Quality assessment of Processed, Street and Restaurant Traditional Pakistani Foods: A case study

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Abstract

The current work is aimed to assess proximate analysis and minerals contents (calcium (Ca), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), magnesium (Mg), manganese (Mn), potassium (K), sodium (Na) and zinc (Zn)) in twenty-threefood products of packaged food (F_P), restaurant food (F_r), and street food (F_s) of Hyderabad city of Pakistan. The estimated daily intake (EDI) of macro and micro-nutrients as well as toxic risk assessment of micro minerals by the consumption of studied food dishes of three categories were also conducted. The moisture contents studied food products of all three categories have great variation based on the recipe of the dishes (addition of water). All the food dishes of F_p examined based on their shelf life (6 to 12 months at room temperature in packing) provided approximately 172 - 316 kcals100g^{-1} (on dried basis). Whereas, the food dishes of F_s, and F_r have short shelf life (2 to 3 h at ambient condition) and supplied 172 –341, and 134 – 454 kcals 100g^{-1}, respectively depending on the variety of food dish. The chicken/meat, and pulse food dishes of all three categories were enriched with protein except bhindi masala. All the dishes of studied categories have huge variation in the fat contents (highest in daal fried) and differing based on the used quantity of hydrogenated oil during their preparations. The vegetable and wheat-based food items except paratha have low contents of both protein and fat whilst comparatively high contents of fibres as compared to other food dishes. This study showed a huge variation in the macro and micro mineral contents in studied food products depending on the food preparation recipes as well as the levels and kind of ingredients added. All food dishes are a good supplementary source of fundamental nutrients led to meet the recommended daily allowances for adults. The toxic risk assessment study revealed that hazardous index (I_h) of micro minerals in some food products of F_s and F_r were > 1.00 reflected the possible toxicity risk for workers of auto mechanic workshops. These possible toxic risk of the use of food products of F_s and F_r might be due happened to the unhygienic conditions for their preparation and hawking places.

Keywords: Food · Proximate analysis; Macro minerals; Micro minerals; Dietary intake, Pakistani street foods; packed foods; restaurant foods

Introduction

Food is a necessary component of the human diet, required to provide energy for sustainable life, and nurture the body functions. The nutritious diet may sustain, strengthen, and give treatment and/or resistance to illnesses by repairing, stimulating, and developing tissues in the body [1]. A large variety of traditional and popular Pakistani foods in the form of cereal-, fruit, legume-, vegetable-, or meat-based ready-to-eat (processed or fresh) at a street vendor or a restaurant and easy-to-reconstitute available in the local market [2]. Ready-to-eat foods are those that can be purchased straight from street sellers or hawkers or from local markets and consumed right away, without the need to prepare them first [3]. Several attractive aspects contribute to the popularity of street meals as a food source. Familiarity, flavour, cheap cost, and convenience are just a few of them [4]. However, most upper- and middle-class individuals are concerned about the unhygienic conditions of street vendors and small restaurants. Consequently, dislike these readily accessible ready-to-eat food products. Furthermore, the manufacturers of these process packaged foodstuffs are massively contributing in marketing their commodities through printing, broadcasting, and social networking through promoting benefits such as simplicity of preparation, diversity of ingredients, and accessibility during off-seasons [2, 5]. As a result, such processed foodstuffs stimulate attention of their consumers.

Unfortunately, the mismanagement and surveillance of these foodstuffs during production, preservation, transport, and distribution may express concern about their quality. Pathogenic microorganisms or toxic chemicals present in these foods can harm public health by producing different chronic and acute food-related illnesses. Street food items are ready-to-eat foodstuffs made and sold by sellers in public locations such as streets and malls. In both the rural and urban sectors, street food is highly prevalent. Rapid urbanization has offered these occupation additional dimensions. These street foods are fast to prepare, delicious, and inexpensive. It appeals to people of all ages, notably the younger generations. Despite the source of production or the quality of raw supplies utilized, street food is typically consumed, even if it is prepared in a non-hygienic environment. The choice of specific street food is based on personal preference, financial means, and provision at the time of consumption[6].

