protein (gluten, refined wheat flour protein), jackfruit |
| **Momos** | Soy protein (including flour and textured formats), pea protein, wheat protein flour, vegetable protein mix |
| **Samosa** | Soy protein (including flour format), textured pea protein, wheat gluten |
| **Chunks** | Soy protein (including isolate, concentrate, and their textured formats), wheat protein (gluten), pea protein |
| **Curry** | Soy protein (including isolate, concentrate, and flour), wheat protein (gluten), pea protein |
| **Biryani** | Soy protein (including isolate, concentrate, and their textured formats), textured vegetable protein, wheat protein (gluten), pea protein, gram *dal* |
| **Chicken fingers** | Soy protein (including isolate and its textured format), wheat protein (gluten) |

Proportions of individual and complementing plant proteins in plant-based meat products

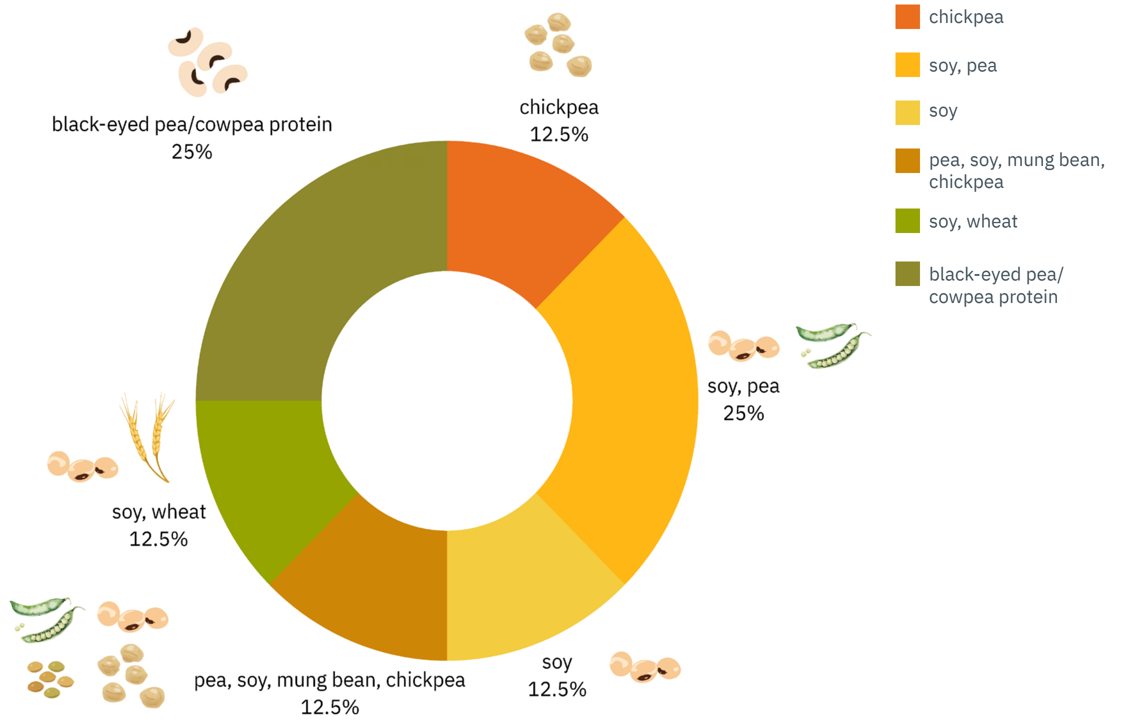



*others: {pea + wheat gluten + potato protein}, {jackfruit + soy}, {pea + wheat gluten}, wheat, lentil, {soy + lentil}, chickpea

**(b) Plant-based egg products**

| Category | Major protein sources (as identified from the list of ingredients) |
|---|---|
| ***Bhurji*** | Soy protein isolate, pea protein, wheat protein |
| **Egg powder** | Soy protein powder, mung protein isolate |
| **Omelette pre-mix** | Black-eyed pea protein concentrate, mung bean flour & powder, pea protein concentrate, soy protein isolate |
| **Scrambled egg pre-mix** | Chickpea powder, soy protein, pea protein |

Proportions of individual and complementing plant proteins in plant-based egg products




### 3.2.2. Amino acid composition

#### Plant-based meat products

Diets must provide adequate amounts of essential amino acids and essential fatty acids to realise maximum growth potential among children and to meet the requirements of vital body functions in adults (protein synthesis, tissue repair, building muscles, nutrient transport and absorption, prevention of illness).[31] The total amino acid content in the 22 different plant-based meat products considered in this study ranges between 0.37–19.91 g/100 g. The variations in amino acid composition between different product formats (Fig. 5[a]; Table S2 [I-VIII]; Appendix) can be attributed to diversity in their protein sources. Nevertheless, glutamic acid is the amino acid present at the highest concentration in all the plant-based meat and plant-based egg products tested, irrespective of their format. However, the amino acid at the lowest concentration varies with the product format.

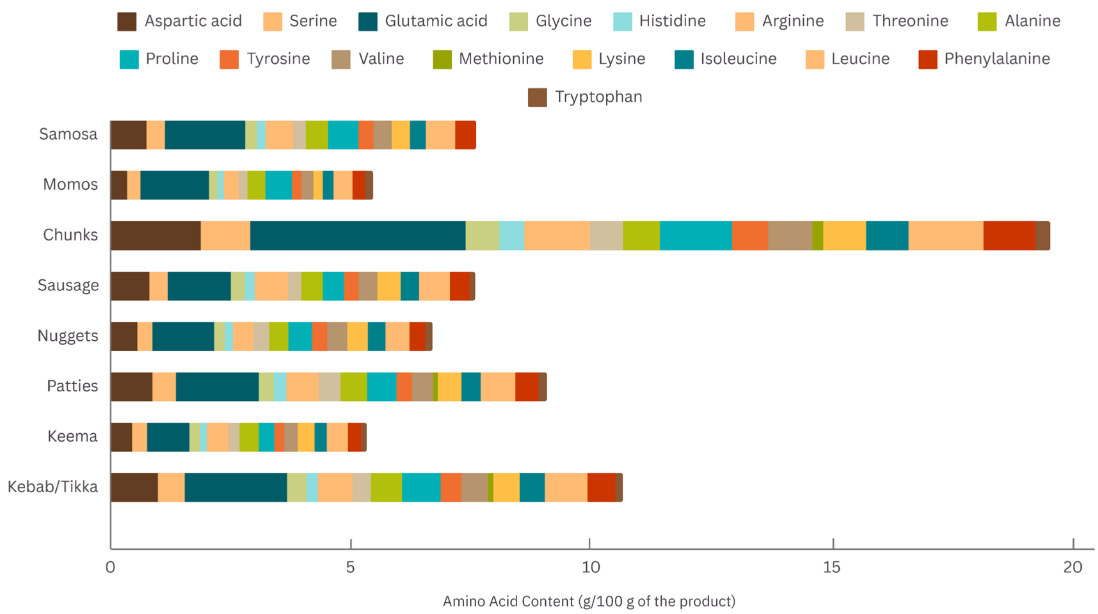
The concentration of sulphur-containing amino acids (SAAs), i.e., methionine and cystine, is less than 0.1 g/100 g in plant-based keema, nuggets, sausage, momos, and samosa. Cystine is the only amino acid that is below the detectable limit in patties and chunks. This is justified by the fact that SAAs and tryptophan are the limiting amino acids of soybean,[38-39] which is the predominantly used protein source in these products. Similar observations have been reported by earlier studies.[40] Tryptophan is the amino acid at the lowest concentration in pea and jackfruit-based keema, pea-based patties, nuggets, sausages, momos, and soy-based samosa. Cysteine, methionine, and tryptophan are the amino acids present in the least quantities in both soy and pea.[41-44] Further, gluten proteins are low in their content of essential amino acids, including lysine (0.3% to 1.1%), methionine (0.0% to 1.8%), and tryptophan (0.0% to 1.0%).[45] In the jackfruit-based keema product, except for aspartic acid and alanine, the concentration of other amino acids is found to be less than 0.1 g per 100 g. This observation is mostly in accordance with the amino acid profile of tender jackfruit reported in the literature,[46] which shows aspartic acid as the most abundant amino acid. Jackfruit is a climacteric fruit, edible in both tender and ripened states, of which the tender form predominantly is used in plant-based meat products.

Contrastingly, methionine is detected at a relatively higher concentration in plant-based chunks, kebabs and patties containing a combination of soy protein and wheat gluten (0.11-0.23 g/100 g) and soy, wheat, and pea proteins (0.11-0.21 g/100 g). This is justified as methionine is not the limiting amino acid in wheat gluten. Similarly, tryptophan is detected (0.17 g/100 g) in one of the two plant-based patty products containing a blend of soy protein and wheat gluten. This demonstrates the usefulness of the 'protein complementation' approach, which is usually employed to improve the utilisation efficiency of a poor-quality protein with another protein. Two protein sources with a more balanced mixture of amino acids provide an essential amino acid pattern approximating or equal to those found in animal proteins. The protein complementation approach has been applied to develop both commercial products and food formulations with high protein quality for inclusion in the nutrition programs of many developing countries.[47] Given the nutritional benefits of the protein complementation approach, future studies should focus on scientific methods to arrive at optimal and cost-effective combinations of plant proteins with enhanced amino acid scores for the development of plant-based alternative protein products. However, this should be achieved without compromising on the organoleptic and functional properties of the end product. With recent technical advancements, bioinformatics and computational modelling tools can be used to predict complementary protein pairs based on their amino acid profiles. Artificial intelligence (AI) and Machine Learning (ML) algorithms can also be used to evaluate large datasets of plant-based protein sources and identify optimal combinations with a complete amino acid profile.

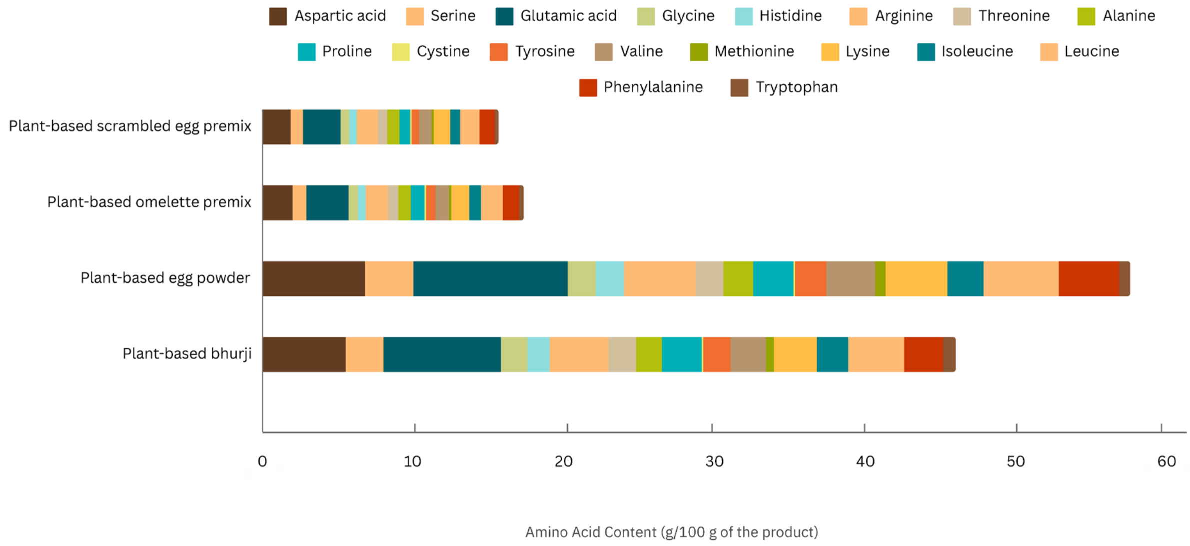
The FAO's recommendation on the essential amino acid requirements for adults is listed in Table S2. Comparing the average amino acid content of each plant-based meat product format tested, kebabs, patties, and chunks fulfil 17-56% and 15-65%, 34-79% of the requirement for essential amino acids, respectively. Except for methionine, keema, nuggets, sausages, and momos meet 16-42%, 20-56%, 23-42%, and 10-62% of the requirements for other amino acids, respectively. Samosa meets 19-28% of the requirements for amino acids except for methionine and tryptophan.

## Plant-based egg products

The total amino acid content of the different plant-based egg products ranges between 15.56-57.45g/100 g (Fig. 5[b]; Table S2[IX]), which is substantially higher than the range of plant-based meat products. The plant-based egg powder product with mung bean as the protein source has the highest total amino acid content (57.45 g/100 g). Similar to the plant-based meat products, glutamic acid is the amino acid present at the highest concentration in all the plant-based egg products, regardless of the format. Cystine is the amino acid present at the lowest concentration in all the product formats, irrespective of their protein source (soy, pea, mung bean, and chickpea). However, with the plant-based egg products, the essential amino acids are present in quantities that are significantly above the FAO's recommendation[29] (Table S2 [IX]; Appendix).




(a)




(b)

*Figure 5. Amino acid composition per 100 g of (a) plant-based meat products; (b) plant-based egg products*

## 3.2.3. Dietary fibre

Fibre is an essential component of a balanced diet. High fibre intake has been associated with a lower risk of major diseases like pancreatic cancer, coronary artery disease, cardiovascular disease, and all-cause mortality.[48] According to the FSSAI, foods having at least 3 g of fibre per 100 g (or 1.5 g per 100 calories) are considered a source of dietary fibre. Further, high-fibre foods are those that contain at least 6 g per 100 g (or 3 g per 100 calories).[27] While none of the animal-derived products meet these criteria, all the plant-based meat products in the Indian market can be considered a source of fibre. Indeed, except the biryani format, all the other plant-based meat product formats fall within the high fibre category (Fig. 6). The plant-based egg products have an average dietary fibre content in the range of 6.43-13.95 g, with the omelette premix category having the maximum value (Table 1[b]). Therefore, these products can also be considered as *'high in fibre'*. The fibre content of plant-based meat and egg products can be attributed to flour-based ingredients derived from wheat, oats, rice, soy, quinoa, barley, konjac, and corn. Other ingredients contributing to the dietary fibre content of plant-based meat are pea fibre, inulin, and psyllium fibre.

According to the FDA, the upper limits above which a product can be claimed as *'healthy'*, *'high'* or *'good source'* of dietary fibre are 2.8 g, 5.6 g, and 5.32 g, respectively.[28] Therefore, all the formats of plant-based meat and egg products can be considered *'healthy'*. All the plant-based egg products and plant-based meat products except biryani are high sources of dietary fibre. Thus, it is evident that higher fibre content is a noteworthy advantage of plant-based meat and egg products over conventional products.

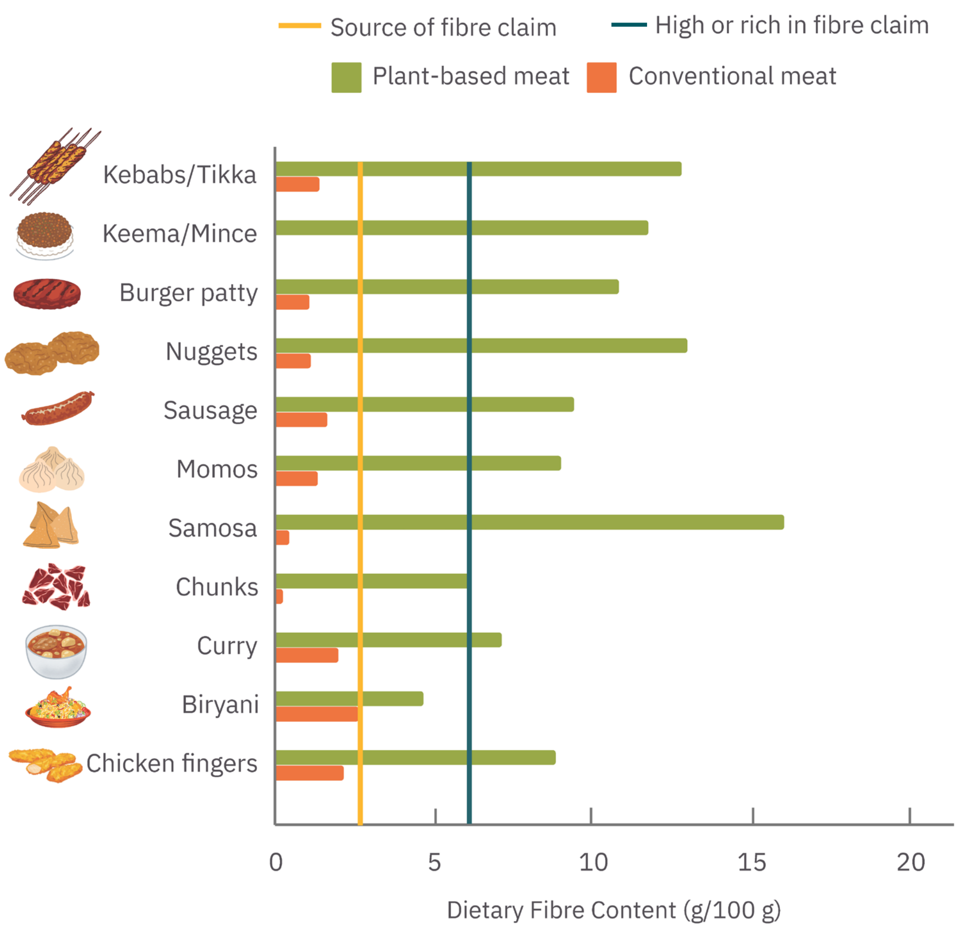



*Figure 6. Comparison of average dietary fibre content per 100g: Plant-based meat versus conventional meat products (Requirement for 'high fibre' claim: 6 g per 100 g of product; 'source of fibre' claim: 3 g per 100 g of product)*

### 3.2.4. Fat

**Plant-based meat products**

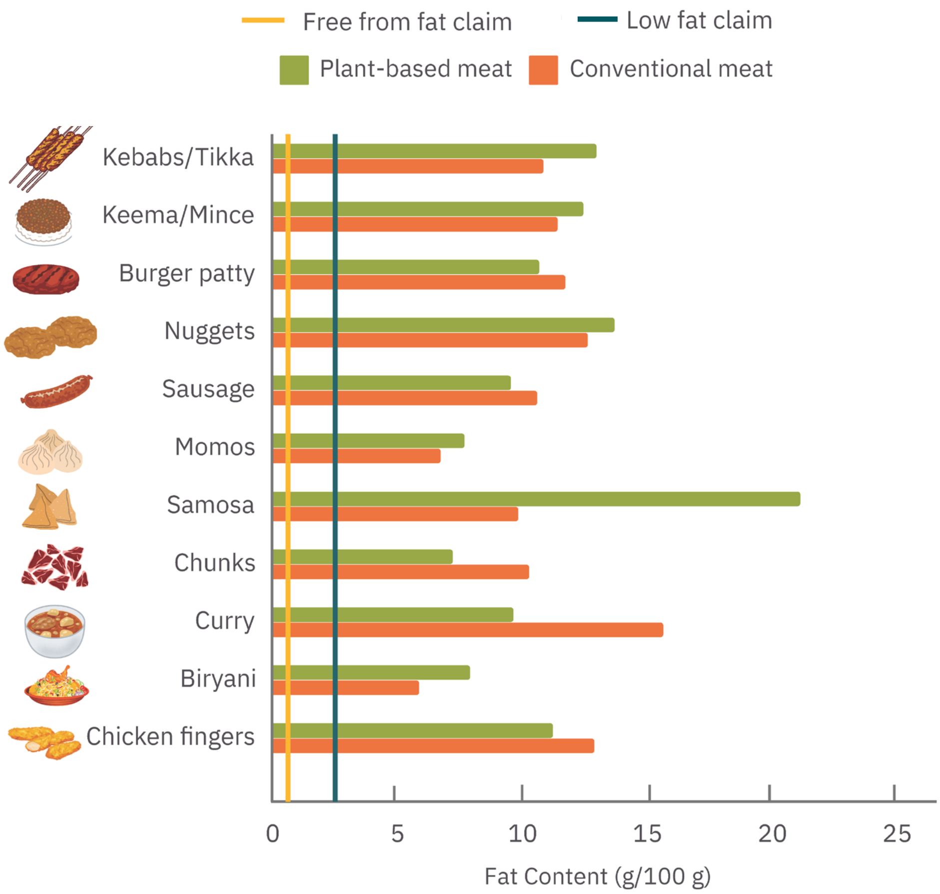
Based on the average values, except samosa, all the other formats of plant-based meat products have a lower or comparable total fat content (*P value* > 0.05; P = 0.66) relative to animal-derived products (Fig. 7[a]). The plant-based chunks, curry, and fingers/strips formats show a lower mean saturated fat content than the corresponding conventional products (Fig. 7[b]). However, the scope for improvement exists in terms of reducing the saturated fat content in the other plant-based meat product formats. Both the plant-based and conventional meat products do not meet the requirements for the *'free'* or *'low'* claims related to total fat and saturated fat content specified by the FSSAI[27] and FDA[28] (Figs. 7[a & b]). Recent research investigations have revealed the potential of 3-dimensional microgels of plant proteins as fat substitutes in plant-based meat products.[49] It is imperative that these proofs-of-concept should be transformed and scaled up for commercial applications.

