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Determination of nutrient composition of some selected traditional home- made meals commonly consumed in Syria

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ABSTRACT

Background: Modifying lifestyles through healthy dietary choices, enhanced cooking skills, and improved nutritional knowledge has been established as an effective strategy for reducing obesity and associated chronic diseases. **Aims:** This study aims to contribute to this effort by investigating the nutritional profiles of commonly consumed Syrian home-cooked meals. The primary objective was to analyze the macronutrient composition (carbohydrates, protein, fat) of five selected Syrian dishes and compare them to a frequently consumed, plant-based modern meal component. Additionally, the study aimed to assess the contribution of these nutrients to daily dietary needs. **Methods:** Four traditional Syrian vegetarian mixed dishes (grape leaves stuffed with rice, rice with pea broth, bulgur with chickpeas and pasta with tomato sauce) were selected for analysis. These were compared to a modern, plant-based food component (fried potatoes). Proximate analysis, based on standard methods established by the Association of Official Analytical Chemists (AOAC), was used to determine the content of macronutrients. Carbohydrate, protein, and fat exchanges for each meal were calculated using a rounding-off method. **Results:** All tested traditional dishes exhibited low energy density, with moisture content ranging from 63.16 – 75,63% and ash content ranging from 0.49 – 1.01% ash. Macronutrient compositions revealed carbohydrate contents between 17.43 – 25.41%, fat contents between 0.2 – 2.84%, and protein contents between 2.34 -3.83%. Crude fiber content ranged from 0.15 – 2.17%, and energy density varied from 0.96 – 1.44 Kcal/g. These traditional dishes contributed (63.04 – 75.26%) of total food energy from carbohydrates, (6.48 – 13.85%) from fat and (1.25 – 23.11%) from protein. In contrast, fried potatoes, the modern meal component, displayed medium energy density (1.83 kcal/g), with a distinct macronutrient profile: 60.22% carbohydrate, 1.44% ash, 24.56% fat, 7.26% protein, 4.90% crude fiber, and 1.62% moisture. The energy contribution of fried potatoes was 53.63% from carbohydrates, 35.67% from fat, and 10.70% from protein. **Conclusion:** This study provides valuable data for the potential development of a Syrian Food Database. The results suggest that incorporating popular Syrian traditional dishes into healthy dietary intervention programs holds promise for promoting better nutrition.

Keywords: Nutrient composition; Proximate analysis; Syria; Traditional dishes; Food exchange

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1 Introduction

Chronic diseases including diabetes mellitus, cardiovascular diseases, osteoporosis and cancer represent a major public health challenge globally [1,2]. Their prevalence has been steadily increasing worldwide, leading to detrimental consequences for morbidity rates and healthcare costs [3,4]. Obesity is considered as a major underlying risk factor of these diseases [5,6]. Alarmingly, data from 2017 suggests a high and potentially rising prevalence of overweight and obesity within the Syrian population [7].

According to the World Health Organization (WHO), obesity is described as abnormal or excessive accumulation of fat, with a body mass index (BMI) greater than 30 kg/m^2. Obesity arises from a chronic imbalance between energy consumed and energy expended [8]. While larger portion sizes can contribute to excessive energy intake, the frequent consumption of high-energy-density foods also plays a significant role. research has established a strong correlation between high-energy-density diets, sedentary lifestyles, and increased odds of developing obesity [9,10].

Energy density refers to the amount of energy (kcal) per unit weight (typically grams) of food consumed. Energy density affects the total energy intake by interacting with gastrointestinal, hormonal and neural control pathways. High-energy-dense foods are frequently characterized by higher amounts of saturated fat, added sugars, and/or salt, while lower-energy-density foods tend to be higher in fiber and/or water content, such as fruits and vegetables [11]. Convenience often seen as a time-saving factor, has significantly influenced food choices leading to the expansion of the fast-food, packaged, and ready-to-eat meal markets [11]. However, research suggests that consumption of these commercially prepared, away-from-home meals is associated with higher energy intakes and poorer dietary quality [13,14]. Conversely, studies have shown that engaging in cooking practices, preparing meals at home, and consuming more home-cooked meals are generally linked to healthier dietary patterns, reduced obesity risk, and lower prevalence of diet-related non-communicable diseases (NCDs) [15-17]. Nutrition labeling was developed as one of several public health strategies to inform, guide and empower consumer awareness towards healthier choices, promoting healthy lifestyles [18]. While the promotion of home cooking contributes to educational public health tools [19,20] a significant gap exists in various food composition databases, which often lack information on the nutritional composition of traditional home-cooked foods.