Metals as a significant factor of human nutrition are involved in various physiological and immunology functions in humans, plants, and animals. Metals in foods have a major impact on health and illness, ranging from the requirement for essential trace elements to the toxicity associated with their excess. These are categorized as macro or micro minerals depend on how much they are needed in the body. Excessive amount of these metals can cause a variety of physiological disorders[7, 8].

Some of these foods also have been investigated by Prasad et al., for proximate parameters and mineral composition[9, 10]. In the case of the sooji halwa, mango bar, and fruit drinks that were not salted, the Na content is low. The plant foods contain almost 10 times greater contents of K than Na. According to the National Institute of Nutrition meat has greater contents of Zn than pulses and grains[10]. The legume-based items, such as IPS baked beans, canned vegetable curry, and canned peas in brine had greater Cu contents. Semwal et al. (2016), also reported higher concentrations of Cu contents in pulse-based products [11]. Mn concentrations were greater in the legume or pulse-based products [10]. Only a few studies of Nigerian foods for metal concentration have been found in the literature, and these research are restricted in terms of the elements and foods assessed [12-15].

In this study, proximate analysis and elemental contents of the food dishes and their proportion should be controlled in convenience with health safety measures and it is obligatory to screen for their quality check. This work leads the researchers to study the effect of proximate analysis (moisture, ash, protein, fat, fiber, Carbohydrate), essential major (Na, K, Mg and Ca) and trace (Cu, Fe, Zn, Mn, Al, Cr, Co, and Zn) metals in food and determining their permissibility for human consumption.

Material and method

Chemicals, reagents, and instrumentation

De-ionized water (electric conductivity < 0.05 µS/cm) utilized throughout the experimental studies, obtained from the water purifying system (Bedford, MA, USA). E. Merck (Darmstadt, Germany) supplied concentrated H_2SO_4 (40%) and HNO_3 (65%), H_2O_2(30%) as well as NaOH, Na_2SO_4, and $CuSO_4$. Merck (Darmstadt, Germany) provided high purity, hydrochloric acid (HCl), boric acid (H_3BO_3), ammonia (NH_3), and diethyl ether ($(C_2H_5)_2O$), while Sigma Aldrich(St. Louis, MO, USA) provided acetone ($(CH_3)_2CO$).The essential metals standard working solutions (Ca, Co, Cr, Cu, Fe, Na, Mg, Mn, K, and Zn) were newly prepared in 0.2 mol/L HNO3 by diluting certified standard solutions of the appropriate element (1,000 mg/L) acquired from Fluka Kamica (Buchs, Switzerland).For the measurement of Cr and Mn, a 2,000 mg/L chemical modifier $Mg(NO_3)_2$ stock standard solution was made by taking a sufficient quantity of $Mg(NO_3)_2$(Merck). For the determination of Ca, Mg, K, and Na, a releasing agent 2,000 mg/L $SrCl_2$ stock standard solution was prepared by taking a sufficient quantity of $SrCl_2$ (Merck). Community Bureau of References (BCR; Brussels) provided certified reference material (CRM) of beech leaves BCR-100 and wholemeal flour BCR-189.

The Agate ball mixer mill (MM-2000 Haan, Germany) was used to ground dry materials. Spices samples were digested on an electric hot plate (at a temperature of 80 °C). An atomic absorption spectrometer (AAS; Hitachi, Tokyo, Japan) with Ca, Cr, Cu Na, K, Mg, Fe, Mn, and Zn hollow cathode lamps, as well as an air-acetylene flame atomizer and electro thermal atomic absorption (ET; graphite atomizer GA-3) was used. Cr, Co, and Mn contents were measured using pyrolytically coated graphite tubes. As indicated in our earlier study, the instrumental conditions were established according to the vendor's handbook[16, 17]. The instrumental conditions of atomic absorption spectrometry for each macro and micro minerals is provided in the Table 1 and also followed as reported elsewhere [17]. The GF heating procedure for Cr, Co, and Mn, as well as modifiers, was employed as previously described in literature [17].