While some plant-based meat products use a single source, other products use a combination of fat sources. 20% of the plant-based meat products use sunflower oil as their fat source. Canola oil and rice bran oil are the sources of fat in 4.3% and 3.5% of the products, respectively. Other single and composite sources of fats employed in plant-based meat products are shown in Fig. S1 (Appendix). In 6.7% (n = 8) of plant-based meat products (belonging to the chunks and tikka formats), an ingredient considered a source of fat is not identified. 14.2% of the plant-based meat products (n = 17) mention the general class of fat as ‘oil’, ‘vegetable oil’, ‘edible vegetable oil’, ‘vegetable fat’, or ‘edible vegetable fat’, without listing the specific name or class title. The relatively higher saturated fat content of some plant-based meat products, such as kebabs and keema can be ascribed to the use of hydrogenated vegetable fat (coconut and palm) and cocoa butter as ingredients. However, the plant-based meat manufacturers also use other fat sources, as listed in Table 3, which are rich sources of polyunsaturated fatty acids (PUFA).

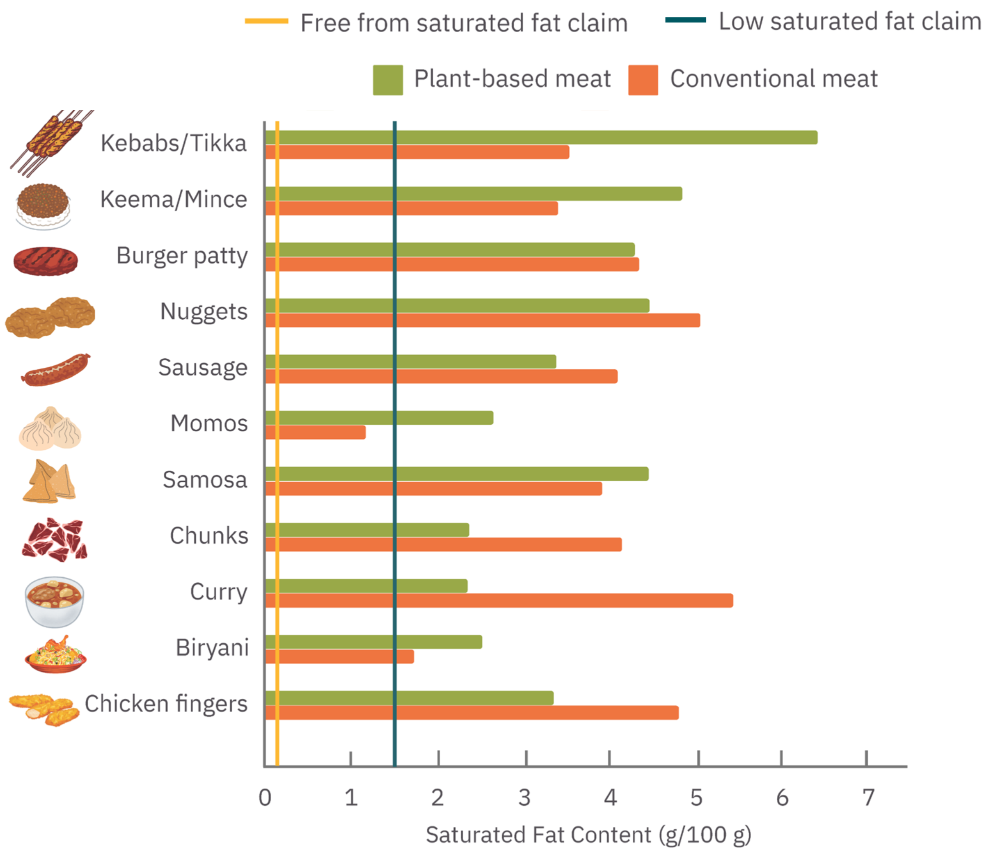
According to the Indian Lifestyle and Heart Study, coronary artery disease and coronary risk factors bear a significant correlation with the level of saturated fat consumption in a cross-sectional study of a cohort of urban North Indians.[50-51] On the other hand, Stanford medical school researchers found that consumption of plant-based meat led to weight loss and reduced cardiovascular risk factors relative to the consumption of organic animal-based meat.[52] Hence, efforts to reduce or eliminate saturated fat content in plant-based meat products can lead to significant nutritional and health advantages over the consumption of animal-derived products.

## Plant-based egg products

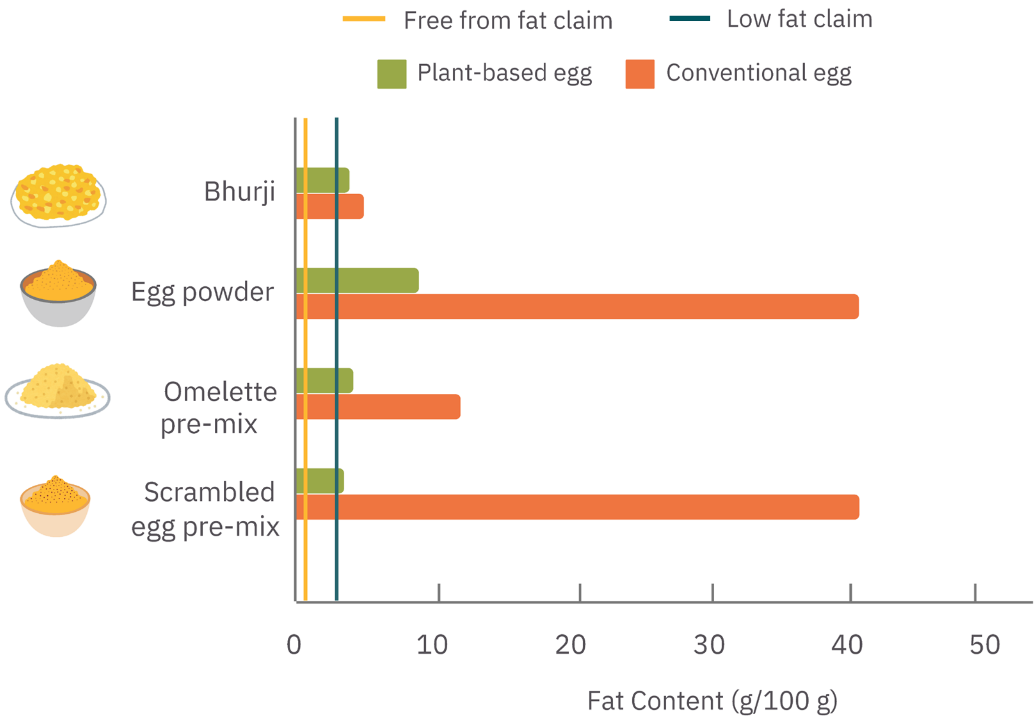
All the formats of plant-based egg products have a lower total fat content than their conventional counterparts (Fig. 7[c]; Table 1[b]). Notably, the plant-based egg powder and scrambled egg pre-mix formats have 78% and 91.2% lower fat content than their corresponding conventional egg products. A similar trend is observed with their saturated fat content (Table 1[b]). However, the total fat content and saturated fat content of both the plant-based and conventional egg products do not meet the conditions for *‘free’* or *‘low’* claims put forth by the FSSAI[27] and FDA[28]. Out of the eight plant-based egg products considered in this study, only three products declare the presence of edible oil in their list of ingredients, of which two products specify soybean oil as the fat source.


Free from fat claim
Low fat claim
Plant-based meat
Conventional meat
Kebabs/Tikka
Keema/Mince
Burger patty
Nuggets
Sausage
Momos
Samosa
Chunks
Curry
Biryani
Chicken fingers
0
5
10
15
20
25
Fat Content (g/100 g)

(a)


Free from saturated fat claim
Low saturated fat claim
Plant-based meat
Conventional meat
Kebabs/Tikka
Keema/Mince
Burger patty
Nuggets
Sausage
Momos
Samosa
Chunks
Curry
Biryani
Chicken fingers
0
1
2
3
4
5
6
7
Saturated Fat Content (g/100 g)

(b)




(c)

*Figure 7. Comparison of (a) average fat content and (b) average saturated fat content per 100g between plant-based meat and conventional meat products; (c) average fat content per 100g of plant-based egg versus conventional egg products (Requirement for 'free from fat' claim: 0.5 g per 100 g of product; 'low fat' claim: 3 g per 100 g of product; 'free from saturated fat' claim: 0.1 g per 100 g of product; 'low saturated fat' claim: 1.5 g per 100 g of product)*

### Table 3. Sources of fat in plant-based meat and egg products

| Category | Major fat sources (as identified from the list of ingredients) |
|---|---|
| **Plant-based meat products** | |
| **Kebabs/Tikka** | Coconut oil, refined sunflower oil, cocoa butter, fat flakes, cashew nut paste, hydrogenated vegetable fat (coconut), vegetable fat soybean oil, coconut oil, hydrogenated vegetable fat |
| **Keema/Mince** | Rapeseed oil, coconut oil, cocoa butter, refined canola oil, rice bran oil, refined soybean oil, cocoa butter, fat flakes, refined sunflower oil, cocoa butter |
| **Burger patties** | Canola oil, refined coconut oil, cocoa butter, refined sunflower oil, fat flakes, olive oil, refined rapeseed oil, refined palm oil, refined sunflower oil, hydrogenated vegetable fat (coconut), cashew nuts, vegetable fat, rice bran oil, soybean oil |
| **Nuggets** | Refined sunflower oil, refined palm oil, refined rapeseed oil, refined palm oil, hydrogenated vegetable fat (coconut), rice bran oil, vegetable fat, soybean oil, interesterified vegetable fat |

| | |
|---|---|
| **Sausage** | Cocoa butter, rapeseed oil, coconut oil, hydrogenated coconut and palm, fennel oil, ginger oil, vegetable fat, refined sunflower oil, refined soybean oil, hydrogenated vegetable fat (coconut), cashew nuts |
| **Momos** | Refined palm oil, interesterified vegetable fat, refined sunflower oil, sesame oil |
| **Samosa** | Refined sunflower oil, cashew nut |
| **Chunks** | Rice bran oil, refined sunflower oil, vegetable oil, cashew |
| **Curry** | Rice bran oil, refined sunflower oil, refined mustard oil, cashew, canola oil, soybean oil |
| **Biryani** | Rice bran oil, natural kewra oil, sunflower oil, cashew nut paste, cocoa butter |
| **Chicken fingers** | Sunflower oil, vegetable fat, rice bran oil, refined palm oil, interesterified vegetable fat, refined sunflower oil |
| **Plant-based egg products** | |
| ***Bhurji*** | Edible vegetable oil, refined soybean oil |
| **Egg powder** | Fat source is not mentioned |
| **Omelette pre-mix** | Fat source is not mentioned |
| **Scrambled egg pre-mix** | Refined soybean oil |

## 3.2.5. Fatty acid composition

Dietary fats and fatty acids play a major role in immunity building, vitamin absorption, and providing flavour to food.[53] High amounts of saturated fatty acids (SFA) and *trans* fats have been predicted to cause various health implications, such as increased risk of cardiovascular disease, allergies, diabetes, obesity, and nervous system disorders.[54] The fatty acid profiles of plant-based meat and egg products estimated in this study are presented in Figs. 8 [a & b] and Table S3 [I-IX] (Appendix). The content of individual fatty acids is assessed against the conditions put forth by FSSAI for claims such as *'high in monounsaturated fatty acids, polyunsaturated fatty acids, or omega-3 fatty acids'* and *'source of omega-3 fatty acids'* (Table S1; Appendix). The daily intake values for fatty acids recommended by the ICMR-NIN[31] and FAO[29] have also been considered as references for the assessment.

Indian plant-based meat products are predominated by vegetable oils such as sunflower oil (1), palm oil (0.27), soybean oil (0.27), and coconut oil (0.25) (mentioned in descending order of prevalence indicated within parenthesis; calculated based on a word cloud analysis of the sources of fat mentioned in the list of ingredients; data not shown). Both sunflower oil and soybean oil are primarily composed of unsaturated fatty acids, specifically linoleic acid (C18:2), a polyunsaturated omega-6 fatty acid. Coconut oil is high in saturated fats (medium-chain triglycerides or MCTs). Palm oil, with a higher proportion of long-chain saturated and unsaturated fatty acids, has a more balanced fatty acid composition than coconut oil.

FSSAI's conditions for claims related to MUFA, PUFA, and omega-3 fatty acids are listed in Table S1 (Appendix). Of the three plant-based keema products examined, monounsaturated fat (51.7%) accounts for more than 45% of the total fatty acids. More than 45% of the total fatty acids in the tested products, including two out of the three plant-based kebabs, are derived from polyunsaturated fat (55.18% and 54.71%; fat sources: refined sunflower oil and refined canola oil, respectively), one out of the four patties (54.8%; fat source: refined sunflower oil), one out of the three sausages (48.79%; fat source: refined sunflower oil), and the plant-based scrambled egg pre-mix (46.2%). This corroborates with the fatty acid composition of their respective fat source in the list of ingredients. However, the energy provided by the monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) contents of these products does not exceed 20% of the energy derived from the product, because of which they do not qualify to be claimed as sources of MUFA and PUFA. The tested plant-based egg powder and scrambled egg products fulfil the requirement to claim being a *'source'* of omega-3 fatty acids. But the plant-based meat products need improvement to fulfil the nutrient content claims on MUFA, PUFA (specifically, the energy derived from MUFA and PUFA), and omega-3 fatty acids.

The FAO recommends a lower minimum fat intake for countries like India, Oman, and South Korea (15%E, where E is the total energy intake per day = 2000 kcal). Considering the lower value of 15%E of total fat in India, the range for total fats becomes ~33-78 g per day. Considering only the Acceptable Macronutrient Distribution Ranges (AMDR) levels into account (Table S4; Appendix), the values for fatty acid content in all plant-based meat and egg products are well within the recommended ranges. Regardless of the format, the *trans* fatty acid content is less than 0.1 g/100 g in all the products. The RDA for MUFAs, calculated by difference, can be approximated to a range of ~3-13%E, or 6.67-28.89 g/day. For n-6 PUFAs, mainly derived from linoleic acid, the values across all products are well within the recommended dietary intake range. n-3 PUFAs, derived from α-linolenic acid, plant-based meat products show lower values in the range of 0.01-0.1 g/100 g. Whereas, plant-based egg products show higher values closer to the recommended values of n-3 PUFAs (Table S3 [IX]; Appendix). The presence of n-3 and n-6 PUFAs has been linked to various health benefits, such as decreasing the risk of cardiovascular disease and improving immunity.[55]

Among the kebabs, a product with coconut oil as the major fat source has the highest SFA content (12.75 g/100 g), whereas the other two products with refined sunflower oil and canola oil as sources of fat show higher MUFA (mainly oleic acid) and PUFA (mainly C18:2 linoleic acid) content. Canola oil is rich in oleic acid (C18:1).[56] The burger patty products with coconut oil as the fat source exhibit relatively higher levels of saturated fatty acids (7.12-8.4 g/100 g), mainly lauric acid (C12:0) and stearic acid (C18:0) compared to other products containing sunflower oil and soybean oil (0.84 g/100 g & 3.26 g/100 g) (Table S3 [III]; Appendix). This is expected as more than 50% of fat in coconut oil is lauric acid.[57] On the other hand, burger patty products containing sunflower oil and a combination of sunflower oil and soybean oil show higher amounts of MUFAs and PUFAs, specifically linoleic acid (C18:2) (2 g/100 g and 3.75 g/100 g, respectively).

The plant-based nugget product with rice bran oil as the fat source shows almost equal levels of MUFAs and PUFAs, particularly oleic and linoleic acid (Table S3 [IV]; Appendix), and this characteristic of rice bran oil is corroborated by literature.[56] A similar MUFA and PUFA profile is also observed with both the plant-based chunks products tested, which use soybean oil and rice bran oil as their fat sources. The plant-based chunks product is the only sample out of all those analysed, which contains soybean oil, a source of oleic, linoleic, and smaller levels of α-linolenic acid (C18:3n3).[58] Another nugget product that contains a blend of fat sources, such as palm oil, sunflower oil, and interesterified vegetable fat, appears to exhibit higher levels of palmitic (C16:0) (4.76 g/100 g) and oleic acid (4.38 g/100 g). Although this product shows higher SFA levels compared to other nugget products, it also shows MUFA and PUFA levels higher than most products within other formats. Two of the three plant-based sausage products having a combination of vegetable fat and sunflower oil contain comparatively higher levels of lauric acid. Whereas, a third sausage product that uses only sunflower oil as the fat source shows higher levels of linoleic acid and lauric acid is below detectable levels (BDL).

Both plant-based momos samples having palm (palm olein) oil and a blend of sunflower oil, palm oil, and sesame oil, respectively, are higher in saturated fatty acids, while the plant-based samosa sample shows a balanced composition of SFA, MUFA, and PUFA. However, the list of ingredients of this samosa product does not indicate a specific fat source. Among the different formats, kebab, nuggets, and burger patties have the highest average PUFA content. Sausage, burger patties, and nuggets contain the highest average SFA content. The highest average MUFA is observed in nuggets, chunks, and kebabs. The nuggets category appears to have a relatively more balanced fatty acid profile compared to other product formats.

While many studies have found that plant-based meat products are healthier than animal meat, owing to the presence of decreased amounts of saturated fats and *trans* fats,[25,59] scope for improvement exists with respect to achieving a PUFA-rich fatty acid profile. The use of sunflower oil, soybean oil, rice bran oil, and canola oil as fat sources for plant-based meat products would help increase MUFA and PUFA content, conferring health benefits to the consumers.