The present study aimed to investigate the following aspects of four popular home-cooked, plant-based Syrian dishes: a) determine the energy density; b) analyze the content of fat, protein, and carbohydrates in each dish. c) evaluate the contribution of these dishes to daily dietary for the analyzed nutrients; d) utilize the proximate analysis results to establish food exchange lists for meal planning purposes specific to these 4 dishes; and e) compare the nutritional profile of the Syrian dishes to a frequently consumed, modern, plant-based restaurant meal component, such as fried potatoes.

2 Materials and Methods

2.1 Selection and preparation of the recipes

Four traditional plant-based dishes commonly consumed in Syria were randomly selected from broader pool of known Syrian recipes: a) Grape leaves stuffed with rice (GR); b) Rice with pea broth (RPB); c) Bulgur with chickpeas (BC); and c) Pasta with tomato sauce (PTS). Fried potatoes (FP) were considered as a modern plant-based meal component for comparison purposes. This dish is frequently encountered in restaurants and ready-to-eat meals. Table 1 presents a detailed breakdown of the essential ingredients frequently used in preparing the tested dishes, along with their corresponding preparation methods.

2.2 Preparation of the samples

Each tested meal component including Fried potatoes was prepared in triplicate. Following preparation each individual portion was homogenized and stored in separate plastic bags at - 20°C. To ensure consistency and minimize degradation, samples were analyzed for proximate composition within two days of preparation. During this interim period, samples remained in storage at -20°C. The analyses were conducted at the Tishreen University Food Chemistry Laboratory.

2.3 Proximate composition

Proximate analysis was performed on all tested meal components to determine their moisture, ash, protein, crude fat, and crude fiber content. Established standard methods from the Association of Official Analytical Chemists (AOAC) [21] were followed for each analysis. The moisture content was determined using the oven-drying method at 105 C^0 until a constant weight was achieved. Ash content was determined by incineration at 600 C^0 in the presence of concentrated nitric acid as an oxidizing agent. The protein content was analyzed using the Kjeldahl method with a nitrogen-to-protein conversion factor of 6.25. Concerning the crude fat content, this was extracted from 8 g samples using a Soxhlet apparatus with Benzene as the solvent. The crude fiber content of was evaluated gravimetrically after sequential chemical digestion using sulfuric acid and sodium hydroxide solutions. The weight of the remaining fiber residue was then corrected for ash content following incineration.

2.4 Energy content and - density calculation

Due to the absence of standardized serving sizes for these traditional dishes, nutritional information was reported presented per 100 grams. Energy content per 100 g-serving size was calculated using established conversion factors (4 kcal/g for protein and carbohydrates, 9 kcal/g for fat) [22]. The contribution of individual macronutrients to total energy content was also evaluated for each tested food. Energy density was expressed as kcal per gram of meal weight. Following British Nutrition Foundation categorization [23], foods were classified as: very low energy density (< 0.6 kcal/g), low energy density (0.6 – 1.5 kcal/g), medium energy density (1.5 – 4 kcal/g), and high energy density (> 4 kcal/g). The contribution of energy and macronutrients from a 100 g serving of each tested dish to the nutrient adequacy ratios (%) for adults aged 31 – 50 years was calculated. To facilitate meal planning, a food exchange list was developed for the tested dishes using a previously described rounding-off method [24]. Briefly, the carbohydrate, protein, and fat content (in grams) obtained from proximate analysis were divided by established conversion factors (15 g for carbohydrates, 7 g for protein, and 5 g for fat) [24]. Portions containing 11 – 20 g of carbohydrate, 4 – 10 g of protein, or 4 – 7 g of fat were considered one exchange. Portions containing 6 – 10 g of carbohydrate or 3 g fat were considered half an exchange. Portions containing ≤ 5 g of carbohydrate, ≤ 2 g of fat or ≤ 3 g of protein were not assigned an exchange value [25].