Sampling and sample preparation:

Currently, the proximate and mineral compositions of twenty-three food items have been analyzed. The food products divided into three categories based on the mode of availability as packed food (F_p), street food (F_s) and restaurant food (F_r). Seven F_p food servings (n = 21) from three distinct brands were purchased at mega markets in Hyderabad, Pakistan. Similarly, five and ten Fs (n = 15) and Fr (n = 33) food items were acquired from street vendors and local restaurants in Hyderabad, respectively. Prior to the analysis, all the samples were preserved in polythene bags and stored in a cold, dry cardboard box. Food dish samples were collected and ground in a grinder before being transferred to a round bottled flask. These flasks were placed in freezer for 36 hours. These food samples were then freeze-dried in FD-1 (freeze-drying device) (Eyela Co, Tokyo, Japan) for 20 hours at a chamber pressure of0.225 torr. In an agate ball mill, the lyophilized materials were crushed and homogenized to a fine powder for 5 minutes at 60% power. The powdered materials were sieved to attain a particle size of 30–65 μm using a nylon sieve. The powder was then kept in plastic bottles at – 4 °C until further analysis[18, 19].

Proximate Composition

Proximate composition including moisture, ash, protein, and crude fat, crude fibre and carbohydrate contents indifferent food dishes at the laboratories of National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro followed the standard procedures of Association of Official Analytical Chemists (AOAC). The moisture contents in the various food dishes of F_p, F_s, and F_r were determined by placing an adequate quantity of each sample (5.0 g) in Petri-dishes and dehydrating them in an electric oven at 105 °C for around 10 hours to achieve a consistent weight. The samples on Petri-dishes were then put in a desiccator for 1 hour to cool before being reweighed. The difference between fresh and dried weights is used to assess the moisture content of each sample [20]. Dried samples of various food dishes obtained after the moisture content measurements were placed in a muffle furnace at 550°C for 12 h. The percent ash content is calculated by dividing the weight of ash by the original dry weight of each food dish[21]. Each food dish sample was processed step-by-step by digestion, distillation, and titration methods before being converted from total nitrogen (g/100g) to crude protein using a 6.25 conversion factor to determine crude protein using the Kjeldahl technique[21]. For the crude fat measurement 5.0 g of each dry food dish sample wrapped on filter paper and placed in a Soxhlet assembly coupled to an extraction flask containing 200 mL of petroleum ether. The Soxhlet assembly was then placed on a hot plate at 60 degrees Celsius for 6.0 h. The extract was then transferred to a desiccator and allows cooling for 30 minutes before the separation of fat by ether using a rotary evaporator. The fat contents of each food dish was determined by standard method [21].The crude fibre content of each food sample was evaluated by digestion with H_2SO_4 and NaOH, followed by incineration of the residue at 550°C for 5.0 – 8.0 h in a muffle furnace. Following that, the crude fibre contents (g/100g) of each food dishes sample was calculated [21]. The total carbohydrate content of food samples is calculated by subtracting the sum of ash, moisture, protein, and fat contents out of 100 [22, 23].

Conventional Acid digestion methods

In separate Pyrex flasks, triplicate sub-samples of dried powder of each food sample (0.5 g) and replicate six sub-samples of certified reference material BCR-100 (0.2 g) were treated with 5.0 mL of a concentrated acid mixture of HNO_3 and H_2O_2 and kept at room temperature for 30.0 minutes. The colourless digests were obtained by placing each flask on hot plate at

80.0 °C. To get semi-dried material, the surplus acid was evaporated, then cooled and diluted with 0.20 M HNO_3up to the level of 10.0mL. The sample was then filtered using Whatman No. 42. Along with the samples/standards for elemental analysis, blanks were prepared with same acid matrixes [24, 25].