Blending multiple oils, such as coconut oil (high in SFA) and canola oil (high in PUFA), could lead to a more balanced fatty acid profile, which may provide health benefits compared to using a single fat source in addition to shelf stability.[60-61] Oleogels, which are fat sources consisting of oils in a solid-like gel network, can be used as a healthier substitute for solid fats such as hydrogenated vegetable fat (high in SFA and *trans* fats).[62] Novel sources of omega-3 fatty acids, such as algal oils could be researched for use in these products to enhance the preference among health-conscious consumers.[54]

Plant-based egg products across various formats, such as *bhurji*, powder, omelette, and scrambled egg, show relatively similar fatty acid profiles, with the exception of high amounts of linoleic acid in the scrambled egg product. It is possible that the chickpea powder, used as the protein source, contributes to the linoleic acid which is the predominant PUFA in chickpea powder.[63-64]

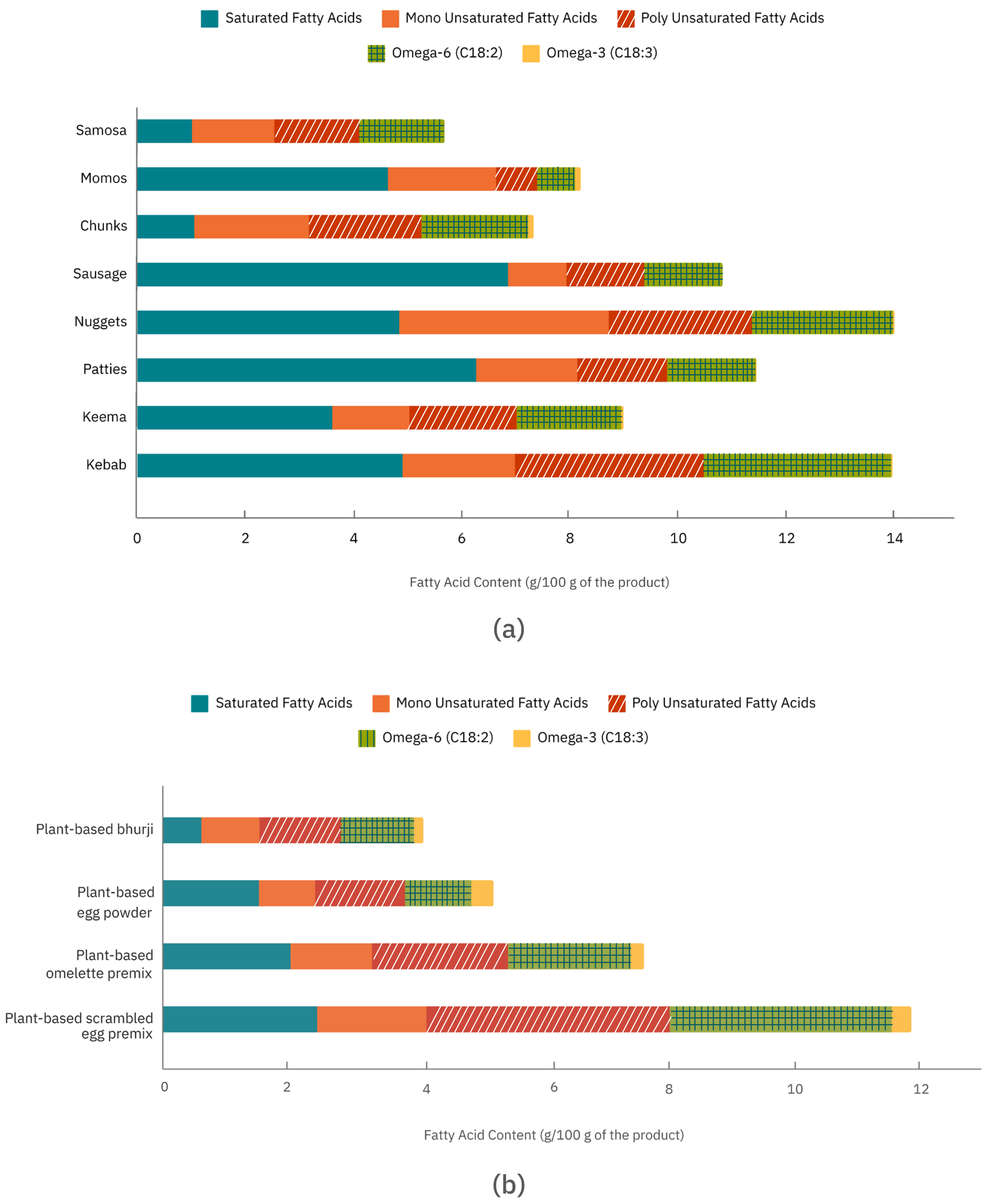
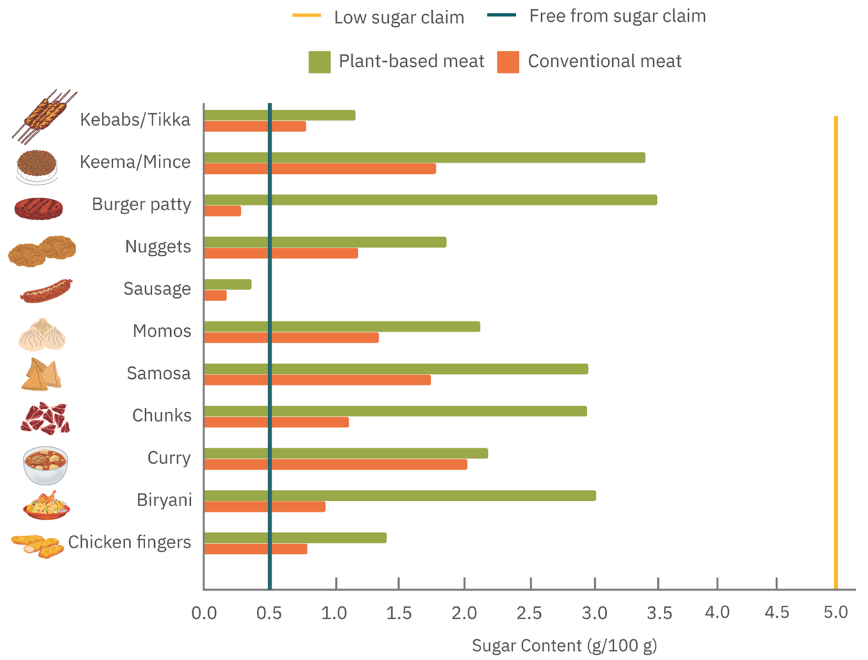


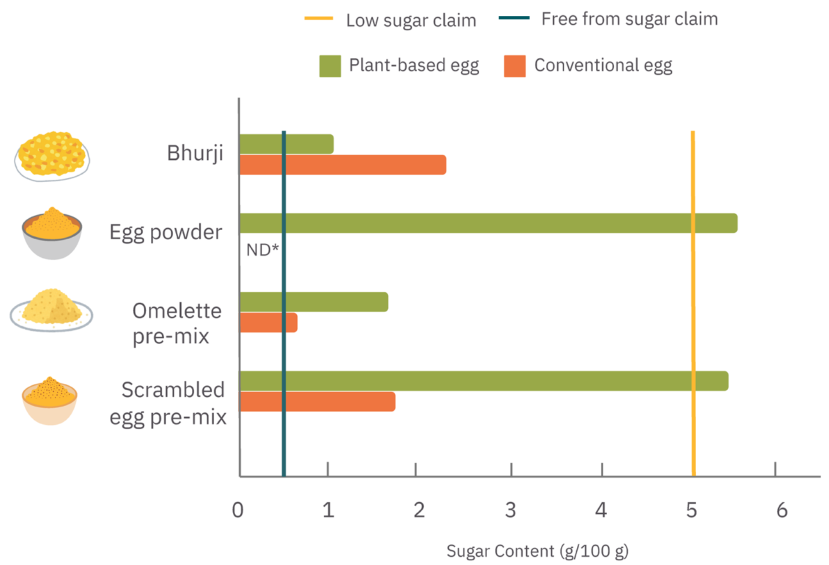

*Figure 8. Fatty acid composition per 100 g of (a) plant-based meat products; (b) plant-based egg products*

## 3.2.6. Sugar

Generally, the average sugar content of both plant-based and conventional meat products is well within the *'low sugar'* threshold specified by FSSAI (less than 5 g per 100g) (Fig. 9[a]). Besides, the average sugar content of both plant-based and conventional sausage categories is below 0.5 g/100 g, which is the limit for the *'free from sugar'* claim defined by FSSAI.[27] However, plant-based meat products contain a higher sugar content (~2-fold) than conventional meat. With plant-based egg products, the scenario is different with the average sugar content below FSSAI's low sugar threshold in *bhurji* and omelette but more than 5 g/100 g in powder and scrambled egg formats (Fig. 9[b]; Table 1[b]). The total sugar content of none of the plant-based and conventional egg products falls below the limit specified for the *'free from sugar'* claim declared by FSSAI[27] (Table S1; Appendix). The FDA specifies that food products can be claimed as *'not a significant source of sugars'* or *'sugar-free'* if they contain less than 0.5 g of sugars per serving. Also, products can be considered to have *'less or reduced sugar'* if they contain at least 25% less sugar per RACC than an appropriate reference food (or, for meals and main dishes, at least 25% less sugar per 100 g).[28]




(a)




ND*: Data not available

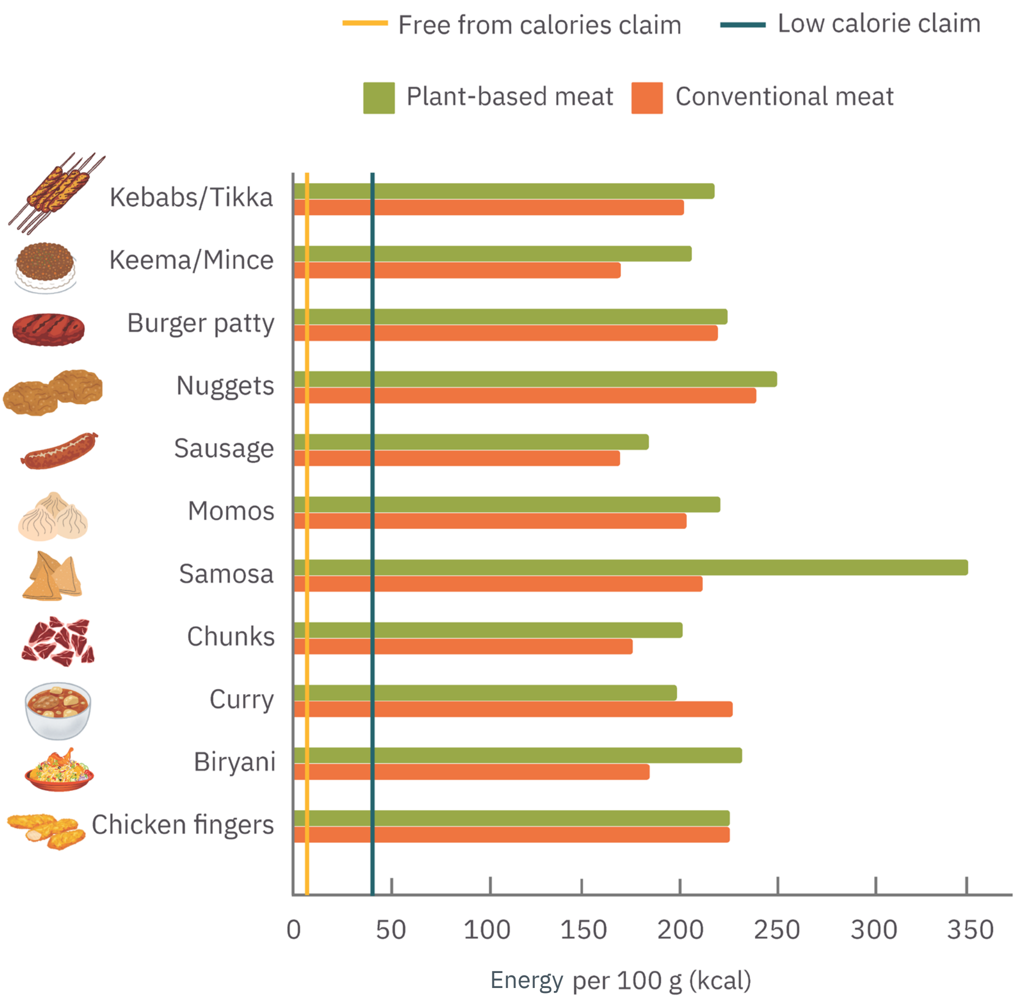
(b)

*Figure 9. Comparison of total sugar content per 100 g: (a) Plant-based meat versus conventional meat products; (b) Plant-based egg versus conventional egg products (Requirement for 'free from sugar' claim: 0.5 g/100 g; 'low sugar' claim: 5 g/100 g)*

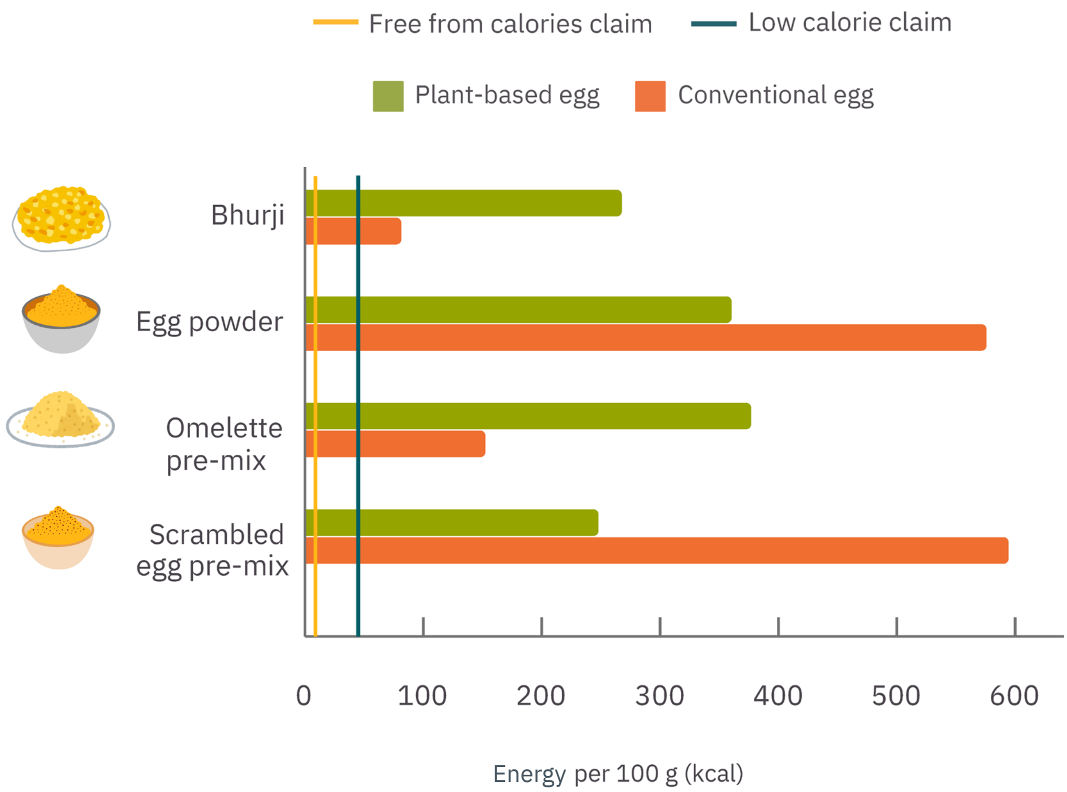
### 3.2.7. Energy

The energy in calories provided by different formats of plant-based meat and egg products (per 100 g) range between 169-349 kcal and 249-378 kcal, respectively. Based on the 11 formats of plant-based meat products considered for the comparative assessment, the energy values did not present a significant difference ($P$-value > 0.05; $P$ = 0.106) compared to the corresponding animal-derived products. 5 of the 11 categories provide similar or fewer calories per 100 g relative to their conventional meat counterparts (Fig. 10[a]). The differences are mostly modest, except for samosa, which can be correlated with its fat content. While plant-based egg powder and scrambled egg pre-mix provide fewer calories (by 37.4% and 58.2%, respectively), plant-based *bhurji* and omelette pre-mix provide 2.5-3.3 fold more calories than conventional egg products (Fig. 10[b]). The latter can be attributed to the higher protein content of the plant-based formats that contribute 4 kcal of energy per gram. According to FSSAI, foods containing not more than 40 kcal per 100 g and 4 kcal per 100 g can be considered *'low in energy or calories'* and *'calorie free'*, respectively (Table S1)[27]. The FDA regulatory requirements for energy-related claims are as follows: (1) free from calories: Less than 5 calories per labelled serving; (2) low in calories: 40 calories or less per RACC; (3) reduced/less: at least 25% fewer calories per RACC than an appropriate reference food (for meals and main dishes, at least 25% fewer calories per 100 g).[28] Therefore, both the plant-based and conventional meat and egg products do not meet the above requirements for energy-related nutritional claims.

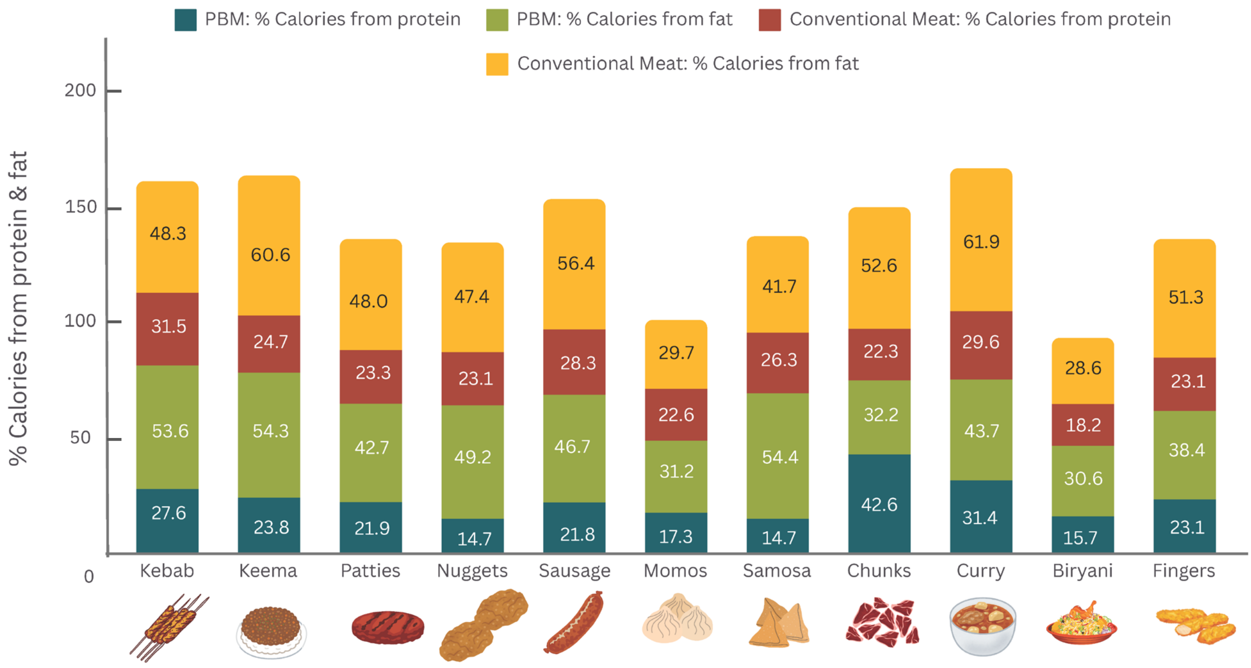
Dietary guidelines typically characterise nutritional protein sources not just in terms of weight-based protein content but also in terms of the proportion of protein-containing calories in a product (as opposed to other macronutrients like fat or carbohydrates).[25] In this context, most of the plant-based meat product formats are comparable to conventional meat. Indeed, the chunk and curry formats are better than their traditional counterparts, with 42.6% and 31.4% of energy derived from their protein content, against 22.3% and 29.6% in the case of animal-derived products. These values are comparable with the recommended share of calories from protein sources (29%) specified in the reference diet of EAT-Lancet.[4] While the protein content of plant-based egg products contributes to 22-44% of the calories provided, conventional egg products contribute relatively less to their total energy value (18-32%). All the plant-based egg formats except the scrambled egg pre-mix derive more than 29% of calories from protein. 6 out of 11 plant-based meat formats and all the plant-based egg formats derive fewer calories from fat than the corresponding conventional meat product formats (Figs. 10[c & d]).