The quantity (in grams) of each tested dish corresponding to 1 carbohydrate, 1 protein and 1 fat exchange was determined.

Table 1: Ingredients of studied traditional Syrian dishes and preparation methods.

Dish	Ingredients	Preparation method
Grape leaves stuffed with rice (GR)	- Half a kilo of French grape leave- - Two 250 mL cups of rice - A medium sized head of garlic - ½ tablespoon of cumin - ½ tablespoon of mint - ½ tablespoon of mixed black pepper - ½ tablespoon of salt - 60 mL vegetable ghee	- Rice was first rinsed and soaked in two cups of water for six hours; - Drained rice was then combined with crushed garlic, cumin, mint, black pepper, and vegetable heated for two minutes; - Grape leaves were blanched for one minute; - Approximately one teaspoon of the rice mixture was added to each leaf, which were then wrapped and placed in a pot; - Salt and four cups of water were added, and the mixture was brought to a boil over high heat. - The heat was then reduced, and the grape leaves were simmered for two hours.
Rice with pea broth (RP)	- ½ 250 mL - cup vermicelli - 1 1/2 250mL - cups rice - ½ tablespoon of salt - 1 tablespoon of vegetable ghee - 1 250 mL - cup peas - A 250 mL - cup of diced potatoes - ½ cup chopped carrots - A medium sized onion - 1 tablespoon of salt - ½ tablespoon of pepper molasses - 1 tablespoon tomato molasses - 1 tablespoon sunflower oil	**Rice with Vermicelli:** - Ghee and vermicelli were heated in a pot until the vermicelli became golden brown. - Rice was added and stirred gently. - Three cups of water and salt were added, and the mixture was cooked until tender (approximately 15-20 minutes). **Pea Broth:** - Onions were sautéed in oil over medium heat until softened (approximately two minutes). - Peas, carrots, and potatoes were added and stirred for one minute. - Three cups (350 ml each) of water and salt were added, and the mixture was simmered for 20 minutes. - Pepper and tomato molasses were added, and the broth was simmered for an additional 10 minutes before serving.
Bulgur with chickpeas (BC)	- A 250 mL - cup of chickpeas - A cup and a half of bulgur - ½ tablespoon of salt - tablespoons olive oil	- Chickpeas, soaked for a full day, were cooked in a pot with four cups of water and salt until tender (approximately 10 minutes). - Bulgur was added and brought to a boil. The mixture was simmered until tender (approximately 30 minutes). - Olive oil was then added.
Pasta with tomato sauce (PTS)	- 2 kilos of tomatoes - A tablespoon of olive oil - A teaspoon of salt - A quarter of a tablespoon of green thyme - 350 g pasta	- Peeled tomatoes were combined with olive oil, salt, and green thyme. The mixture was simmered over medium heat for 30 minutes until slightly reduced. - After cooling, the cooked pasta (boiled in three liters of water for 10 minutes) was added to the tomato sauce, and the mixture was well combined.
Fried potatoes (FP)	- Medium size potatoes (Spunta variety)- sunflower oil	- Potatoes (100-200 g) were purchased, washed, and peeled using a stainless-steel peeler. - The peeled potatoes were rinsed again and cut lengthwise into finger shapes, approximately 0.5-1 cm wide and in lengths corresponding to the potato size. - The potatoes were deep-fried in sunflower oil until golden brown (approximately 20 minutes).

2.5 Statistical Analysis

Each tested food component was prepared in triplicate. All subsequent analyses were also performed in triplicate to ensure data consistency and minimize experimental error. Data are presented as mean ± standard deviation (SD). The Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) version 22 was used to perform one-way analysis of variance (ANOVA) and a post-hoc test: Least significant difference (LSD) test.