Calibration and sensitivity

A set of elemental standards of macro and micro minerals were used to calibrate the system. The slope value derived by least-square regression analysis of calibration curves based on peak area measurements was referred to as sensitivity. The results indicated that each element had a good co-efficient of determination (R^2> 0.990). For the analysed elements, the linear range of the calibration curve was drawn, ranging from the limit of quantification to 2,000 µg/L. The following formula was used to calculate the LOD and LOQ:

$$\mathrm{LOD} = 3.0 \times \mathrm{s} \,/\, \mathrm{m}$$

$$\mathrm{LOQ} = 10.0 \times \mathrm{s} \,/\, \mathrm{m}$$

Where "s" is the standard deviation of 10 blank measurements and "m" denotes the calibration graph's slope. The LOD/LOQ of Ca, Co, Cr, Cu, Fe, Na, Mg, Mn, K, and Zn were found164/547,0.317/1.02,4.70/15.8,17.3/57.7,69.2/231,5.52/18.4,2.46/8.21,17.7/59.1, 14.0/46.8, and 10.0/33.5 µg/L, respectively.

The replicates six sub-samples of each certified reference material (wholemeal flour BCR 189 and Beech leaves BCR 100 (n = 6)) were used to evaluated mineral contents. This was done to evaluate the applicability and accuracy of the acid digestion technique for the analysis of essential elements (minerals) by AAS. The observed concentrations of all elements in each CRM sample were in good agreement with certified values. Each element's percentage recovery was found > 97 % (Table 2). The acquired results were compared to certified/estimated values, by using paired t-test. At a 95% ($p < 0.05$) confidence interval, the

$t_{Experimental}$ values were lower than the $t_{Critical}$ (2.57), showing that there is no discrepancy between the observed and indicated values. The method's precession was expressed as a percentage of relative standard deviation (%RSD)which was found less than 2.5 percent, for a set of nine independent assessments of each element in the same CRM sample.

Estimated daily intake and toxic risk assessment

The estimated daily intake ($DI_{est.}$) from consumption (mg/kg bw/day)

$DI_{est.}$= [($C_{macro/micro\ mineral}$ × IR food) × EF × ED] / (AT × BW)

Whereas,

'$C_{macro/micro\ mineral}$' indicates the nutrients or minerals values (mg/kg) in food

'IR food' the food (kg/day) in ingestion rate

'EF' exposure frequency for (days/year) or (365/year)

'ED' exposure duration (years) (5 years)

'AT' average age time (days) (365 ×5 = 1825 days)

'BW' body weight (kg)

The toxic risk assessment of micro minerals (Co, Cr, Cu, Fe, Mn and Zn) has been calculated for non-carcinogenic exposure, as Hazard Index (I_h), can be calculated as,

$$I_h = DI_{avrg.}/RfD$$

Where,

'$R_{f.}D$' are the oral toxicity reference value of Co, Cr, Cu, Fe, Mn and Zn which are0.007, 1.5, 0.04, 0.07, 0.41 and 0.3 mg/kg/day, respectively.

According to the United State environmental protection agency US EPA, 2005, if calculated I_h is <1, then there is no expected adverse health effects as a result of exposure. The I_h was > 1, may have possible adverse health effects.

Statistical Analysis

The observed findings (included data processing and statistical analysis) were performed using Excel XP 2007 (Microsoft Corp., Redmond, WA) and the STATISTICA (TIBCO Software Inc., Palo Alto, USA) software programme. The significance differences between the variables evaluated in this method was assessed using Student's paired *t*-test and the ANOVA test. The normally distribution data was given as means ± SD.