Free from calories claim
Low calorie claim
Plant-based meat
Conventional meat
Kebabs/Tikka
Keema/Mince
Burger patty
Nuggets
Sausage
Momos
Samosa
Chunks
Curry
Biryani
Chicken fingers
0
50
100
150
200
250
300
350
Energy per 100 g (kcal)

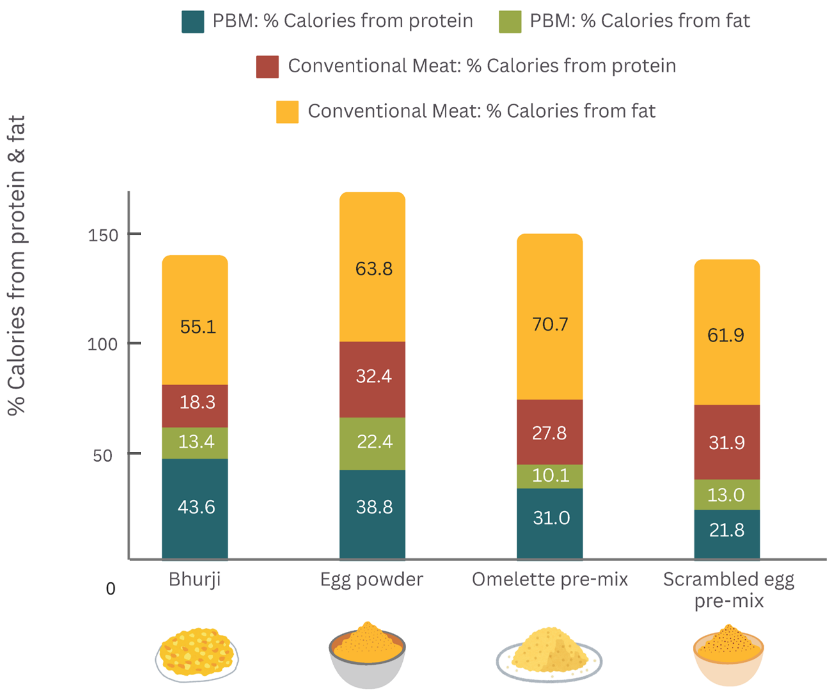
(a)


Free from calories claim
Low calorie claim
Plant-based egg
Conventional egg
Bhurji
Egg powder
Omelette pre-mix
Scrambled egg pre-mix
0
100
200
300
400
500
600
Energy per 100 g (kcal)

(b)




(c)




(d)

*Figure 10. (a) Comparison of average energy (in calories) provided by 100 g of plant-based meat versus conventional meat products; (b) Comparison of average energy (in calories) provided by 100 g of plant-based egg versus conventional egg products; (Requirement for 'free from calories' claim: 4 kcal/100 g; 'low calorie' claim: 40 kcal/100 g) Share of calories derived from protein and fat sources of (c) plant-based meat versus conventional meat products; (d) plant-based egg versus conventional egg products*

### 3.2.8. Sodium

Common salt or sodium chloride (NaCl) is the major source of sodium in a daily diet. High salt content is a common apprehension associated with any processed food product. Generally, high salt intake is associated with high blood pressure, hypertension, and related heart ailments and strokes. Excessive salt intake can also increase the risk of stomach cancer. Despite its disadvantages, consumption of sodium at optimal levels is essential for water and fluid balance and electrolyte equilibrium. Further, sodium plays a vital role in nerve conduction. According to the Indian food intake data, the average salt consumption ranges from 3 g to 10 g per day with more than 45% of the population consuming more than 5 g/day. This is more than the recommended sodium intake of 2300 mg per day, suggested by the WHO and the ICMR-National Institute of Nutrition in the Dietary Guidelines for Indians (2024),[31] which translates to about 5000 mg or 5 g of common salt per day. A major proportion of sodium in foods is derived from added salt, either through cooking or processing.[31]

The average sodium content is either similar or higher in most plant-based meat products compared to conventional meat (Fig. 11[a]), with significant variation existing across formats and even within certain product formats (especially plant-based momos and curry). Plant-based sausages have a lower sodium content than meat sausages. 3 out of 4 plant-based egg product formats contain higher sodium content than the conventional egg counterparts (Fig. 11[b]). The plant-based scrambled egg pre-mix contains lower sodium content than its conventional counterpart (Table 1[b]). Significant variation in the sodium levels is observed between the products within the plant-based *bhurji* and egg powder formats. The higher sodium content (> 1000 mg) of certain plant-based egg product formats may be attributed to the fact that these are pre-mixes that include ingredients such as garlic powder and onion powder, which might also contain sodium apart from iodised salt or black salt. However, these plant-based meat and egg products often replace processed conventional meats and egg products, which are high in sodium. Therefore, plant-based products have already been seasoned at the point of sale, which is not the case with conventional unprepared/unprocessed meat. Hence, the difference would be reduced vividly after meal preparation.[65]

Further, plant proteins are mostly extracted using salt solutions or alkaline solutions (sodium hydroxide or NaOH),[66] due to which the extracted protein might contain a certain amount of sodium. Incorporation of sodium chloride is known to improve the process of extracting protein.[67] Consequently, the sodium ions can bind to the protein molecules during extraction. Besides, sodium chloride can form during the neutralisation step of the alkaline extraction process, wherein the protein solution is often neutralised using hydrochloric acid (HCl) to bring the pH down to ~7. When sodium hydroxide (NaOH) and HCl are combined during the neutralisation step, they react to form sodium chloride (NaCl) and water ($H_2O$):

$$NaOH + HCl \rightarrow NaCl + H_2O$$

The final concentration of sodium in the plant proteins would depend on the concentration of NaCl used during the extraction process and the purification steps applied to remove salts. Therefore, the plant protein ingredients can also contribute to the sodium content of the end product.

The FSSAI's conditions for claims related to sodium *('free from sodium', 'very low in sodium', or 'low in sodium')*[27] are specified in Table S1. According to the FDA regulatory requirements for nutrient content claims, a food product with a sodium content less than 5 mg per labelled serving, 140 mg per 100 g, or 35 mg per 100g can be claimed as *'free from sodium', 'low in sodium', or 'very low in sodium',* respectively.[28] Both the plant-based and conventional meat and egg products do not comply with the above Indian and FDA regulatory requirements. Though the plant-based meat and egg products fulfil the FDA's *'healthy product'* claim with respect to their protein and dietary fibre content, the same does not hold true with reference to their sodium content. Therefore, there exists a high potential for future work leading to reduced sodium content in plant-based meat and egg products. Recent research has been focusing on reducing sodium levels in plant-based meat analogues by using taste modulators such as yeast extract or other flavourings that do not contain high sodium.[68]

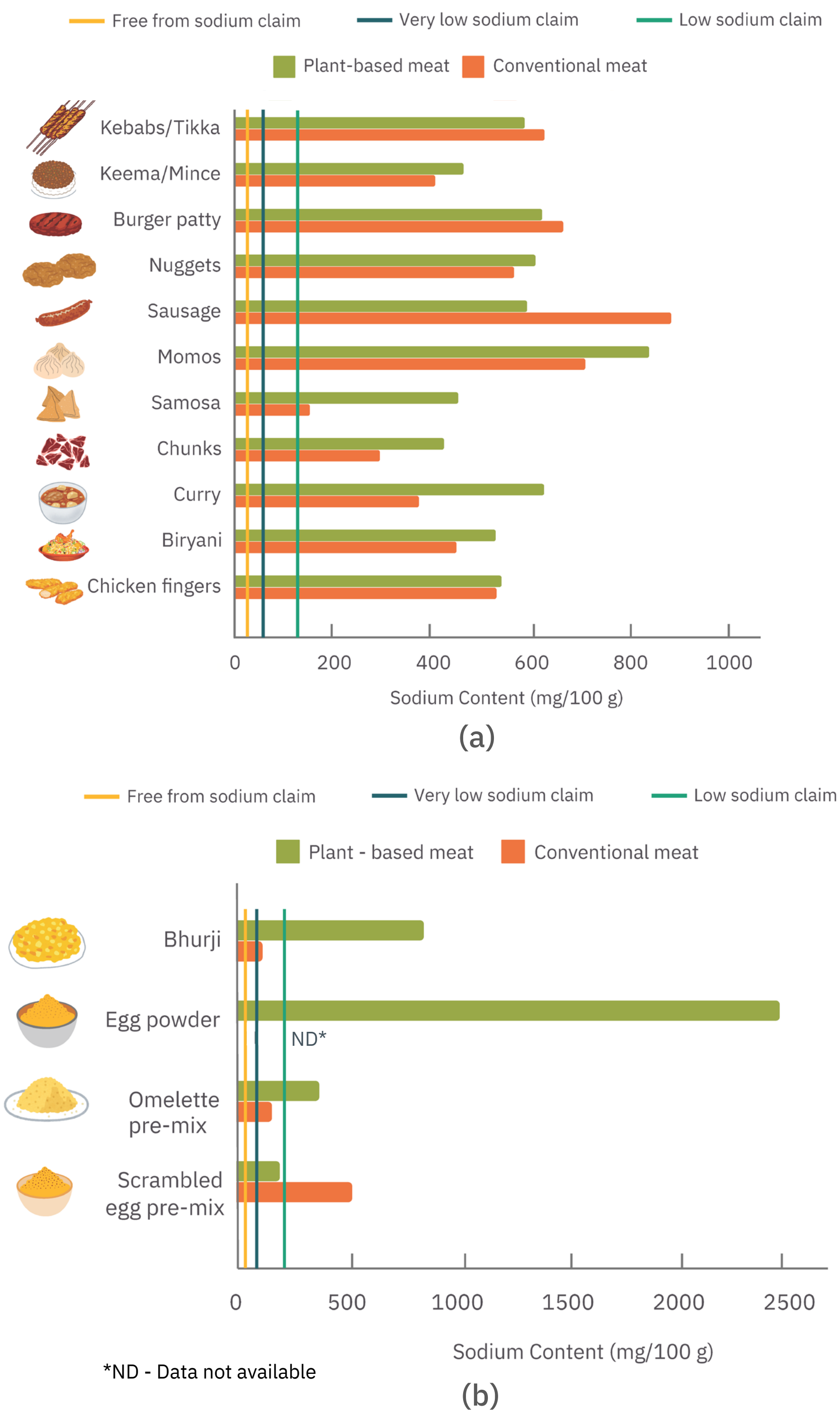



*Figure 11. Comparison of average sodium content: (a) plant-based meat versus conventional meat products; (b) plant-based egg versus conventional egg products (Requirement for 'free from sodium' claim: 0.005 g/100 g; 'very low sodium' claim: 0.04 g/100 g ; 'low sodium claim': 0.12 g/100 g)*

## 3.2.9. Micronutrients

Micronutrient content is one of the areas that demands the plant-based sector's attention. The plant-based meat and egg products could be potential delivery vehicles for maximising the benefits of micronutrients to the consumers. As the plant-based sector continues to evolve in India and as consumers increasingly adopt these products, plant-based meat has the potential to address some important nutritional needs that whole plant sources might not be able to fulfil due to the presence of antinutrients. Currently, either the information related to micronutrients is scarce or the variance in their content is high in plant-based meat products.

## Plant-based meat products

Iron is one of the key micronutrients for a plant-based diet, ensuring the production of haemoglobin and myoglobin for optimal vascular and metabolic function.[69] Heme iron, easily absorbed by the body and available only through the consumption of animal meat, is not consumed by vegetarian and vegan consumers. Plant-based foods are sources of non-heme iron, which is less readily absorbed; hence, vegetarians and vegans have a 1.8-fold higher RDA of iron compared to meat consumers.[70] One product each from the plant-based meat chunks and curry categories shows considerable levels of iron (Table 4[a]), with one serving accounting for 60.9% (adult male)/39.9% (adult female) and 51.6%/33.8% of the RDA for iron,[71] respectively.

Vitamin A levels are also noteworthy in plant-based products, particularly kebabs in the Indian market. These products deliver between 34.08 and 289.73 µg/100 g, significantly higher than their conventional counterparts, which often contain undetectable levels of this essential nutrient (Table 4[b]). Given that the RDA for vitamin A is 1000 µg/day for men and 840 µg/day for women, these products can make a meaningful contribution to daily needs. Consuming vitamin C-rich foods is known to help iron absorption from plant sources, whereas foods rich in calcium can prevent iron absorption when eaten together.[72] Plant-based sausages contribute 4.4% of the RDA for vitamin C per serving. Similarly, plant-based patties and kebabs contribute 2.4% and 4.5% of the RDA for vitamin C per serving, respectively. Vitamin B12, or cobalamin, is mainly obtained from animal sources such as fish, chicken, and other meat but can also be derived from some plant sources such as lentils, pulses, and legumes in trace quantities.[72] Two plant-based sausage products contain reasonable levels of vitamin B12, contributing to 34.1% of the RDA per serving. Many vegetarians and vegans are found to be deficient in vitamin B12, but plant-based meat and egg products provide an opportunity for consumers to receive recommended amounts of this vitamin.

A single serving of plant-based patties, chunks, curry, and sausages provides 8.6%, 8.75%, 12%, and 30.3% of the RDA for calcium, respectively. The calcium content of plant-based kebabs is observed to vary between the products, and their contribution to the RDA for calcium per serving ranges between 13.9-83.7%. The data shows that many of the plant-based meat and egg products are lacking certain micronutrients. Nevertheless, adopting strategies such as biofortification in the upstream stages of the plant-based value chain (say, crop development and cultivation) can improve the content and bioavailability of nutrients in food crops.[73] Further, processing-based ingredient optimisation approaches such as sprouting, enzymatic treatment, and controlled fermentation under standardised conditions can enhance micronutrient levels in the different plant-based ingredients used in these products. Adding nutrients (vitamins or minerals) in quantities not exceeding one Recommended Dietary Allowance of the respective micronutrients as per the regulatory guidelines could also be a plausible approach.[74]

## Plant-based egg products

Each serving of the plant-based egg *bhurji* products contributes to 17.6-27%, 5.7%, and 5.9% of the RDA for iron, vitamin C, and calcium, respectively. The plant-based omelette product provides 6.5%, 6.6%, and 39.9% of the RDA for vitamin A, vitamin C, and calcium, correspondingly. Since the label of this product does not mention fortification, it may be assumed that the blend of multiple plant protein sources such as mung bean, chickpea, soy, and pea contributed to the distribution of micronutrients in the final product. The plant-based egg powder product contributes to 15% of the RDA for calcium and 4% of the RDA for potassium, likely obtained from the mung bean protein, which is rich in both minerals.[75]

**Table 4. Micronutrient content of plant-based meat & egg products *versus* conventional meat & egg products**

(a) Plant-based meat & egg products

| Micronutrients | Patties | Chunks | Curry | | Kebab/Tikka | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Product-1 | Product-2 | Product -1 | Product-2 | Product-3 | Product-4 |
| Iron (mg) | 3.2 | 18.52 | 15.7 | 9.43 | 4.84 | 5.42 | 4.01 | 5.36 |
| Vitamin B12 (mcg) | * | * | * | * | * | * | * | * |
| Vitamin A (mcg) | BDL (DL-15) | * | * | * | 289.73 | 34.08 | BDL (DL-15) | - |
| Vitamin C (mg) | 2.78 | * | * | * | 2.03 | 2.11 | 2.73 | 3.18 |
| Vitamin D (mg) | * | | * | * | * | * | * | * |
| Potassium (mg) | * | 96.14 | 295 | * | * | * | * | * |
| Calcium (mg) | 138.21 | 192.74 | * | 109.32 | 837.38 | 261.23 | 92.48 | 122.3 |

| Micronutrients | Sausage | | | | | *Bhurji* | | Egg powder |
|---|---|---|---|---|---|---|---|---|
| | Product-1 | Product-2 | Product-3 | Product-4 | Product-5 | Product-1 | Product-2 | |
| Iron (mg) | 4.98 | 3.43 | 4.98 | - | - | 6.48 | 13.4 | * |
| Vitamin B12 (mcg) | * | * | * | 0.75 | 0.75 | * | * | * |
| Vitamin A (mcg) | BDL (DL-15) | BDL (DL-15) | BDL (DL-15) | - | - | 0 | * | * |
| Vitamin C (mg) | 2.96 | 3.59 | 2.96 | * | * | 4.16 | * | * |
| Vitamin D (mg) | * | * | * | * | * | * | * | * |
| Potassium (mg) | * | * | * | * | * | * | * | 1000 |
| Calcium (mg) | 315.63 | 296.06 | 315.63 | * | * | 59.43 | * | 1000 |

(b) Conventional meat products

| Micronutrients | Patties | | Chicken fingers | Sausage | Nuggets | Curry | Kebab/Tikka | |
|---|---|---|---|---|---|---|---|---|
| | Product-1 | Product-2 | | | | | Product-1 | Product-2 |
| Iron (mg) | 4.35 | 1.2 | 1.36 | 1.08 | 1.07 | 6.27 | * | 3.25 |
| Vitamin B12 (mcg) | * | * | * | * | * | * | * | * |
| Potassium (mg) | * | * | * | * | * | * | * | * |
| Calcium (mg) | 34.2 | 56 | 54.29 | 43.8 | 28.96 | 144 | 144 | 38.31 |
| Vitamin A (mg) | 0.0284 | 0 | 0 | 0 | 0 | 0 | Not detected; DL: 0.5 | 0 |
| Vitamin C (mg) | - | 3.2 | 3.21 | 0 | 6.21 | 1.17 | 60.62 | 0 |

(c) Conventional egg products

| Micronutrients | Whole egg powder | | | *Bhurji* |
|---|---|---|---|---|
| | Product-1 | Product-2 | Product-3 | |
| Iron (mg) | * | * | * | 5.51 |
| Choline (mg) | 1007 | 1007 | 8.4 | * |
| Vitamin B12 (mcg) | 3.9 | 3 | 0.5 | * |
| Potassium (mg) | * | * | * | 601 |
| Vitamin D2 (IU) | * | * | * | 37 |
| Calcium (mg) | 231 | 231 | 89 | 35 |

* Data not available

# 4. Conclusions and recommendations to the plant-based smart protein industry

The findings of this study show that the plant-based meat and egg products available in the Indian market offer consumers an option to switch from conventional meat to healthier plant-based diets. By providing comparable or higher protein content and higher dietary fibre content than animal-derived products, plant-based meat and egg products are effective solutions for those intending to change or improve their diets. The Indian plant-based smart protein sector can work towards improving their communication and marketing strategies to convey the nutritional advantages and claims of products to consumers, in line with FSSAI's Labelling and Display Regulations. Besides, the plant-based industry should continue to improve the micronutrient content and reduce the levels of saturated fat and sodium in their end products through ingredient diversification, extraction, functionalisation, and product reformulation efforts.

The ingredient diversification and functionalisation endeavours could focus on

1. biofortification approaches to improve nutritional traits of crop sources;
2. identifying unconventional sources of plant protein with better amino acid composition;
3. exploring dry fractionation and green technologies for the extraction of plant proteins;
4. arriving at an optimal combination of plant protein blends;
5. optimising plant-based ingredients by pre-treatments such as soaking, germination, and controlled fermentation and
6. formulating novel plant-based fat ingredients with superior fatty acid profiles.

Efforts to reformulate products should be rooted in scientific evidence rather than trial-and-error approaches. This includes strategies to reduce saturated fat and sodium levels while maintaining sensory appeal. Such advancements can pave the way for a new generation of healthier, plant-based meat and egg products that meet consumer demands for both taste and nutrition. Looking ahead, future research in this line could focus on evaluating the digestibility, bioavailability, and bioaccessibility of proteins and micronutrients from plant-based meat and egg products. Such insights will ensure the industry continues to meet and exceed consumer expectations, driving the growth of India's smart protein sector.

# References

01. Aune, D., Keum, N., Giovannucci, E., Fadnes, L. T., Boffetta, P., Greenwood, D. C., Tonstad, S., Vatten, L. J., Riboli, E., & Norat, T. (2016). Whole grain consumption and risk of cardiovascular disease, cancer, and all cause and cause specific mortality: Systematic review and dose-response meta-analysis of prospective studies. BMJ, i2716. https://doi.org/10.1136/bmj.i2716.