3 Results and discussion

The results of the proximate analysis for moisture, ash, crude fiber, protein, and fat content of the tested dishes are shown in Table 2. Moisture content of Grape leaves varied across the dishes, ranging from 60.22% in Fried Potatoes (FP) to 75.62% in Rice with Pea Broth (RPB) as shown in Table 2. Depending on the results of other studies showed that vegetable soups contain the high content of moisture [26], it was not surprising to find the highest moisture content (75.62%) in (RPB), as the pea broth is considered as soup and its texture is liquid. As the moisture content of the dishes depends on the preparation/cooking methods used, (FP), the only tested food prepared by deep-frying, showed the lowest content of moisture (60.22 %) among others. Ash and crude fiber content did not vary between the studied dishes. Ash content ranged from 0.49% (BC) to 1.44% in (FP), while the lowest fiber content (0.15%) and the highest fiber content (2.17 %) were found in (RPB) and (PTS), respectively. Protein content displayed moderate variation, with BC having the lowest (2.34%) and FP having the highest (4.90%). Fat content varied considerably, with the highest level found in FP (7.26%) due to the deep-frying process. The next lowest fat contents were in PTS (2.84%) and GR with (2.57%), RPB (0.63%), and BC (0.2%). Current labeling regulations define a "low-fat" claim for a serving containing ≤ 3 grams [22]. Based on this criterion, all analyzed dishes except FP qualify as low-fat options considered as appropriate for a healthy diet.

The energy content of the analyzed dishes, as presented in Table 3, ranged from 96 kcal/100 g for rice with Pea Broth (RPB) to 183 kcal/100 g for Fried Potatoes (FP). This variation can be attributed to the differing proportions of macronutrients (carbohydrates, protein, and fat) within each dish. The contribution of carbohydrates, protein, and fat to the total energy content varied among the analyzed dishes (Table 3). Traditional dishes (excluding FP) derived 63.04% - 92.27% of their energy from carbohydrates, 1.25% - 23.11% from protein, and 6.48% - 13.85% from fat. Fried potatoes (FP) deviated from this pattern, with carbohydrates contributing 53.63% of its energy, protein contributing 10.70%, and fat contributing a significantly higher proportion (35.67%). The Acceptable Macronutrient Distribution Ranges (AMDRs) recommend that 45%–65% of daily energy intake for adults should be provided from carbohydrates, 20%–35% from fat, and 10%–35% from protein [27]. All analyzed dishes met the AMDRs for carbohydrates, as their carbohydrate content exceeded 50% of their total energy content. Protein intake varied across the dishes. While GR and BC derived less than 10% of their energy from protein, suggesting they are not significant protein sources, RPB, PTS, and FP all contained a higher proportion of protein and could be considered good protein sources.

Table 2: Proximate Composition analysis of tested foods commonly consumed in Syria

Tested food	Moisture%	Ash%	Fat%	Protein%	Crude fiber %	CHO%
GR	68.06 ± 2.49[a]	1.01 ± 0.13 [a]	2.57 ± 0.27 [a]	2.57 ± 0.15 [a]	0.36 ± 0.09 [a]	25.41 ± 2.38 [a]
RPB	75.62 ± 1.02[b]	0.89 ± 0.05 [b]	0.63 ± 0.02 [b]	3.34 ± 0.23 [b]	0.15 ± 0.01 [b]	19.35 ± 1.07 [b]
BC	63.16 ± 1.44[c]	0.49 ± 0.09 [c]	0.20 ± 0.01 [c]	2.34 ± 0.06 [c]	0.47 ± 0.01 [c]	33.32 ± 1.48 [c]
PTS	72.55 ± 0.12[d]	0.61 ± 0.01 [d]	2.84 ± 0.01 [a]	3.83 ± 0.01 [d]	2.17 ± 0.01 [d]	17.43 ± 3.09 [d]
FP	60.22 ± 0.74[e]	1.44 ± 0.09 [e]	7.26 ± 0.06 [e]	4.90 ± 0.12 [e]	1.62 ± 0.05 [e]	24.56 ± 0.5 [a]

Values are expressed as mean ± SD; ANOVA and LSD test: by column, means followed by different letters are significantly different ($p < 0.05$).