Results and discussion

The proximate and mineral compositions of 23 food items were determined. Table 3 shows the results of proximate analysis such as ash, carbohydrate, fat, fibre moisture, and protein content in seven F_p (n = 21), five F_s(n = 15), and eleven F_r (n = 33) meal items. Moisture level in F_p items was found to be high in bindi masala, chicken karahi ghost, Lahori choley, and shami kabab (61.70– 69.20 %), moderate in chicken achari and shahi qorma (32.90 –47.60 %), and low in daal fry (4.03 – 5.56 %).Except for chapati (27.50 –27.90 g/100g), daal (5.72 – 5.87 g/100g), naan (11.5 – 14.2 g/100g), paratha (14.60 –14.90 g/100g), and chicken white qorma (31.70 –31.90 g/100g) all F_s and F_r items have significant level of moisture contents (> 40.0 %). The amount of moisture/water in meals depends on the recipe as well as the primary ingredients, such as vegetables, rice/grain, or meat. The ash contents of F_p food items ranged from 1.50 to 5.50 g/100g, which is comparable with the amounts indicated in several Indian packaged foods (Prasad et al., 2000). Similarly, the ash contents of all F_s and F_r food items range from 1.20 – 5.80 g/100g. However, there is a minor difference between the same F_p, F_s, and F_r food items (p 0.01). These differences might be related to variation in the food production process, recipes, and how hygienic/unhygienic conditions are used.

The macronutrients (carbohydrates, fat, and protein) are the most important requirement of a healthy lifestyle, and they rely heavily on a well-balanced diet to reduce the risk of chronic illness[26].According to the findings of macronutrient analysis in F_p, the protein contents was lowest in the bhindi masala (from 4.19–4.33 g/100g), whereas it ranged from 9.27 – 23.1 g/100g in the other six food products. These recipes are the rich source of protein for consumers. These differences in protein might be due to the protein content of the raw materials used during the production process. The protein distribution in F_p food product samples have been found in decreasing order as chicken food dishes (shahi qorma and chicken achari) >beef food dish (karahi gosht) >grain, chicken, potato mixed product (chicken shami kabab) > grain product (daal fry and Lahori choley) > bhindi masala. Protein level was found from 2.31 – 9.84 g/100g and 2.19 – 14.4 g/100g, in F_s and F_r food items respectively. Naan, chapati, and paratha are made by wheat flour, which is a vital grain and a good source of calories, minerals, and protein[27]. The protein levels of F_r(naan and chapatti) as well as in F_s(naan) were comparable to those reported by the Wheat Research Institute in Faisalabad, Pakistan[27].These all food products assisted to fulfil the required protein level for a healthy adult and were found to be within the suggested dietary reference intakeof calories from protein (10 – 35% of total calories) for an adult [26].

Low-fat and high-carbohydrate diets have been shown to be harmful to those with a certain kind of blood-lipid profile, whereas excessive fat content in the diet can contribute to obesity and its associated issues[26]. However, in the current study (in ether-extract) the fat content was found to be lowest in bhindi masala (2.97–3.10 g/100g), chicken Lahori choley (4.98–5.90 g/100g), and shami kabab (4.01–4.11 g/100g). The other F_p food products had 8.20 to 19.3 g/100g content of fat. However, chola biryani, has the highest fat level (8.23 –

8.47g/100g), followed by chicken biryani, haleem, and chola (Table 3). Moreover, the naan has the lowest fat level (1.57-1.78g/100g). The contents of fat in F_r food items varies greatly, ranging from 1.14 to 19.8 g/100g. The low level of fat in bhindi, chapati, and naan of F_r might be attributed to the use of a small amount of vegetable oil or the usage of low contents of fat in raw ingredients such as green bhindi, spices, or wheat flour. The fat level of both F_p and F_r daal fry (gramme lentil curry) was found to be the highest. It is due of the significant amount of vegetable oil used, as well as the fact that the gram lentil has a high fat content[28, 29]. However, fat content in F_r paratha was found to be high (14.8–15.0 g/100g). It is because of mostly the parathas are made by using hydrogenated vegetable oil. This large variety of fat concentrations in distinct F_p, F_s, and F_r food items might be attributable to differences in the quantity and kind of dehydrogenated vegetable oil used during food dish production or the presence of fat in raw materials. As a result, all F_p, F_s, and F_r food products have good agreement with the recommended dietary reference intake of calories from fat (20–35%) for an adult.