02. English, L. K., Ard, J. D., Bailey, R. L., Bates, M., Bazzano, L. A., Boushey, C. J., Brown, C., Butera, G., Callahan, E. H., de Jesus, J., Mattes, R. D., Mayer-Davis, E. J., Novotny, R., Obbagy, J. E., Rahavi, E. B., Sabate, J., Snetselaar, L. G., Stoody, E. E., Van Horn, L. V., ... Heymsfield, S. B. (2021). Evaluation of dietary patterns and all-cause mortality. JAMA Network Open, 4(8). https://doi.org/10.1001/jamanetworkopen.2021.22277.

03. Zargarzadeh, N., Mousavi, S. M., Santos, H. O., Aune, D., Hasani-Ranjbar, S., Larijani, B., & Esmaillzadeh, A. (2023). Legume consumption and risk of all-cause and cause-specific mortality: A systematic review and dose–response meta-analysis of prospective studies. Advances in Nutrition, 14(1), 64–76. https://doi.org/10.1016/j.advnut.2022.10.009.

04. EAT-Lancet Commission. (2019). Food in the Anthropocene: The EAT-Lancet Commission on healthy diets from sustainable food systems. The Lancet. https://www.thelancet.com/commissions/EAT.

05. Registrar General & Census Commissioner, India (2014). Sample Registration System: Statistical report 2014. Ministry of Home Affairs, Government of India. Available from: https://censusindia.gov.in/. International Institute for Population Sciences (IIPS) & ICF (2021).

06. National Family Health Survey (NFHS-5), 2019-21: India fact sheet. Ministry of Health and Family Welfare, Government of India. Available from: https://dhsprogram.com/pubs/pdf/OF43/India_National_Fact_Sheet.pdf.

07. World Resources Institute (2019). Creating a sustainable food future: A menu of solutions to feed nearly 10 billion people by 2050. World Resources Institute. Available from: https://research.wri.org/sites/default/files/2019-07/WRR_Food_Full_Report_0.pdf.

08. UNDESA (2017). World Population Prospects: The 2017 Revision. United Nations, New York. Available from: https://population.un.org/wpp/Publications/Files/WPP2017_KeyFindings.pdf.

09. Alexandratos, N., & Bruinsma, J. (2012). World Agriculture towards 2030/2050: The 2012 Revision. Rome: FAO (Food and Agriculture Organization of the United Nations).

10. Sharma, M., Kishore, A., Roy, D., & Joshi, K. (2020). A comparison of the Indian diet with the EAT-lancet reference diet. BMC Public Health, 20(1). https://doi.org/10.1186/s12889-020-08951-8.
11. Steinfeld, H., Gerber, P.J., Wassenaar, T., Castel, V., Rosales, M., & De Haan, C. (2006). Livestock's Long Shadow: Environmental Issues and Options. FAO, Rome, Italy.
12. World Economic Forum (2019). 50% of all land in the world is used to produce food. Available from: https://www.weforum.org/agenda/2019/12/agriculture-habitable-land/.
13. Tongia, R. (2019). India's Biggest Challenge: The Future of Farming. Available from: https://www.theindiaforum.in/article/india-s-biggest-challenge-future-farming.
14. Søndergaard, N., Adrien Fernandes, J. F., Potent, J., Karl, K., Furtado, M., & Baethgen, W. (2023). A governance framework to manage the food-environment-livelihood trilemma of alternative proteins. One Earth, 6(7), 843–853. https://doi.org/10.1016/j.oneear.2023.06.008.
15. Clark, M., Springmann, M., Rayner, M., Scarborough, P., Hill, J., Tilman, D., Macdiarmid, J. I., Fanzo, J., Bandy, L., & Harrington, R. A. (2022). Estimating the environmental impacts of 57,000 food products. Proceedings of the National Academy of Sciences, 119(33). https://doi.org/10.1073/pnas.2120584119.
16. Rajyalakshmi, G., Bhardwaj, S. & Jaswal, M.B. (2024). Meat your match. Available from: https://gfi-india.org/wp-content/uploads/2024/09/Product-test-report-09.09.pdf.
17. Rajyalakshmi, G. (2023). Insights on awareness, trial, and purchase behavior - Plant-based meat and dairy, India. Available from: https://gfi-india.org/wp-content/uploads/2024/07/Insights-on-awareness-trial-and-purchase-behavior-FINAL.pdf.
18. Global Alliance for Improved Nutrition (GAIN) (2017). What constitutes a nutritious and safe food? Available from: https://www.gainhealth.org/sites/default/files/publications/documents/gain-nutritious-food-definition.pdf.
19. Drewnowski, A. (2005). Concept of a nutritious food: toward a nutrient density score. American Journal of Clinical Nutrition, 82(4), 721–732. https://doi.org/10.1093/ajcn/82.4.721.
20. Katz, D. L., Doughty, K., Njike, V., Treu, J. A., Reynolds, J., Walker, J., Katz, C. (2011). A cost comparison of more and less nutritious food choices in US supermarkets. Public Health Nutrition, 14(9), 1693–1699. https://doi.org/10.1017/s1368980011000048.
21. Alessandrini, R., Brown, M. K., Pombo-Rodrigues, S., Bhageerutty, S., He, F. J., & MacGregor, G. A. (2021). Nutritional quality of plant-based meat products

available in the UK: A Cross-sectional survey. Nutrients, 13(12), 4225. https://doi.org/10.3390/nu13124225.

22. Bryngelsson, S., Moshtaghian, H., Bianchi, M., & Hallström, E. (2022). Nutritional Assessment of Plant-Based Meat Analogues on the Swedish Market. International Journal of Food Sciences and Nutrition, 73 (7), 889–901. https://doi.org/10.1080/09637486.2022.2078286.
23. Coffey, A. A., Lillywhite, R., & Oyebode, O. (2023). Meat versus meat alternatives: Which is better for the Environment and Health? A nutritional and environmental analysis of animal-based products compared with their plant-based alternatives. Journal of Human Nutrition and Dietetics, 36(6), 2147–2156. https://doi.org/10.1111/jhn.13219.
24. Cutroneo, S., Angelino, D., Tedeschi, T., Pellegrini, N., & Martini, D. (2022b). Nutritional quality of meat analogues: Results from the food labelling of Italian Products (FLIP) project. Frontiers in Nutrition, 9. https://doi.org/10.3389/fnut.2022.852831.
25. GFI Europe (2023). Plant-based meat and health in Europe. Available from: https://gfieurope.org/plant-based-meat-and-health-in-europe/.
26. Locatelli, N. T., Chen, G. F., Batista, M. F., Furlan, J. M., Wagner, R., Bandoni, D. H., & de Rosso, V. V. (2024). Nutrition classification schemes for plant-based meat analogues: Drivers to assess nutritional quality and identity profile. Current Research in Food Science, 9, 100796. https://doi.org/10.1016/j.crfs.2024.100796.
27. FSSAI (2018; last updated in December 2022). Food Safety and Standards (Advertising and Claims) Regulations. Available from: https://www.fssai.gov.in/upload/uploadfiles/files/Compendium_Advertising_Claims_Regulations_14_12_2022.pdf
28. USFDA (2013). A Food Labeling Guide – Guidance for Industry. Available from: https://www.fda.gov/files/food/published/Food-Labeling-Guide-%28PDF%29.pdf
29. FAO (2011). Dietary protein quality evaluation in human nutrition. Available from: https://www.fao.org/ag/humannutrition/35978-02317b979a686a57aa4593304ffc17f06.pdf.
30. Gavin-Smith, B. (2020). Plant-based meats. Available from: https://sightandlife.org/resource-hub/blog/alternative-proteins-the-nutritionists-perspective.
31. Indian Council of Medical Research - National Institute of Nutrition (2024). Dietary guidelines. National Institute of Nutrition. Available from: https://www.nin.res.in/dietaryguidelines/pdfjs/locale/DGI07052024P.pdf.
32. FDA (2023). Daily value and percent daily value on the nutrition and supplement facts labels. Available from: https://www.fda.gov/media/135301/download.
33. Ahmad, M., Qureshi, S., Akbar, M. H., Siddiqui, S. A., Gani, A., Mushtaq, M., Hassan, I., & Dhull, S. B. (2022). Plant-based meat alternatives: Compositional analysis,

current development and challenges. Applied Food Research, 2(2), 100154. https://doi.org/10.1016/j.afres.2022.100154.

34. Pelzer, E., Bazot, M., Makowski, D., Corre-Hellou, G., Naudin, C., Al Rifaï, M., Baranger, E., Bedoussac, L., Biarnès, V., Boucheny, P., Carrouée, B., Dorvillez, D., Foissy, D., Gaillard, B., Guichard, L., Mansard, M.-C., Omon, B., Prieur, L., Yvergniaux, M., … Jeuffroy, M.-H. (2012). Pea–wheat intercrops in low-input conditions combine high economic performances and low environmental impacts. European Journal of Agronomy, 40, 39–53. https://doi.org/10.1016/j.eja.2012.01.010.
35. Mamine, F., & Farès, M. (2020). Barriers and levers to developing wheat–pea intercropping in Europe: A Review. Sustainability, 12(17), 6962. https://doi.org/10.3390/su12176962.
36. Timaeus, J., Weedon, O. D., & Finckh, M. R. (2022). Harnessing the potential of wheat-pea species mixtures: Evaluation of multifunctional performance and Wheat Diversity. Frontiers in Plant Science, 13. https://doi.org/10.3389/fpls.2022.846237.
37. Maningat, C. C., Jeradechachai, T., & Buttshaw, M. R. (2021). Textured wheat and pea proteins for meat alternative applications. Cereal Chemistry, 99(1), 37–66. https://doi.org/10.1002/cche.10503.
38. Fu, S., Ma, Y., Wang, Y., Sun, C., Chen, F., Cheng, K., & Liu, B. (2023). Contents and Correlations of Nε-(carboxymethyl)lysine, Nε-(carboxyethyl)lysine, Acrylamide and Nutrients in Plant-Based Meat Analogs. Foods, 12(10), 1967. https://doi.org/10.3390/foods12101967.
39. Mundi, S., & Aluko, R. (2012). Physicochemical and functional properties of kidney bean albumin and globulin protein fractions. Food Research International, 48(1), 299–306. https://doi.org/10.1016/j.foodres.2012.04.006.
40. De Marchi, M., Costa, A., Pozza, M., Goi, A., & Manuelian, C. L. (2021). Detailed characterization of plant-based burgers. Scientific Reports, 11(1). https://doi.org/10.1038/s41598-021-81684-9.
41. Banaszek, A., Townsend, J. R., Bender, D., Vantrease, W. C., Marshall, A. C., & Johnson, K. D. (2019). The effects of whey vs. Pea Protein on physical adaptations following 8-weeks of high-intensity functional training (HIFT): A pilot study. Sports, 7(1), 12. https://doi.org/10.3390/sports7010012.
42. Çabuk, B., Nosworthy, M. G., Stone, A. K., Korber, D. R., Tanaka, T., House, J. D., & Nickerson, M. T. (2018). Effect of fermentation on the protein digestibility and levels of non-nutritive compounds of pea protein concentrate. Food Technology and Biotechnology, 56(2). https://doi.org/10.17113/ftb.56.02.18.5450.
43. Gorissen, S. H., Crombag, J. J., Senden, J. M., Waterval, W. A., Bierau, J., Verdijk, L. B., & van Loon, L. J. (2018). Protein content and amino acid composition of commercially available plant-based protein isolates. Amino Acids, 50(12), 1685–1695. https://doi.org/10.1007/s00726-018-2640-5.

44. Liu, J., Klebach, M., Visser, M., & Hofman, Z. (2019). Amino acid availability of a dairy and vegetable protein blend compared to single casein, whey, soy, and pea proteins: A double-blind, cross-over trial. Nutrients, 11(11), 2613. https://doi.org/10.3390/nu11112613.
45. Wieser, H., Koehler, P., & Scherf, K. A. (2022). Chemistry of wheat gluten proteins: Qualitative composition. Cereal Chemistry, 100(1), 23–35. https://doi.org/10.1002/cche.10572.
46. Konsue, N., Bunyameen, N., & Donlao, N. (2023). Utilization of young jackfruit (Artocarpus heterophyllus lam.) as a plant-based food ingredient: Influence of maturity on chemical attributes and changes during in vitro digestion. LWT, 180, 114721. https://doi.org/10.1016/j.lwt.2023.114721.
47. Bressani, R. (1988). Protein Complementation of Foods. In: Springer eBooks, pp. 627–657. https://doi.org/10.1007/978-94-011-7030-7_23.
48. Veronese, N., Solmi, M., Caruso, M. G., Giannelli, G., Osella, A. R., Evangelou, E., Maggi, S., Fontana, L., Stubbs, B., & Tzoulaki, I. (2018). Dietary fiber and health outcomes: An Umbrella Review of systematic reviews and meta-analyses. The American Journal of Clinical Nutrition, 107(3), 436–444. https://doi.org/10.1093/ajcn/nqx082.
49. Kew, B., Holmes, M., Liamas, E., Ettelaie, R., Connell, S. D., Dini, D., & Sarkar, A. (2023). Transforming sustainable plant proteins into high performance lubricating microgels. *Nature Communications*, 14(1). https://doi.org/10.1038/s41467-023-40414-7.
50. Begom, R., & Singh, R. B. (1995). Prevalence of coronary artery disease and its risk factors in the urban population of South and North India. *Acta cardiologica*, 50(3), 227–240.
51. Singh, R. B., Ghosh, S., Niaz, A. M., Gupta, S., Bishnoi, I., Sharma, J. P., Agarwal, P., Rastogi, S. S., Beegum, R., & Chibo, H. (1995). Epidemiologic study of diet and coronary risk factors in relation to central obesity and insulin levels in rural and urban populations of north India. International Journal of Cardiology, 47(3), 245–255. https://doi.org/10.1016/0167-5273(94)02186-m.
52. Crimarco, A., Springfield, S., Petlura, C., Streaty, T., Cunanan, K., Lee, J., Fielding-Singh, P., Carter, M. M., Topf, M. A., Wastyk, H. C., Sonnenburg, E. D., Sonnenburg, J. L., & Gardner, C. D. (2020). A randomized crossover trial on the effect of plant-based compared with animal-based meat on trimethylamine-N-oxide and cardiovascular disease risk factors in generally healthy adults: Study with Appetizing Plant Food-Meat Eating Alternative Trial (SWAP-MEAT). The American Journal of Clinical Nutrition, 112(5), 1188–1199. https://doi.org/10.1093/ajcn/nqaa203.
53. National Research Council (US) Committee on Diet and Health (1989). Diet and

Health: Implications for Reducing Chronic Disease Risk. In: Fats and other lipids, National Academies Press (US), Washington (DC).
54. Munialo, C. D., & Vriesekoop, F. (2023). Plant-based foods as meat and fat substitutes. Food Science & Nutrition, 11(9), 4898–4911. https://doi.org/10.1002/fsn3.3421.
55. Yang, Y., Xia, Y., Zhang, B., Li, D., Yan, J., Yang, J., Sun, J., Cao, H., Wang, Y., & Zhang, F. (2023). Effects of different N-6/n-3 polyunsaturated fatty acids ratios on lipid metabolism in patients with hyperlipidemia: A randomized controlled clinical trial. Frontiers in Nutrition, 10. https://doi.org/10.3389/fnut.2023.1166702.
56. Ghazani S.M., & Marangoni A.G. (2016). Healthy fats and oils. In: C.W. Wrigley, H. Corke, K. Seetharaman, & J. Faubion, Encyclopedia of Food Grains, 2nd Edition, Academic Press, Cambridge, MA. pp. 257–267.
57. Boateng, L., Ansong, R., Owusu, W. B., & Steiner-Asiedu, M. (2016). Coconut oil and palm oil's role in nutrition, health and national development: A review. Ghana Medical Journal, 50(3), 189–196.
58. Nill, K. (2016). Soy Beans: Properties and Analysis. In: B. Caballero, P.M. Finglas, & F. Toldrá (Eds.), Encyclopedia of Food and Health, Academic Press, pp. 54-55.
59. Costa-Catala, J., Toro-Funes, N., Comas-Basté, O., Hernández-Macias, S., Sánchez-Pérez, S., Latorre-Moratalla, M. L., Veciana-Nogués, M. T., Castell-Garralda, V., & Vidal-Carou, M. C. (2023). Comparative assessment of the nutritional profile of meat products and their plant-based analogues. Nutrients, 15(12), 2807. https://doi.org/10.3390/nu15122807.
60. Lin, L., Allemekinders, H., Dansby, A., Campbell, L., Durance-Tod, S., Berger, A., & Jones, P. J. (2013). Evidence of health benefits of canola oil. Nutrition Reviews, 71(6), 370–385. https://doi.org/10.1111/nure.12033.
61. Rabail, R., Shabbir, M. A., Sahar, A., Miecznikowski, A., Kieliszek, M., & Aadil, R. M. (2021). An intricate review on nutritional and analytical profiling of coconut, flaxseed, olive, and sunflower oil blends. Molecules, 26(23), 7187. https://doi.org/10.3390/molecules26237187.
62. Martins, A. J., Vicente, A. A., Cunha, R. L., & Cerqueira, M. A. (2018). Edible oleogels: an opportunity for fat replacement in foods. Food & Function, 9(2), 758–773. https://doi.org/10.1039/c7fo01641g.
63. USDA (2019). Chickpea Flour. Available from: https://fdc.nal.usda.gov/fdc-app.html#/food-details/475613/nutrients.
64. Vivar-Quintana, A. M., Absi, Y., Hernández-Jiménez, M., & Revilla, I. (2023). Nutritional Value, Mineral Composition, Fatty Acid Profile and Bioactive Compounds of Commercial Plant-Based Gluten-Free Flours. Applied Sciences, 13(4), 2309. https://doi.org/10.3390/app13042309.

65. GFI (n.d.). Plant-based meat is more nutritious. Available from: https://gfi.org/resource/plant-based-meat-nutrition-facts/.
66. Ishwarya, S.P. & Aakashraj, B. (2024). Plant protein extraction guide. Available from: https://gfi-india.org/resource/plant-protein-extraction-guide/.
67. Wanasundara, J. P., McIntosh, T. C., Perera, S. P., Withana-Gamage, T. S., & Mitra, P. (2016). Canola/rapeseed protein-functionality and nutrition. OCl, 23(4), D407.
68. Kyriakopoulou, K., Keppler, J. K., & van der Goot, A. J. (2021). Functionality of ingredients and additives in plant-based meat analogues. Foods, 10(3), 600. https://doi.org/10.3390/foods10030600.
69. National Institute of Health (2024). Iron. Available from: https://ods.od.nih.gov/factsheets/Iron-HealthProfessional/.
70. Institute of Medicine (US) Panel on Micronutrients (2001). Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc. National Academies Press (US), Washington (DC).
71. ICMR-NIN (2020; updated 2024). ICMR-NIN Expert Group on Nutrient Requirement for Indians, Recommended Dietary Allowances (RDA) and Estimated Average Requirements (EAR) - 2020. Available from: https://www.nin.res.in/RDA_short_Report_2024.html.
72. Watanabe, F., Yabuta, Y., Bito, T., & Teng, F. (2014). Vitamin B12-containing plant food sources for vegetarians. Nutrients, 6(5), 1861–1873. https://doi.org/10.3390/nu6051861.
73. McGuire, S., FAO, IFAD, & WFP (2015). The state of food insecurity in the World 2015: Meeting the 2015 international hunger targets: Taking stock of uneven progress. Rome: FAO, 2015. Advances in Nutrition, 6(5), 623–624. https://doi.org/10.3945/an.115.009936.
74. FSSAI (2018; updated in 2021). Food Safety and Standards (Fortification of Foods) Regulations. Available from: https://www.fssai.gov.in/upload/uploadfiles/files/Compendium_Food_Fortification_Regulations_30_09_2021.pdf
75. Mehta, N., Rao, P., & Saini, R. (2021). A review on metabolites and pharmaceutical potential of food legume crop mung bean (Vigna radiata L. Wilczek). BioTechnologia, 102(4), 425–435. https://doi.org/10.5114/bta.2021.111107.