Table 3: Energy content, energy density and macronutrient contribution of tested foods commonly consumed in Syria

Tested food	Energy content Kcal/100g	Energy density Kcal/g	Energy contribution		
			% as CHO	% as Fat	% as protein
GR	135	1.35	75.26	17.13	7.61
RPB	96	0.96	80.27	5.88	13.85
BC	144	1.44	92.27	1.25	6.48
PTS	111	1.11	63.04	23.11	13.85
FP	183	1.83	53.63	5.67	10.7

Fat's contribution to the total energy content varied across the analyzed dishes. In most dishes, fat contributed less than 20% of the energy. However, FP exhibited the highest fat contribution (35.67%), followed by PTS at 23.11%.

While the total fat content of the analyzed dishes varied, a complete understanding of their health impact necessitates determining their fatty acid profiles, particularly saturated fat content. High consumption of saturated fat is a known risk factor for cardiovascular disease [28]. The observed variations in fat content might be attributed to the differing proportions of olive oil, sunflower oil, and vegetable ghee used during cooking. These oils have varying fatty acid compositions, and the specific oil blend employed can significantly influence the overall fat quality of the dish. Current dietary recommendations advise that total fat intake should not exceed 30% of daily energy intake to promote healthy weight management and reduce the risk of diet-related chronic diseases [29]. The analyzed traditional dishes exhibited energy densities ranging from 0.96 kcal/g to 1.44 kcal/g, classifying them as low energy density foods according to established criteria [23]. FP, however, deviated from this pattern with a higher energy density of 1.83 kcal/g, placing it in the medium energy density category. This is surprising given its high fat content and fat contribution to total energy. This observation can likely be explained by the higher water content (60.22%) of FP. Water adds weight and volume to the food without significantly increasing its energy content, thus lowering the overall energy density even in the presence of high fat levels.

Consistent with previous research, consuming low energy density foods plays a vital role in managing body weight by promoting satiety and reducing overall energy intake [30].

Carbohydrate, protein, and fat exchanges were calculated for 100 g servings of each tested dish on the proximate macronutrient analysis values (Table 4). All analyzed dishes contained at least one carbohydrate exchange, with BC exhibiting the highest number of carbohydrate exchanges.

population were used. This reference was employed to determine the percentage contribution of a 100 g serving size of each analyzed traditional food to the daily intake needs for adult males and females aged 31 – 50 years [27].

Table 5: Contribution of 100g serving of tested traditional foods to the RDI of carbohydrate, protein and fiber

Tested food	CHO% M & F 130 g/d	Protein% M 56 g/d	Protein% F 46 g/d	Fiber% M 38 g/d	Fiber% F 25 g/d
GR	19.55	4.59	5.59	6.76	10.28
RPB	14.88	5.96	7.26	1.66	2.52
BC	25.63	4.18	5.09	0.53	0.8
PTS	13.41	6.84	8.33	7.47	11.36
FP	18.89	8.75	10.65	19.11	29.04

A 100 g serving size of the analyzed dishes provided (13.41 – 25.63 %) of the daily carbohydrate requirements (130 g/d) for both males and females. This intake represents a portion of the recommended daily intake. Men could obtain 4.18 – 8.75% of their daily protein needs (56 g/d), while women could obtain 5.09 – 10.65% of theirs (46 g/d), from a 100 g serving of these traditional foods. Similarly, the daily fiber requirement of 38 g for men and 25 g for women could be fulfilled by 0.53 – 19.11% and 0.8 – 29.04%, respectively, with 100 g serving size.