In F_p Daal fry (59.9–60.2 g/100g), chicken achari (33.4–34.3 g/100g), and bhindi masala (19.1–20.1 g/100g) had the highest carbohydrate content, whereas Lahori choley, karahi gosht, shahi qorma, and chicken shami kabab had carbohydrate amounts in the range of 10.90–16.10 g/100g (Table 3). Carbohydrate content in F_s and F_r food items ranges from 18.60– 78.90 g/100g and 12.2 – 81.2 g/100g, respectively. However, as compared to the same food products from F_r, F_s, chicken biryani, haleen, and chola had significantly higher carbohydrate levels ($p > 0.05$). Except for naan and chapati (> 80 percent of total calories), in all F_p, F_s, and F_r food products carbohydrate were determined within the dietary reference intake of calories (45–65 percent). It has been suggested that restricting carbohydrates for small periods of time may not be detrimental. As a result, it is recommended that a better strategy be devised to minimise the use of refined carbohydrates such as highly processed meals, sugar, white flour, and so on[26].

The bhindi masala had the highest fibre content (4.91 – 5.03 g/100g) in the comparison of other F_p samples ($p > 0.01$). Except for F_r bhindi (2.17 – 2.40 g/100g), all F_s and F_r food products had fibre content less than 2.0 g/100g. The fiber-rich bhindi masala F_p and F_r may aid in the prevention of degenerative disease[10]. TheF_p macronutrients can provide Calories ranging from 120 to 455 kcal/100g. When compared to the rest of the F_p food products, Daal fry (442–455kcal/100g) had the largest quantity of calories in the form of macronutrients ($p > 0.05$). Similarly, the macronutrients in F_s and F_r food products can give calories ranging from 134 to 454 kcal/100g.

The consumption of each food product by adults was calculated to estimate the daily intake of F_p food products. The main consumers of packaged meals are upper-class families or certain middle-class bachelors (workers/officers).The six pieces of packaged chicken shamikabab weigh a total of 186.0 g. According to the survey, the average person can have two pieces of chicken shami kabab twice a week for lunch or dinner. As a result, its daily consumption is 18.0 g. (average bases). The remaining packet contains 275 g of each F_p food product, including bhindi masala, chicken achari, daal fry, karahi ghost, Lahori choley, and shahi qorma, which is enough to feed two people. These food products are usually consumed once a week, with $DI_{avrg.}$ of 20.0 g. The F_s items were collected from the main city of Hyderabad. It was noticed that the workers of car, tractor, and motorbike maintenance workshops are the most frequent customers of street food sellers. Choley, chola biryani, and chicken biryani were consumed one plate three times a week, while haleem was consumed one plate (250.0 g) twice a week (six working days of the week) at the time lunch by the employees. Thus, the average daily consumption of chola, chola biryani, and chicken biryani was 125.0 g/day, whereas haleem was 84.0 g/day. The workers consume one naan (160.0 g average wt.) with haleem twice a week on average, with an estimated average daily intake of 54.0 g. A survey found that an adult may consume one plate (250.0 g) of F_r beef biryani, bhindi, chola, chicken biryani, chicken pulao, daal, and haleem twice a week for lunch/dinner. As a result, each of these food products is consumed 71.0 g each day. Similarly, the $DI_{est.}$ of chicken white qorma is 36.0 g/day, based on one plate (250.0 g) consumed once a week at lunch/dinner. The average weight of a chapatti, naan, and paratha is 40 g (twice a day), 160 g (thrice a week), and 120 g (once a day) with an adult's typical daily intake of 80.0, 69.0, and 120,0 g/day, respectively (Table 4).