# About the Authors

**Padma Ishwarya, S., PhD**
**Science and Technology Specialist - Plant-based, GFI India**

Padma spearheads plant-based alternative protein innovation in India through strategic research and academic collaboration. She leads the charge to transform the Indian plant-based alternative protein landscape through strategic research initiatives. With a doctoral degree in food technology, she identifies critical technological opportunities and effectively communicates R&D priorities to scientists and the Government of India's scientific bodies. With her expertise in the disciplines of soft matter in foods, food waste valorisation, and food ingredient encapsulation, Padma contributes towards creating innovative research proposals and open-access resources related to plant-based alternative proteins.

**Amrutha Girivasan**
**Science & Technology Associate, GFI India**

Amrutha combines the wonders of science and community building to cultivate the next generation of alt protein scientists in India. With a background in microbiology and food science, Amrutha brings a strong scientific foundation to her role in contributing to our scientific projects. Passionate about community building, she works on building a network of scientists, students, academics, and industry professionals across India to further research and education, and build talent for the smart protein sector. As a regional mentor for the India Smart Protein Project, Amrutha inspires and guides the next generation of innovators, contributing to a thriving ecosystem that will drive the growth of the alt protein sector in India.

# About the Good Food Institute India

The Good Food Institute India (GFI India) is the central expert organisation, thought leader, and convening body in the Indian alternative protein or smart protein sector in India. As part of an international network of organisations with partners in the U.S., Brazil, Europe, Israel, Asia Pacific, and Japan, GFI India is on a mission to build a secure, sustainable, and just global food future. With unique insights across science, policy and industry we are using the power of food innovation and markets to accelerate the transition of our food system toward smart proteins. In building the sector from the ground up in India, we're aiming to establish a model for its growth all across the developing world.

# Appendix

**Table S1. FSSAI's nutrient content claims and requirements to be fulfilled by food products (Food Safety and Standards (Advertising and Claims) Regulations, 2018, FSSAI, Version –IV (14.12.2022))**

| Nutrient or component | Claim | Conditions |
|---|---|---|
| Energy or Calorie | Low | Not more than 40 kcal per 100 g for solids, or 20 kcal per 100 ml for liquids. |
| | Free | Not more than 4 kcal per 100 ml for liquids. |
| Fat | Low | Not more than 3 g of fat per 100 g for solids, or 1.5 g of fat per 100 ml for liquids. |
| | Free | Not more than 0.5 g of fat per 100 g for solids or 100 ml for liquids. |
| Saturated fat | Low | Not more than 1.5 g per 100 g for solids, or 0.75 g per 100 ml for liquids and in either case must provide not more than 10% of energy from saturated fat. |
| | Free | Saturated fatty acids do not exceed 0.1 g per 100 g for solids or 100 ml for liquids. |
| Unsaturated fat | High | At least 70% of the fatty acids present in the product are derived from unsaturated fat under the condition that unsaturated fat provides more than 20% of energy of the product. |
| *Trans* fat | Free | The food contains less than 0.2 g *trans* fat per 100 g for solids or 100 ml for liquids. |
| Monounsaturated Fatty Acids | High | Shall only be made where at least 45% of the total fatty acids present in the product are derived from monounsaturated fat and under the condition that monounsaturated fat provides more than 20% of energy of the product. |
| Polyunsaturated Fatty Acids | High | Shall only be made where at least 45% of the total fatty acids present in the product are derived from polyunsaturated fat and under the condition that polyunsaturated fat provides more than 20% of energy of the product. |
| Omega 3 fatty acids | Source | The product contains - at least 0.3 g alpha-linolenic acid per 100 g or per 100 kcal, or at least 40 mg of the sum of eicosapentaenoic acid and docosahexaenoic acid per 100 g or per 100 kcal. |
| | High | The product contains: at least 0.6 g alpha-linolenic acid per 100 g or per 100 kcal, or at least 80 mg of the sum of eicosapentaenoic acid and docosahexaenoic acid per 100 g or per 100 kcal. |
| Sugars | Low | The product contains not more than 5 g of sugars per 100 g for solids, or 2.5 g of sugars per 100 ml for liquids. |
| | Free | The product contains not more than 0.5 g of sugars per 100 g for solids or 100 ml for liquids. |
| Protein | Source | 10% of Recommended Dietary Allowance per 100 g for solids; 5% of Recommended Dietary Allowance per 100 ml for liquids, or 5% of Recommended Dietary Allowance per 100 kcal, or 10% of Recommended Dietary Allowance per serving. |
| | Rich / High | 20% of Recommended Dietary Allowance per 100 g for solids; 10% of Recommended Dietary Allowance per 100 ml for liquids, or 10% of Recommended Dietary Allowance per 100 kcal, or 20% of Recommended Dietary Allowance per serving. |
| Sodium | Low | Product contains not more than 0.12 g of sodium per 100 g for solids or 100 ml for liquids. |
| | Very low | Product contains not more than 0.04 g of sodium per 100 g for solids or 100 ml for liquids. |
| | Sodium free | Product contains not more than 0.005 g of sodium per 100 g for solids or 100 ml for liquids. |
| Dietary fibre | Source | Product contains at least - 3 g of fibre per 100 g for solids; or 1.5 g of fibre per 100 ml for liquids; or 1.5 g of fibre per 100 kcal. |
| | Rich / High | The product contains at least - 6 g of fibre per 100 g for solids; or 3 g of fibre per 100 ml for liquids; or 3 g of fibre per 100 kcal. |
| Docosahexaenoic acid (DHA) | Source | Product contains at least 40 mg of DHA per 100 g or per 100 kcal. |

### Table S2. Amino acid composition of plant-based meat and egg products

## I. Kebab/Tikka

| Amino acid (Unit: g/100 g) | Kebab/Tikka | | | Average | Amino acid Requirements of adults according to the FAO (Unit: g/100 g) | % fulfilment of the RDA |
|---|---|---|---|---|---|---|
| | Protein sources: soy, wheat | Protein sources: soy, wheat, lentil | Protein source: pea | | | |
| Aspartic acid | 1.32 | 0.91 | 0.74 | 0.99 | | |
| Serine | 0.83 | 0.42 | 0.42 | 0.56 | | |
| Glutamic acid | 3.60 | 1.68 | 1.10 | 2.13 | | |
| Glycine | 0.60 | 0.35 | 0.24 | 0.40 | | |
| Histidine* | 0.34 | 0.21 | 0.17 | 0.24 | 0.65 | 37 |
| Arginine | 0.91 | 0.61 | 0.65 | 0.72 | | |
| Threonine* | 0.57 | 0.28 | 0.28 | 0.38 | 0.98 | 38 |
| Alanine | 0.81 | 0.62 | 0.52 | 0.65 | | |
| Proline | 1.36 | 0.58 | 0.47 | 0.80 | | |
| Cystine | <0.10 | <0.10 | <0.10 | | 0.26 | |
| Tyrosine | 0.62 | 0.33 | 0.33 | 0.43 | | |
| Valine* | 0.78 | 0.45 | 0.42 | 0.55 | 1.69 | 33 |
| Methionine* | 0.11 | <0.10 | <0.10 | 0.11 | 0.65 | 17 |
| Lysine* | 0.66 | 0.47 | 0.51 | 0.55 | 1.95 | 28 |
| Isoleucine* | 0.76 | 0.43 | 0.37 | 0.52 | 1.3 | 40 |
| Leucine* | 1.28 | 0.74 | 0.65 | 0.89 | 2.54 | 35 |
| Phenylalanine* | 0.82 | 0.49 | 0.42 | 0.58 | | |
| Tryptophan* | 0.19 | 0.15 | 0.10 | 0.15 | 0.26 | 56 |

*Essential amino acids

## II. Keema

| Amino acid (Unit: g/100 g) | Keema | | | Average | Amino acid Requirements of adults according to the FAO (Unit: g/100 g) | % fulfilment of the RDA |
|---|---|---|---|---|---|---|
| | Protein sources: Pea | Protein sources: Soy | Protein source: Jackfruit | | | |
| Aspartic acid | 0.64 | 0.60 | 0.13 | 0.46 | | |
| Serine | 0.26 | 0.36 | <0.10 | 0.31 | | |
| Glutamic acid | 0.75 | 1.01 | <0.10 | 0.88 | | |
| Glycine | 0.25 | 0.19 | <0.10 | 0.22 | | |
| Histidine* | 0.14 | 0.13 | <0.10 | 0.14 | 0.65 | 21 |
| Arginine | 0.46 | 0.45 | <0.10 | 0.46 | | |
| Threonine* | 0.19 | 0.25 | <0.10 | 0.22 | 0.98 | 22 |
| Alanine | 0.49 | 0.46 | 0.24 | 0.40 | | |
| Proline | 0.23 | 0.41 | <0.10 | 0.32 | | |
| Cystine | <0.10 | <0.10 | <0.10 | | 0.26 | |
| Tyrosine | 0.20 | 0.21 | <0.10 | 0.21 | | |
| Valine* | 0.24 | 0.31 | <0.10 | 0.28 | 1.69 | 16 |
| Methionine* | <0.10 | <0.10 | <0.10 | | 0.65 | 0 |
| Lysine* | 0.36 | 0.34 | <0.10 | 0.35 | 1.95 | 18 |
| Isoleucine* | 0.21 | 0.29 | <0.10 | 0.25 | 1.3 | 19 |
| Leucine* | 0.39 | 0.48 | <0.10 | 0.44 | 2.54 | 17 |
| Phenylalanine* | 0.24 | 0.31 | <0.10 | 0.28 | | |
| Tryptophan* | <0.10 | 0.11 | <0.10 | 0.11 | 0.26 | 42 |

*Essential amino acids

### III. Burger patties

| Amino acid (Unit: g/100 g) | Burger patties | | | | Average | Amino acid Requirements of adults according to the FAO (Unit: g/100 g) | % fulfilment of the RDA |
|---|---|---|---|---|---|---|---|
| | Protein sources: soy, wheat | Protein source: pea | Protein source: pea | Protein sources: soy, wheat | | | |
| Aspartic acid | 0.29 | 0.76 | 0.74 | 1.14 | 0.88 | | |
| Serine | 0.24 | 0.38 | 0.37 | 0.71 | 0.49 | | |
| Glutamic acid | 1.17 | 1.03 | 1.05 | 3.07 | 1.72 | | |
| Glycine | 0.20 | 0.22 | 0.23 | 0.47 | 0.31 | | |
| Histidine* | 0.14 | 0.19 | 0.20 | 0.38 | 0.26 | 0.65 | 39 |
| Arginine | 0.24 | 0.64 | 0.60 | 0.81 | 0.68 | | |
| Threonine* | 0.14 | 0.64 | 0.30 | 0.41 | 0.45 | 0.98 | 46 |
| Alanine | 0.45 | 0.50 | 0.51 | 0.63 | 0.55 | | |
| Proline | 0.48 | 0.39 | 0.43 | 1.00 | 0.61 | | |
| Cystine | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.26 | |
| Tyrosine | 0.18 | 0.25 | 0.23 | 0.49 | 0.32 | | |
| Valine* | 0.22 | 0.37 | 0.31 | 0.65 | 0.44 | 1.69 | 26 |
| Methionine* | <0.10 | <0.10 | <0.10 | 0.10 | 0.10 | 0.65 | 15 |
| Lysine* | 0.14 | 0.50 | 0.45 | 0.53 | 0.49 | 1.95 | 25 |
| Isoleucine* | 0.19 | 0.31 | 0.34 | 0.55 | 0.40 | 1.3 | 31 |
| Leucine* | 0.32 | 0.60 | 0.53 | 1.03 | 0.72 | 2.54 | 28 |
| Phenylalanine* | 0.20 | 0.41 | 0.34 | 0.68 | 0.48 | | |
| Tryptophan* | <0.10 | <0.10 | <0.10 | 0.17 | 0.17 | 0.26 | 65 |

*Essential amino acids

## IV. Nuggets

| Amino acid (Unit: g/100 g) | Nuggets | | | | Average | Amino acid Requirements of adults according to the FAO (Unit: g/100 g) | % fulfilment of the RDA |
|---|---|---|---|---|---|---|---|
| | Protein source: soy | Protein source: pea | Protein source: soy | Protein source: soy, pea | | | |
| Aspartic acid | 0.59 | 0.27 | 0.91 | 0.52 | 0.57 | | |
| Serine | 0.29 | 0.12 | 0.47 | 0.35 | 0.31 | | |
| Glutamic acid | 1.28 | 0.46 | 1.63 | 1.74 | 1.28 | | |
| Glycine | 0.20 | 0.11 | 0.35 | 0.21 | 0.22 | | |
| Histidine* | 0.14 | <0.10 | 0.18 | 0.15 | 0.165 | 0.65 | 25 |
| Arginine | 0.37 | 0.22 | 0.70 | 0.36 | 0.43 | | |
| Threonine* | 0.20 | <0.10 | 0.39 | 0.26 | 0.325 | 0.98 | 33 |
| Alanine | 0.47 | 0.20 | 0.59 | 0.42 | 0.40 | | |
| Proline | 0.51 | 0.21 | 0.55 | 0.70 | 0.49 | | |
| Cystine | <0.10 | <0.10 | <0.10 | <0.10 | | 0.26 | |
| Tyrosine | 0.21 | <0.10 | 0.38 | 0.25 | 0.315 | | |
| Valine* | 0.29 | <0.10 | 0.49 | 0.34 | 0.415 | 1.69 | 25 |
| Methionine* | <0.10 | <0.10 | <0.10 | <0.10 | | 0.65 | 0 |
| Lysine* | 0.25 | <0.10 | 0.55 | 0.30 | 0.425 | 1.95 | 22 |
| Isoleucine* | 0.24 | <0.10 | 0.44 | 0.29 | 0.365 | 1.3 | 28 |
| Leucine* | 0.48 | 0.17 | 0.79 | 0.55 | 0.50 | 2.54 | 20 |
| Phenylalanine* | 0.32 | 0.11 | 0.52 | 0.37 | 0.33 | | |
| Tryptophan* | 0.12 | <0.10 | 0.14 | 0.15 | 0.145 | 0.26 | 56 |

*Essential amino acids

## V. Sausage

| Amino acid (Unit: g/100 g) | Plant-based sausage | | | Average | Amino acid Requirements of adults according to the FAO (Unit: g/100 g) | % fulfilment of the RDA |
|---|---|---|---|---|---|---|
| | Protein source: soy | Protein source: pea | Protein source: pea | | | |
| Aspartic acid | 0.68 | 0.85 | 0.92 | 0.82 | | |
| Serine | 0.36 | 0.37 | 0.42 | 0.38 | | |
| Glutamic acid | 1.53 | 1.19 | 1.21 | 1.31 | | |
| Glycine | 0.26 | 0.31 | 0.29 | 0.29 | | |
| Histidine* | 0.17 | 0.25 | 0.21 | 0.21 | 0.65 | 32 |
| Arginine | 0.57 | 0.80 | 0.69 | 0.69 | | |
| Threonine* | 0.22 | 0.26 | 0.32 | 0.27 | 0.98 | 27 |
| Alanine | 0.40 | 0.49 | 0.46 | 0.45 | | |
| Proline | 0.53 | 0.41 | 0.38 | 0.44 | | |
| Cystine | <0.10 | <0.10 | <0.10 | | 0.26 | |
| Tyrosine | 0.26 | 0.32 | 0.32 | 0.30 | | |
| Valine* | 0.34 | 0.40 | 0.43 | 0.39 | 1.69 | 23 |
| Methionine* | <0.10 | <0.10 | <0.10 | | 0.65 | 0 |
| Lysine* | 0.33 | 0.54 | 0.61 | 0.49 | 1.95 | 25 |
| Isoleucine* | 0.33 | 0.39 | 0.41 | 0.38 | 1.3 | 29 |
| Leucine* | 0.56 | 0.66 | 0.70 | 0.64 | 2.54 | 25 |
| Phenylalanine* | 0.37 | 0.42 | 0.45 | 0.41 | | |
| Tryptophan* | 0.11 | <0.10 | <0.10 | 0.11 | 0.26 | 42 |

*Essential amino acids

## VI. Chunks

| Amino acid (Unit: g/100 g) | Plant-based chunks | | Average | Amino acid Requirements of adults according to the FAO (Unit: g/100 g) | % fulfilment of the RDA |
|---|---|---|---|---|---|
| | Protein source: soy, wheat | Protein source: soy, wheat, pea | | | |
| Aspartic acid | 1.94 | 1.83 | 1.885 | | |
| Serine | 1.05 | 1.01 | 1.03 | | |
| Glutamic acid | 4.59 | 4.35 | 4.47 | | |
| Glycine | 0.71 | 0.68 | 0.695 | | |
| Histidine* | 0.56 | 0.47 | 0.515 | 0.65 | 79 |
| Arginine | 1.43 | 1.30 | 1.365 | | |
| Threonine* | 0.69 | 0.67 | 0.68 | 0.98 | 69 |
| Alanine | 0.78 | 0.76 | 0.77 | | |
| Proline | 1.48 | 1.51 | 1.495 | | |
| Cystine | <0.10 | <0.10 | - | 0.26 | |
| Tyrosine | 0.78 | 0.72 | 0.75 | | |
| Valine* | 0.96 | 0.89 | 0.925 | 1.69 | 55 |
| Methionine* | 0.23 | 0.21 | 0.22 | 0.65 | 34 |
| Lysine* | 0.89 | 0.89 | 0.89 | 1.95 | 46 |
| Isoleucine* | 0.85 | 0.91 | 0.88 | 1.3 | 68 |
| Leucine* | 1.59 | 1.53 | 1.56 | 2.54 | 61 |
| Phenylalanine* | 1.10 | 1.06 | 1.08 | | |
| Tryptophan* | 0.28 | 0.32 | 0.3 | 0.26 | 115 |

*Essential amino acids

## VII. Momos

| Amino Acid (Unit: g/100g) | Plant-based momos | | Average | Amino acid Requirements of adults according to the FAO (Unit: g/100 g) | % fulfilment of the RDA |
|---|---|---|---|---|---|
| | Protein source: Soy | Protein source: Pea | | | |
| Aspartic acid | 0.45 | 0.26 | 0.355 | | |
| Serine | 0.32 | 0.23 | 0.275 | | |
| Glutamic acid | 1.51 | 1.34 | 1.425 | | |
| Glycine | 0.21 | 0.15 | 0.18 | | |
| Histidine* | 0.15 | 0.11 | 0.13 | 0.65 | 20 |
| Arginine | 0.39 | 0.22 | 0.305 | | |
| Threonine* | 0.21 | 0.15 | 0.18 | 0.98 | 18 |
| Alanine | 0.42 | 0.31 | 0.365 | | |
| Proline | 0.61 | 0.50 | 0.555 | | |
| Cystine | <0.10 | <0.10 | | 0.26 | |
| Tyrosine | 0.24 | 0.15 | 0.195 | | |
| Valine* | 0.28 | 0.21 | 0.245 | 1.69 | 14 |
| Methionine* | <0.10 | <0.10 | | 0.65 | 0 |
| Lysine* | 0.23 | 0.16 | 0.195 | 1.95 | 10 |
| Isoleucine* | 0.26 | 0.18 | 0.22 | 1.3 | 17 |
| Leucine* | 0.46 | 0.34 | 0.4 | 2.54 | 16 |
| Phenylalanine* | 0.30 | 0.22 | 0.26 | | |
| Tryptophan* | 0.16 | <0.10 | 0.16 | 0.26 | 62 |