Table 4. Meal planning exchanges for selected foods commonly consumed in Syria

Tested food	Amount of macronutrient (g/100g)			Number of exchanges in 100 g of food			Amount of food provides 1 exchange (g)		
	CHO	Fat	Protein	CHO	Fat	Protein	CHO	Fat	Protein
GR	25.41	2.57	2.57	1 1/2	1/2	*	59	195	272
RPB	19.35	0.63	3.34	1	*	*	78	794	210
BC	33.32	0.20	2.34	2	*	*	45	2500	299
PTS	17.43	2.84	3.83	1	1/2	*	86	177	183
FP	24.56	7.26	4.90	1 1/2	1	1 1/2	61	69	149

*: Amount measured is too small to be counted

FP was the only dish containing a quantifiable amount of fat (one exchange) and protein (one exchange) based on the established exchange system. The fat and protein content of all other tested dishes fell below the threshold for counting as one exchange. To develop an exchange list for the analyzed foods (Table 4), the amount of each food needed to constitute one exchange of carbohydrate, protein, or fat was calculated based on its macronutrient composition. As anticipated, a negative correlation exists between the number of exchanges presented in a dish and the recommended portion size of that dish. In the absence of local recommendations intakes, the daily intake guidelines for carbohydrate, protein and fiber f established by the Food and Nutrition Board of the Institute of Medicine, National Academies for the United States

Given the limited availability of research on the nutritional composition of Syrian composite dishes consumed, this study findings were compared data from studies conducted in other countries. No published data on the macronutrient composition of these specific dishes was identified in either Arab or non-Arab countries. GR is a traditional dish which is comparable to the Turkish "dolma" analyzed by El et al. [31]. A 100 g serving of their dolma reportedly contained 70.96 g moisture, 1.65 g ash, 11.19 g fat, 2.48 g protein, 13.80 g carbohydrate, and 164 kcal [31].

Abong et al. [32] investigated the nutrient content of processed Kenyan potato products, including French fries [32]. Compared to our findings for FP, French fries exhibited lower ash (1.01

– 1.14 %), moisture (46.78 – 54.52%) and fat content (3.09 – 5.55%) but a higher content of carbohydrate (33.96 – 41 .30%). The crude fiber (1.21 – 2.12 %) and protein (3.69 – 4.83%) content of French fries were identical to our results for FP. Triasih and Utami [33] reported the nutritional profile of fried sweet potato in Indonesia to be 55.17% moisture, 1.17% ash, 0.20% fat, 1.37% protein, 42.09% carbohydrate, 175.6 kcal per 100 g. These variations highlight the potential influence of processing methods on nutrient composition. Neves et al. [34] demonstrated the significant variation in the nutritional profile of commercially available pastas and tomato sauces due to differing ingredients (vegetables, cheese, etc.).

The observed discrepancies between the macronutrient composition of the dishes analyzed in this study and those reported in previous research can likely be attributed to variations in: *a) ingredients:* The specific types and qualities of ingredients used can significantly impact the final nutrient profile of a dish and in *b) preparation methods*: Different cooking methods (e.g., boiling, frying) can affect nutrient content by altering factors like water content and fat absorption.

This study has limitations. The number of Syrian traditional dishes analyzed was limited, and only their proximate composition (moisture, ash, protein, fat, fiber, carbohydrate) was determined. Future research should include a broader range of commonly consumed Syrian traditional dishes and should analyze the mineral, vitamin content, and fatty acid profiles of these dishes to provide a more comprehensive nutritional picture.

4 Conclusion

This study has determined the nutritional profiles of severely commonly consumed traditional foods in Syria. Understanding the nutritional profile is crucial for:

- Regulating nutrition and health claims: Accurate nutritional data is essential for verifying and substantiating claims made about the health benefits of specific foods.
- Developing a Syrian Food Database: Establishing a comprehensive food database for Syria would facilitate dietary assessments and nutrition education initiatives.
- Providing consumer information: Empowering consumers with accurate nutritional information allows them to make informed and healthy food choices.

Furthermore, the findings suggest that these traditional Syrian dishes generally exhibit a more favorable nutrient profile and lower energy density compared to modern recipes. Such data paly an essential role in identifying foods with potentially beneficial nutritional profiles can inform strategies for promoting dietary patterns that may contribute to disease prevention. Accurate data on the nutrient composition of commonly consumed foods is essential for estimating population dietary intakes and informing public health interventions. Meal planning and dietary quality: The development of an exchange list for these foods can empower the Syrian population to design balanced and nutritious meal plans, potentially leading to improved overall dietary quality.

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