*Essential amino acids

## VIII. Samosa

| Amino Acid (Unit: g/100g) | Plant-based keema samosa | Average | Amino acid Requirements of adults according to the FAO (Unit: g/100 g) | % fulfilment of the RDA |
|---|---|---|---|---|
| | Protein source: Soy | | | |
| Aspartic acid | 0.76 | 0.76 | | |
| Serine | 0.38 | 0.38 | | |
| Glutamic acid | 1.67 | 1.67 | | |
| Glycine | 0.24 | 0.24 | | |
| Histidine* | 0.18 | 0.18 | 0.65 | 28 |
| Arginine | 0.57 | 0.57 | | |
| Threonine* | 0.27 | 0.27 | 0.98 | 28 |
| Alanine | 0.46 | 0.46 | | |
| Proline | 0.63 | 0.63 | | |
| Cystine | <0.10 | | 0.26 | |
| Tyrosine | 0.31 | 0.31 | | |
| Valine* | 0.38 | 0.38 | 1.69 | 22 |
| Methionine* | <0.10 | | 0.65 | 0 |
| Lysine* | 0.38 | 0.38 | 1.95 | 19 |
| Isoleucine* | 0.33 | 0.33 | 1.3 | 25 |
| Leucine* | 0.61 | 0.61 | 2.54 | 24 |
| Phenylalanine* | 0.43 | 0.43 | | |
| Tryptophan* | <0.10 | | 0.26 | 0 |

*Essential amino acids

## IX. Plant-based egg products

| Amino Acid (Unit: g/100g) | Plant-based egg *Bhurji* | Plant-based egg Powder | Plant-based omelette pre-mix | Plant-based scrambled egg pre-mix | FAO's recommendation on the amino acid requirements for adults (FAO, 2011) (Unit: g/100 g) | % fulfilment of FAO's requirement | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Protein source: Soy, pea | Protein source: Mung bean | Protein source: Mung bean, chickpea, pea, soy | Protein source: Chickpea | | *Bhurji* | Egg Powder | Omelette pre-mix | Scrambled egg pre-mix |
| Aspartic acid | 5.54 | 6.81 | 2.03 | 1.89 | | | | | |
| Serine | 2.50 | 3.23 | 0.90 | 0.83 | | | | | |
| Glutamic acid | 7.8 | 10.23 | 2.80 | 2.49 | | | | | |
| Glycine | 1.76 | 1.87 | 0.63 | 0.56 | | | | | |
| Histidine* | 1.46 | 1.86 | 0.49 | 0.50 | 0.65 | 225 | 286 | 75 | 77 |
| Arginine | 3.91 | 4.76 | 1.51 | 1.43 | | | | | |
| Threonine* | 1.83 | 1.83 | 0.68 | 0.59 | 0.98 | 187 | 187 | 69 | 60 |
| Alanine | 1.72 | 1.98 | 0.82 | 0.83 | | | | | |
| Proline | 2.64 | 2.67 | 0.91 | 0.70 | | | | | |
| Cystine | <0.10 | <0.10 | <0.10 | <0.10 | 0.26 | - | - | - | - |
| Tyrosine | 1.80 | 2.08 | 0.63 | 0.48 | | | | | |
| Valine* | 2.35 | 3.23 | 0.89 | 0.83 | 1.69 | 139 | 191 | 53 | 49 |
| Methionine* | 0.53 | 0.70 | 0.16 | 0.15 | 0.65 | 82 | 108 | 25 | 23 |
| Lysine* | 2.85 | 4.09 | 1.20 | 1.09 | 1.95 | 146 | 210 | 62 | 56 |
| Isoleucine* | 2.07 | 2.41 | 0.77 | 0.66 | 1.3 | 159 | 185 | 59 | 51 |
| Leucine* | 3.73 | 4.98 | 1.45 | 1.29 | 2.54 | 147 | 196 | 57 | 51 |
| Phenylalanine* | 2.57 | 4.01 | 1.07 | 1.00 | | | | | |
| Tryptophan* | 0.82 | 0.71 | 0.29 | 0.24 | 0.26 | 315 | 273 | 112 | 92 |

*Essential amino acids

## Table S3. Fatty acid composition of plant-based meat and egg products

### I. Kebab/Tikka

| Fatty acid (Unit: g/100 g) | | Plant-based kebabs | | |
|---|---|---|---|---|
| | | Fat source: Refined sunflower oil | Fat source: Refined canola oil | Fat source: Coconut Oil |
| SFA | C 4:0 Butyric Acid | <0.01 | <0.01 | <0.01 |
| | C 6:0 Caproic acid | <0.01 | <0.01 | 0.02 |
| | C 8:0 Caprylic acid | 0.02 | 0.01 | 0.74 |
| | C10:0 Capric Acid | 0.01 | 0.01 | 0.56 |
| | C11:0 Undecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C12:0 Lauric Acid | 0.08 | 0.08 | 4.96 |
| | C13:0 Tridecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C14:0 Myristic Acid | 0.04 | 0.02 | 2.00 |
| | C15:0 Pentadecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C16:0 Palmitic Acid | 0.49 | 0.5 | 1.94 |
| | C17:0 Heptadecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C18:0 Stearic Acid | 0.27 | 0.27 | 2.47 |
| | C20:0 Arachidic Acid | 0.01 | <0.01 | 0.02 |
| | C21:0 Heneicosanoic Acid | <0.01 | <0.01 | <0.01 |
| | C22:0 Behenic Acid | 0.05 | 0.05 | 0.03 |
| | C23:0 Tricosanoic acid | <0.01 | <0.01 | <0.01 |
| | C24 Lignoceric acid | 0.02 | 0.02 | 0.02 |
| MUFA | C14:1 Myristoleic Acid | <0.01 | <0.01 | <0.01 |
| | C15:1 Cis-10-Pentadecanoic Acid | <0.01 | <0.01 | <0.02 |
| | C16:1 Palmitoleic Acid | <0.01 | <0.01 | <0.01 |
| | C17:1 Cis-10-Heptadecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C18:1 *Trans*-Elaidic Acid | <0.01 | <0.01 | <0.01 |
| | C18:1 Oleic Acid | 2.30 | 2.32 | 1.60 |
| | C20:1 Eicosenoic Acid | 0.01 | 0.01 | <0.01 |
| | C22:1 Erucic Acid | <0.01 | <0.01 | <0.01 |
| | C24:1n9 Nervonic Acid | <0.01 | <0.01 | <0.01 |

| | | | | |
|---|---|---|---|---|
| PUFA | C18:2 *Trans*-Linoelaidic acid | <0.01 | <0.01 | <0.01 |
| | C18:2 Linoleic acid | 4.08 | 3.98 | 2.32 |
| | C18:3n3 α, Linolenic acid | 0.02 | 0.02 | 0.02 |
| | C18:3n6, γ Linolenic acid | <0.01 | 0.01 | 0.02 |
| | C18:3 (Sum of 3n3 and 3n6), Linolenic acid | 0.03 | 0.03 | 0.03 |
| | C20:2 Eicosadienoic acid | <0.01 | <0.01 | <0.01 |
| | C20:3n3 Eicosatrienoic acid | <0.01 | <0.01 | <0.01 |
| | C20:3n6 Eicosatrienoic acid | <0.01 | <0.01 | <0.01 |
| | C20:4n6 Arachidonic Acid | <0.01 | <0.01 | <0.01 |
| | C 20:5n3 Eicosapentaenoic acid (EPA) | <0.01 | <0.01 | <0.01 |
| | C22:2 Docosadienoic Acid | <0.01 | <0.01 | <0.01 |
| | C22:6n3 Docosahexaenoic acid (DHA) | <0.01 | <0.01 | <0.01 |
| SFA / MUFA / PUFA/ *Trans* fatty acids | Saturated Fatty Acids | 0.99 | 0.97 | 12.75 |
| | Mono Unsaturated Fatty Acids | 2.31 | 2.33 | 1.60 |
| | Polyunsaturated Fatty Acids | 4.10 | 4.01 | 2.36 |
| | *Trans* Fatty Acids | <0.01 | <0.01 | <0.01 |

## II. Keema

| Fatty acid (Unit: g/100 g) | | Plant-based keema | | |
|---|---|---|---|---|
| | | Fat source: Coconut oil | Fat source: Sunflower oil, palmolein oil, Coconut fat | Fat source: Not listed |
| SFA | C 4:0 Butyric Acid | <0.01 | <0.01 | <0.01 |
| | C 6:0 Caproic acid | 0.01 | <0.01 | <0.01 |
| | C 8:0 Caprylic acid | 0.30 | 0.24 | <0.01 |
| | C10:0 Capric Acid | 0.22 | 0.18 | <0.01 |
| | C11:0 Undecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C12:0 Lauric Acid | 1.97 | 1.73 | 0.03 |
| | C13:0 Tridecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C14:0 Myristic Acid | 0.83 | 0.74 | 0.02 |
| | C15:0 Pentadecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C16:0 Palmitic Acid | 1.00 | 1.34 | 0.06 |
| | C17:0 Heptadecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C18:0 Stearic Acid | 0.99 | 0.95 | 0.03 |
| | C20:0 Arachidic Acid | <0.01 | 0.02 | <0.01 |
| | C21:0 Heneicosanoic Acid | <0.01 | <0.01 | <0.01 |
| | C22:0 Behenic Acid | 0.03 | 0.04 | <0.01 |
| | C23:0 Tricosanoic acid | <0.01 | <0.01 | <0.01 |
| | C24 Lignoceric acid | 0.01 | 0.01 | <0.01 |
| MUFA | C14:1 Myristoleic Acid | <0.01 | <0.01 | <0.01 |
| | C15:1 Cis-10-Pentadecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C16:1 Palmitoleic Acid | <0.01 | <0.01 | <0.01 |
| | C17:1 Cis-10-Heptadecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C18:1 *Trans*-Elaidic Acid | <0.01 | <0.01 | <0.01 |
| | C18:1 Oleic Acid | 1.68 | 2.30 | 0.31 |
| | C20:1 Eicosenoic Acid | <0.01 | 0.01 | <0.01 |
| | C22:1 Erucic Acid | <0.01 | <0.01 | <0.01 |
| | C24:1n9 Nervonic Acid | <0.01 | <0.01 | <0.01 |

| | | | | |
|---|---|---|---|---|
| PUFA | C18:2 *Trans*-Linoelaidic acid | <0.01 | <0.01 | <0.01 |
| | C18:2 Linoleic acid | 2.48 | 3.19 | 0.12 |
| | C18:3n3 α, Linolenic acid | 0.03 | 0.07 | 0.01 |
| | C18:3n6, γ Linolenic acid | 0.02 | 0.01 | <0.01 |
| | C18:3 (Sum of 3n3 and 3n6), Linolenic acid | 0.05 | 0.08 | 0.02 |
| | C20:2 Eicosadienoic acid | <0.01 | <0.01 | <0.01 |
| | C20:3n3 Eicosatrienoic acid | <0.01 | <0.01 | <0.01 |
| | C20:3n6 Eicosatrienoic acid | <0.01 | <0.01 | <0.01 |
| | C20:4n6 Arachidonic Acid | <0.01 | <0.01 | <0.01 |
| | C 20:5n3 Eicosapentaenoic acid (EPA) | <0.01 | <0.01 | <0.01 |
| | C22:2 Docosadienoic Acid | <0.01 | <0.01 | <0.01 |
| | C22:6n3 Docosahexaenoic acid (DHA) | <0.01 | <0.01 | <0.01 |
| SFA/ MUFA/ PUFA/ *Trans* fatty acids | Saturated Fatty Acids | 5.39 | 5.26 | 0.14 |
| | Mono Unsaturated Fatty Acids | 1.68 | 2.31 | 0.31 |
| | Polyunsaturated Fatty Acids | 2.53 | 3.27 | 0.14 |
| | *Trans* Fatty Acids | <0.01 | <0.01 | N |

## III. Burger patties

| Fatty acid (Unit: g/100 g) | | Plant-based patties | | | |
|---|---|---|---|---|---|
| | | Fat source: Refined sunflower oil | Fat source: Coconut oil | Fat source: Coconut oil | Fat source: Soy-bean oil, refined sunflower oil |
| SFA | C 4:0 Butyric Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C 6:0 Caproic acid | <0.01 | 0.01 | 0.01 | <0.01 |
| | C 8:0 Caprylic acid | <0.01 | 0.53 | 0.43 | <0.01 |
| | C10:0 Capric Acid | <0.01 | 0.39 | 0.33 | 0.02 |
| | C11:0 Undecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C12:0 Lauric Acid | 0.03 | 3.36 | 3.00 | 0.02 |
| | C13:0 Tridecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C14:0 Myristic Acid | 0.06 | 1.40 | 1.27 | 0.01 |
| | C15:0 Pentadecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C16:0 Palmitic Acid | 2.75 | 1.10 | 0.85 | 0.49 |
| | C17:0 Heptadecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C18:0 Stearic Acid | 0.37 | 1.56 | 1.22 | 0.24 |
| | C20:0 Arachidic Acid | 0.01 | <0.01 | <0.01 | <0.01 |
| | C21:0 Heneicosanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C22:0 Behenic Acid | 0.02 | 0.02 | 0.02 | 0.05 |
| | C23:0 Tricosanoic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C24 Lignoceric acid | 0.01 | 0.01 | <0.01 | 0.02 |
| MUFA | C14:1 Myristoleic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C15:1 Cis-10-Pentade-canoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C16:1 Palmitoleic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C17:1 Cis-10-Heptade-canoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C18:1 *Trans*-Elaidic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C18:1 Oleic Acid | 3.43 | 1.23 | 0.94 | 2.22 |
| | C20:1 Eicosenoic Acid | <0.01 | 0.01 | <0.01 | 0.01 |
| | C22:1 Erucic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C24:1n9 Nervonic Acid | <0.01 | <0.01 | <0.01 | <0.01 |

| | | | | | |
|---|---|---|---|---|---|
| PUFA | C18:2 *Trans*-Linoelaidic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C18:2 Linoleic acid | 2.00 | 1.63 | 1.29 | 3.75 |
| | C18:3n3 α, Linolenic acid | <0.01 | <0.01 | <0.01 | 0.02 |
| | C18:3n6, γ Linolenic acid | 0.01 | 0.01 | <0.01 | <0.01 |
| | C18:3 (Sum of 3n3 and 3n6), Linolenic acid | 0.02 | 0.02 | 0.01 | 0.03 |
| | C20:2 Eicosadienoic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C20:3n3 Eicosatrienoic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C20:3n6 Eicosatrienoic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C20:4n6 Arachidonic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C 20:5n3 Eicosapentae-noic acid (EPA) | 0.03 | <0.01 | <0.01 | <0.01 |
| | C22:2 Docosadienoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C22:6n3 Docosahexae-noic acid (DHA) | <0.01 | <0.01 | <0.01 | <0.01 |
| **SFA / MUFA / PUFA / *Trans* fatty acids** | Saturated Fatty Acids | 3.26 | 8.40 | 7.12 | 0.84 |
| | Mono Unsaturated Fatty Acids | 3.43 | 1.25 | 0.94 | 2.23 |
| | Polyunsaturated Fatty Acids | 2.04 | 1.64 | 1.29 | 3.77 |
| | *Trans* Fatty Acids | <0.01 | <0.01 | <0.01 | <0.01 |

## IV. Nuggets

| Fatty acid (Unit: g/100 g) | | Plant-based nuggets | | | |
|---|---|---|---|---|---|
| | | Fat source: Vegetable fat, rice bran oil | Fat source: Hydrogenated Vegetable Fat (Coconut), Rice Bran Oil | Fat source: Refined palm oil, refined sunflower oil | Fat source: Soybean oil, refined palm oil, interesterified vegetable fat, refined sunflower oil |
| SFA | C 4:0 Butyric Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C 6:0 Caproic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C 8:0 Caprylic acid | 0.19 | <0.01 | <0.01 | <0.01 |
| | C10:0 Capric Acid | 0.15 | <0.01 | <0.01 | 0.06 |
| | C11:0 Undecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C12:0 Lauric Acid | 1.23 | 0.02 | 0.02 | 0.84 |
| | C13:0 Tridecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C14:0 Myristic Acid | 0.47 | 0.06 | 0.03 | 0.36 |
| | C15:0 Pentadecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C16:0 Palmitic Acid | 1.73 | 3.62 | 3.05 | 4.76 |
| | C17:0 Heptadecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C18:0 Stearic Acid | 0.86 | 0.41 | 0.40 | 0.86 |
| | C20:0 Arachidic Acid | 0.03 | 0.02 | <0.01 | 0.02 |
| | C21:0 Heneicosanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C22:0 Behenic Acid | 0.04 | 0.02 | 0.02 | <0.01 |
| | C23:0 Tricosanoic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C24 Lignoceric acid | 0.04 | 0.03 | 0.01 | 0.01 |
| MUFA | C14:1 Myristoleic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C15:1 Cis-10-Pentadecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C16:1 Palmitoleic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C17:1 Cis-10-Heptadecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C18:1 *Trans*-Elaidic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C18:1 Oleic Acid | 3.73 | 3.92 | 3.39 | 4.38 |
| | C20:1 Eicosenoic Acid | 0.04 | 0.03 | <0.01 | 0.01 |
| | C22:1 Erucic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C24:1n9 Nervonic Acid | <0.01 | <0.01 | <0.01 | <0.01 |

| | | | | | |
|---|---|---|---|---|---|
| PUFA | C18:2 *Trans*-Linoelaidic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C18:2 Linoleic acid | 3.65 | 1.76 | 2.24 | 2.75 |
| | C18:3n3 α, Linolenic acid | 0.04 | 0.02 | <0.01 | <0.01 |
| | C18:3n6, γ Linolenic acid | 0.04 | 0.04 | 0.02 | 0.01 |
| | C18:3 (Sum of 3n3 and 3n6), Linolenic acid | 0.08 | 0.06 | 0.02 | 0.02 |
| | C20:2 Eicosadienoic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C20:3n3 Eicosatrienoic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C20:3n6 Eicosatrienoic acid | <0.01 | <0.01 | <0.01 | 0.03 |
| | C20:4n6 Arachidonic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C 20:5n3 Eicosapentaenoic acid (EPA) | <0.01 | <0.01 | <0.01 | <0.01 |
| | C22:2 Docosadienoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C22:6n3 Docosahexaenoic acid (DHA) | <0.01 | <0.01 | <0.01 | <0.01 |
| SFA / MUFA/ PUFA/ *Trans* fatty acids | Saturated Fatty Acids | 4.73 | 4.18 | 3.53 | 6.91 |
| | Mono Unsaturated Fatty Acids | 3.77 | 3.94 | 3.39 | 4.39 |
| | Polyunsaturated Fatty Acids | 3.73 | 1.82 | 2.25 | 2.79 |
| | *Trans* Fatty Acids | <0.01 | <0.01 | <0.01 | <0.01 |

## V. Sausage

| Fatty acid (Unit: g/100 g) | | Plant-based sausage | | |
|---|---|---|---|---|
| | | Fat source: Refined sunflower oil | Fat source: Vegetable fat, sunflower oil | Fat source: Vegetable fat, sunflower oil |
| SFA | C 4:0 Butyric Acid | <0.01 | <0.01 | <0.01 |
| | C 6:0 Caproic acid | <0.01 | <0.01 | 0.03 |
| | C 8:0 Caprylic acid | <0.01 | 0.59 | 0.66 |
| | C10:0 Capric Acid | <0.01 | 0.44 | 0.48 |
| | C11:0 Undecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C12:0 Lauric Acid | <0.01 | 3.98 | 4.11 |
| | C13:0 Tridecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C14:0 Myristic Acid | 0.01 | 1.71 | 1.72 |
| | C15:0 Pentadecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C16:0 Palmitic Acid | 1.05 | 1.03 | 1.01 |
| | C17:0 Heptadecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C18:0 Stearic Acid | 0.29 | 1.64 | 1.74 |
| | C20:0 Arachidic Acid | <0.01 | <0.01 | <0.01 |
| | C21:0 Heneicosanoic Acid | <0.01 | <0.01 | <0.01 |
| | C22:0 Behenic Acid | 0.05 | <0.01 | <0.01 |
| | C23:0 Tricosanoic acid | <0.01 | <0.01 | <0.01 |
| | C24 Lignoceric acid | 0.02 | <0.01 | <0.01 |
| MUFA | C14:1 Myristoleic Acid | <0.01 | <0.01 | <0.01 |
| | C15:1 Cis-10-Pentadecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C16:1 Palmitoleic Acid | <0.01 | <0.01 | <0.01 |
| | C17:1 Cis-10-Heptadecanoic Acid | <0.01 | <0.01 | <0.01 |
| | C18:1 *Trans*-Elaidic Acid | <0.01 | <0.01 | <0.01 |
| | C18:1 Oleic Acid | 2.77 | 0.27 | 0.18 |
| | C20:1 Eicosenoic Acid | 0.01 | <0.01 | <0.01 |
| | C22:1 Erucic Acid | <0.01 | <0.01 | <0.01 |
| | C24:1n9 Nervonic Acid | <0.01 | <0.01 | <0.01 |

| | | | | |
|---|---|---|---|---|
| PUFA | C18:2 *Trans*-Linoelaidic acid | <0.01 | <0.01 | <0.01 |
| | C18:2 Linoleic acid | 4.01 | 0.20 | 0.10 |
| | C18:3n3 α, Linolenic acid | <0.01 | <0.01 | <0.01 |
| | C18:3n6, γ Linolenic acid | 0.01 | <0.01 | <0.01 |
| | C18:3 (Sum of 3n3 and 3n6), Linolenic acid | 0.02 | <0.01 | 0.01 |
| | C20:2 Eicosadienoic acid | <0.01 | <0.01 | <0.01 |
| | C20:3n3 Eicosatrienoic acid | <0.01 | <0.01 | <0.01 |
| | C20:3n6 Eicosatrienoic acid | <0.01 | <0.01 | <0.01 |
| | C20:4n6 Arachidonic Acid | <0.01 | <0.01 | <0.01 |
| | C 20:5n3 Eicosapentaenoic acid (EPA) | <0.01 | <0.01 | <0.01 |
| | C22:2 Docosadienoic Acid | <0.01 | <0.01 | <0.01 |
| | C22:6n3 Docosahexaenoic acid (DHA) | <0.01 | <0.01 | <0.01 |
| SFA / MUFA/ PUFA/ *Trans* fatty acids | Saturated Fatty Acids | 1.42 | 9.39 | 9.74 |
| | Mono Unsaturated Fatty Acids | 2.79 | 0.27 | 0.18 |
| | Polyunsaturated Fatty Acids | 4.02 | 0.20 | 0.10 |
| | *Trans* Fatty Acids | <0.01 | <0.01 | <0.01 |

## VI. Chunks

| Fatty acid (Unit: g/100 g) | | Plant-based chunks | |
|---|---|---|---|
| | | Fat source: Soybean oil | Fat source: Rice bran oil |
| SFA | C 4:0 Butyric Acid | <0.01 | <0.01 |
| | C 6:0 Caproic acid | <0.01 | <0.01 |
| | C 8:0 Caprylic acid | <0.01 | 0.59 |
| | C10:0 Capric Acid | <0.01 | 0.44 |
| | C11:0 Undecanoic Acid | <0.01 | <0.01 |
| | C12:0 Lauric Acid | <0.01 | 3.98 |
| | C13:0 Tridecanoic Acid | <0.01 | <0.01 |
| | C14:0 Myristic Acid | 0.01 | 1.71 |
| | C15:0 Pentadecanoic Acid | <0.01 | <0.01 |
| | C16:0 Palmitic Acid | 1.05 | 1.03 |
| | C17:0 Heptadecanoic Acid | <0.01 | <0.01 |
| | C18:0 Stearic Acid | 0.29 | 1.64 |
| | C20:0 Arachidic Acid | <0.01 | <0.01 |
| | C21:0 Heneicosanoic Acid | <0.01 | <0.01 |
| | C22:0 Behenic Acid | 0.05 | <0.01 |
| | C23:0 Tricosanoic acid | <0.01 | <0.01 |
| | C24 Lignoceric acid | 0.02 | <0.01 |
| MUFA | C14:1 Myristoleic Acid | <0.01 | <0.01 |
| | C15:1 Cis-10-Pentadecanoic Acid | <0.01 | <0.01 |
| | C16:1 Palmitoleic Acid | <0.01 | <0.01 |
| | C17:1 Cis-10-Heptadecanoic Acid | <0.01 | <0.01 |
| | C18:1 *Trans*-Elaidic Acid | <0.01 | <0.01 |
| | C18:1 Oleic Acid | 2.03 | 2.10 |
| | C20:1 Eicosenoic Acid | 0.08 | 0.02 |
| | C22:1 Erucic Acid | <0.01 | <0.01 |
| | C24:1n9 Nervonic Acid | <0.01 | <0.01 |

| | | | |
|---|---|---|---|
| **PUFA** | C18:2 *Trans*-Linoelaidic acid | <0.01 | <0.01 |
| | C18:2 Linoleic acid | 2.36 | 1.58 |
| | C18:3n3 α, Linolenic acid | 0.14 | 0.05 |
| | C18:3n6, γ Linolenic acid | <0.01 | 0.02 |
| | C18:3 (Sum of 3n3 and 3n6), Linolenic acid | 0.14 | 0.07 |
| | C20:2 Eicosadienoic acid | <0.01 | <0.01 |
| | C20:3n3 Eicosatrienoic acid | <0.01 | 0.01 |
| | C20:3n6 Eicosatrienoic acid | <0.01 | <0.01 |
| | C20:4n6 Arachidonic Acid | <0.01 | <0.01 |
| | C 20:5n3 Eicosapentaenoic acid (EPA) | <0.01 | <0.01 |
| | C22:2 Docosadienoic Acid | <0.01 | <0.01 |
| | C22:6n3 Docosahexaenoic acid (DHA) | <0.01 | <0.01 |
| **SFA / MUFA/ PUFA/ *Trans* fatty acids** | Saturated Fatty Acids | 1.04 | 1.06 |
| | Mono Unsaturated Fatty Acids | 2.11 | 2.12 |
| | Polyunsaturated Fatty Acids | 2.50 | 1.66 |
| | *Trans* Fatty Acids | <0.01 | <0.01 |

## VII. Momos

| Fatty acid (Unit: g/100 g) | | Plant-based momos | |
|---|---|---|---|
| | | Fat source: Refined palmolein oil | Fat source: Sunflower Oil, Palm oil, Sesame Oil |
| SFA | C 4:0 Butyric Acid | <0.01 | <0.01 |
| | C 6:0 Caproic acid | <0.01 | <0.01 |
| | C 8:0 Caprylic acid | 0.05 | 0.08 |
| | C10:0 Capric Acid | 0.05 | 0.06 |
| | C11:0 Undecanoic Acid | <0.01 | <0.01 |
| | C12:0 Lauric Acid | 0.72 | 0.82 |
| | C13:0 Tridecanoic Acid | <0.01 | <0.01 |
| | C14:0 Myristic Acid | 0.29 | 0.31 |
| | C15:0 Pentadecanoic Acid | <0.01 | <0.01 |
| | C16:0 Palmitic Acid | 2.99 | 2.78 |
| | C17:0 Heptadecanoic Acid | <0.01 | <0.01 |
| | C18:0 Stearic Acid | 0.55 | 0.52 |
| | C20:0 Arachidic Acid | 0.01 | <0.01 |
| | C21:0 Heneicosanoic Acid | <0.01 | <0.01 |
| | C22:0 Behenic Acid | 0.02 | <0.01 |
| | C23:0 Tricosanoic acid | <0.01 | <0.01 |
| | C24 Lignoceric acid | <0.01 | <0.01 |
| MUFA | C14:1 Myristoleic Acid | <0.01 | <0.01 |
| | C15:1 Cis-10-Pentadecanoic Acid | <0.01 | <0.01 |
| | C16:1 Palmitoleic Acid | <0.01 | <0.01 |
| | C17:1 Cis-10-Heptadecanoic Acid | <0.01 | <0.01 |
| | C18:1 *Trans*-Elaidic Acid | <0.01 | <0.01 |
| | C18:1 Oleic Acid | 2.36 | 1.59 |
| | C20:1 Eicosenoic Acid | 0.03 | <0.01 |
| | C22:1 Erucic Acid | <0.01 | <0.01 |
| | C24:1n9 Nervonic Acid | <0.01 | <0.01 |

| | | | |
|---|---|---|---|
| PUFA | C18:2 *Trans*-Linoelaidic acid | <0.01 | <0.01 |
| | C18:2 Linoleic acid | 0.66 | 0.73 |
| | C18:3n3 α, Linolenic acid | 0.10 | <0.01 |
| | C18:3n6, γ Linolenic acid | 0.02 | 0.01 |
| | C18:3 (Sum of 3n3 and 3n6), Linolenic acid | 0.12 | 0.01 |
| | C20:2 Eicosadienoic acid | <0.01 | <0.01 |
| | C20:3n3 Eicosatrienoic acid | <0.01 | <0.01 |
| | C20:3n6 Eicosatrienoic acid | <0.01 | <0.01 |
| | C20:4n6 Arachidonic Acid | <0.01 | <0.01 |
| | C 20:5n3 Eicosapentaenoic acid (EPA) | <0.01 | <0.01 |
| | C22:2 Docosadienoic Acid | <0.01 | <0.01 |
| | C22:6n3 Docosahexaenoic acid (DHA) | <0.01 | <0.01 |
| SFA / MUFA/ PUFA/ *Trans* fatty acids | Saturated Fatty Acids | 4.68 | 4.57 |
| | Mono Unsaturated Fatty Acids | 2.40 | 1.59 |
| | Polyunsaturated Fatty Acids | 0.78 | 0.74 |
| | *Trans* Fatty Acids | <0.01 | <0.01 |

## VIII. Samosa

| Fatty acid (Unit: g/100 g) | | Plant-based samosa |
|---|---|---|
| | | Fat source: Not Listed |
| SFA | C 4:0 Butyric Acid | <0.01 |
| | C 6:0 Caproic acid | <0.01 |
| | C 8:0 Caprylic acid | 0.19 |
| | C10:0 Capric Acid | 0.12 |
| | C11:0 Undecanoic Acid | <0.01 |
| | C12:0 Lauric Acid | <0.01 |
| | C13:0 Tridecanoic Acid | <0.01 |
| | C14:0 Myristic Acid | <0.01 |
| | C15:0 Pentadecanoic Acid | <0.01 |
| | C16:0 Palmitic Acid | 0.43 |
| | C17:0 Heptadecanoic Acid | <0.01 |
| | C18:0 Stearic Acid | 0.22 |
| | C20:0 Arachidic Acid | <0.01 |
| | C21:0 Heneicosanoic Acid | <0.01 |
| | C22:0 Behenic Acid | 0.04 |
| | C23:0 Tricosanoic acid | <0.01 |
| | C24 Lignoceric acid | 0.01 |
| MUFA | C14:1 Myristoleic Acid | <0.01 |
| | C15:1 Cis-10-Pentadecanoic Acid | <0.01 |
| | C16:1 Palmitoleic Acid | <0.01 |
| | C17:1 Cis-10-Heptadecanoic Acid | <0.01 |
| | C18:1 *Trans*-Elaidic Acid | <0.01 |
| | C18:1 Oleic Acid | 1.52 |
| | C20:1 Eicosenoic Acid | <0.01 |
| | C22:1 Erucic Acid | <0.01 |
| | C24:1n9 Nervonic Acid | <0.01 |

| | | |
|---|---|---|
| PUFA | C18:2 *Trans*-Linoelaidic acid | <0.01 |
| | C18:2 Linoleic acid | 1.57 |
| | C18:3n3 α, Linolenic acid | <0.01 |
| | C18:3n6, γ Linolenic acid | <0.01 |
| | C18:3 (Sum of 3n3 and 3n6), Linolenic acid | <0.01 |
| | C20:2 Eicosadienoic acid | <0.01 |
| | C20:3n3 Eicosatrienoic acid | <0.01 |
| | C20:3n6 Eicosatrienoic acid | <0.01 |
| | C20:4n6 Arachidonic Acid | <0.01 |
| | C 20:5n3 Eicosapentaenoic acid (EPA) | <0.01 |
| | C22:2 Docosadienoic Acid | <0.01 |
| | C22:6n3 Docosahexaenoic acid (DHA) | <0.01 |
| **SFA / MUFA/ PUFA/ *Trans* fatty acids** | Saturated Fatty Acids | 1.01 |
| | Mono Unsaturated Fatty Acids | 1.52 |
| | Polyunsaturated Fatty Acids | 1.57 |
| | *Trans* Fatty Acids | <0.01 |

## IX. Plant-based egg products

| Fatty acid (Unit: g/100 g) | | *Bhurji* | Egg powder | Omelette pre-mix | Scrambled egg pre-mix |
|---|---|---|---|---|---|
| | | **Fat source: Edible vegetable oil** | **Fat source: Oil** | **Fat source: Not listed** | **Fat source: Not listed** |
| **SFA** | C 4:0 Butyric Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C 6:0 Caproic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C 8:0 Caprylic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C10:0 Capric Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C11:0 Undecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C12:0 Lauric Acid | <0.01 | <0.01 | <0.01 | 0.05 |
| | C13:0 Tridecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C14:0 Myristic Acid | 0.03 | 0.07 | 0.03 | 0.07 |
| | C15:0 Pentadecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C16:0 Palmitic Acid | 0.46 | 0.97 | 1.33 | 1.59 |
| | C17:0 Heptadecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C18:0 Stearic Acid | 0.11 | 0.31 | 0.57 | 0.64 |
| | C20:0 Arachidic Acid | <0.01 | 0.04 | 0.04 | 0.04 |
| | C21:0 Heneicosanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C22:0 Behenic Acid | <0.01 | 0.08 | 0.03 | 0.04 |
| | C23:0 Tricosanoic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C24 Lignoceric acid | <0.01 | 0.04 | 0.02 | <0.01 |
| **MUFA** | C14:1 Myristoleic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C15:1 Cis-10-Pentadecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C16:1 Palmitoleic Acid | <0.01 | <0.01 | 0.02 | <0.01 |
| | C17:1 Cis-10-Heptadecanoic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C18:1 *Trans*-Elaidic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C18:1 Oleic Acid | 0.82 | 0.56 | 1.22 | 1.67 |
| | C20:1 Eicosenoic Acid | 0.10 | 0.26 | 0.05 | 0.01 |
| | C22:1 Erucic Acid | <0.01 | 0.07 | <0.01 | 0.05 |
| | C24:1n9 Nervonic Acid | <0.01 | <0.01 | <0.01 | <0.01 |

| | | | | | |
|---|---|---|---|---|---|
| **PUFA** | C18:2 *Trans*-Linoelaidic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C18:2 Linoleic acid | 1.15 | 1.05 | 1.94 | 3.51 |
| | C18:3n3 α, Linolenic acid | 0.15 | 0.35 | 0.21 | 0.31 |
| | C18:3n6, γ Linolenic acid | <0.01 | 0.03 | <0.01 | 0.01 |
| | C18:3 (Sum of 3n3 and 3n6), Linolenic acid | 0.15 | 0.37 | 0.22 | 0.33 |
| | C20:2 Eicosadienoic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C20:3n3 Eicosatrienoic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C20:3n6 Eicosatrienoic acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C20:4n6 Arachidonic Acid | <0.01 | <0.01 | <0.01 | <0.01 |
| | C 20:5n3 Eicosapentaenoic acid (EPA) | <0.01 | <0.01 | <0.01 | <0.01 |
| | C22:2 Docosadienoic Acid | <0.01 | <0.01 | <0.01 | 0.02 |
| | C22:6n3 Docosahexaenoic acid (DHA) | <0.01 | <0.01 | <0.01 | <0.01 |
| **SFA / MUFA/ PUFA/ *Trans* fatty acids** | Saturated Fatty Acids | 0.60 | 1.51 | 2.01 | 2.43 |
| | Mono Unsaturated Fatty Acids | 0.92 | 0.89 | 1.29 | 1.73 |
| | Polyunsaturated Fatty Acids | 1.29 | 1.42 | 2.15 | 3.85 |
| | *Trans* Fatty Acids | <0.01 | <0.01 | <0.01 | <0.01 |

**Table S4. Fats and fatty acids in human nutrition (Data adapted from FAO, 2010; Fats and fatty acids in human nutrition, Report of an expert consultation; FAO food and nutrition paper, 91, pp. 1–166)**

| Fat/Fatty acid | Measure | Numeric Amount | Range (kcal) | Range (g/day)* |
|---|---|---|---|---|
| **Total Fat** | AMDR | 20-35%E | 400-700 kcal | 44.44-77.78 g/day |
| **Saturated fatty acids (SFA)** | U-AMDR | 10%E | 200 kcal | 22.22 g/day |
| **Monounsaturated fatty acids (MUFA)** | AMDR | By difference; Total fat - (SFA+PUFA+T-FA) | Not directly calcu-lable | Not directly calcu-lable |
| **Total polyunsaturated fatty acids (PUFA)** | AMDR | 6-11%E | 120-220 kcal | 13.33-24.44 g/day |
| **n-6 PUFA** | AMDR | 2.5-9%E | 50-180 kcal | 5.56-20 g/day |
| **n-3 PUFA** | AMDR | 0.25-2 g/day | 2.25-18 kcal | 0.25-2 g/day |
| ***Trans* Fatty acids (TFA)** | UL | <1%E | <20 kcal | <2.22 g/day |

E: total energy intake per day (2000 kcal)
* Conversion rubric for kcal to g/day: 1 g=9 kcal
AMDR: Acceptable Macronutrient Distribution Ranges; U-AMDR: Upper Acceptable Macronutrient Distribution Range ; UL: Tolerable Upper Intake Level

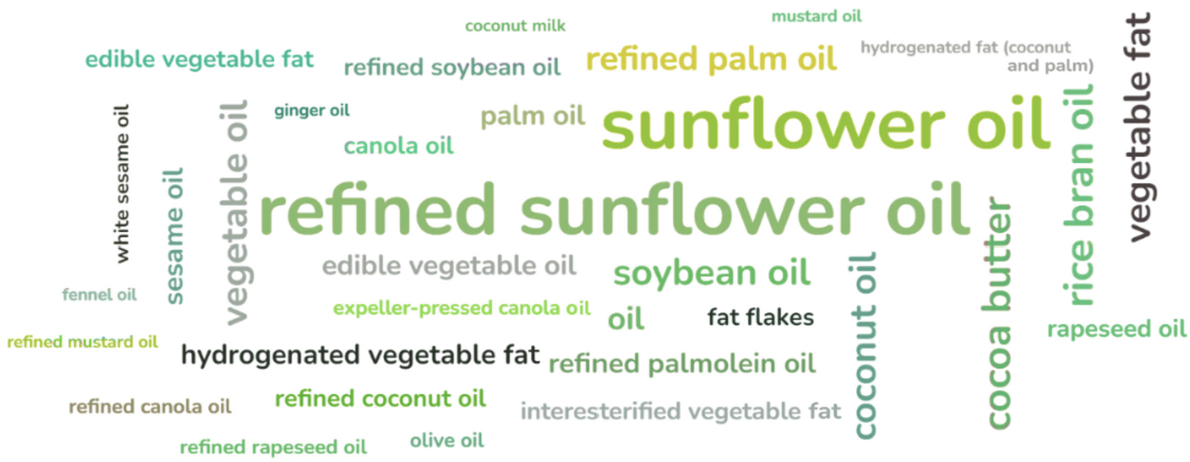



*Figure S1. Sources of fat in plant-based meat products.*