The estimated daily intakes ($DI_{est.}$) of each macro nutrient (carbohydrate, fat, fibre, and protein) from each meal dish of F_p, F_s, and F_r were calculated (based on the estimated consumption) as given in Table 4. There is no information in literature on the recommended daily consumption of macronutrients from common foods. Therefore, the RDA of macronutrients from foodstuff was considered given by Food and Nutrition Board (FNB), Institute of Medicine, National Academies, Washington, DC, USA [30, 31].For the $DI_{est.}$ comparison the RDA (g/day) was divided by 60 kg (average adult body weight) and recommended RDA values for carbohydrate, fat, fibre, and protein were 2.16, 0.30, 0.63, and0.93 g/kg/day, respectively. In all food products of F_p, F_s, and F_r, $DI_{est.}$ for macro nutrients was within the FNB suggested RDA in g/kg/day (Table 4). Except for bhindi (F_r), and naan (F_s and F_r), $DI_{est.}$ values of macro nutrients of F_p food products were considerably lower than those from F_s and F_r ($p > 0.05$). The nutritious composition of street and restaurant food products in Hyderabad district, Pakistan is lower than that of packaged meals ($p > 0.05$). However, it is self-evident that all food products may be regarded good sources of essential nutrients that fulfil the RDA values for adults in the population. However, in a sanitary environment, an exact mix of ingredients in street and restaurant dishes would help to receive a complete nutritious meal outside the house for body growth.

Macro and micro minerals

Table 5 shows the mineral content of F_p, F_s, and F_r meal dishes, including macro minerals (Ca, K, Na, and Mg) and micro minerals (Co, Cr, Cu, Fe, Mn, and Zn). In the seven food dishes of F_p concentrations of Na was found from 120.0 – 1.98 mg/g (Table 5). Cationic electrolytes (Ca, Mg, Na, and K) are the fundamental electrolytes that play a key role in a variety of physiological activities. Extracellular (Na) and intracellular (K) electrolytes play vital roles in fluid balance, blood pressure management, and the regulation of many hormones (i.e., aldosterone, antidiuretic). The highest levels of Na were found in haleem of F_s (8.73–9.68 mg/g) when compared to haleem of F_r ($p > 0.05$). Similarly, the F_r bhindi masala contains more Na contents than the F_p bhindi masala ($p > 0.05$). The high level of Na in these food products might be attributed to a combination of high content of spices enhanced with Na and table salt (NaCl) used in their production to improve the receptive quality of flavour and the preparation of thick gravies[32]. However, the high concentration of Na in chapatti and paratha (6.14 and 5.97 mg/g, respectively) in the F_r of Hyderabad is due to theuse of a large amount of table salt in their manufacture to keep the local community's taste. Moreover, the Na level of the rest of the food items from all three classes of meals is greater than 2.0 mg/g.

The K is a vital intercellular electrolyte in the human body that generates electrical potentials in the neurological system[33]. Except for naan (8.03-8.61), and chola (8.03–8.76) of F_s, and chapatti (6.50–7.37 mg/g), naan (3.88–4.68 mg/g, and paratha (2.94–3.45 mg/g) of F_r, all the analysed food products had lower levels of K (2.0 mg/g). The high levels of K in these foods might be due to the unhealthy conditions of the hawking location (exposed to road dust) or to excessive levels of K in the ingredients. In comparison to F_r, the F_s food items are shown to be more exposed to road dust ($p > 0.01$). As a result, F_s food items may have more minerals than F_r food products, however both have same recipes and preparation procedure. Low levels of K in humans can cause serious neurological problems [34], however the studied dietary products could help adults to fulfil their K level. Similarly, the sodium-to-potassium (Na/K) ratio is thought to be a predictor of cardiovascular disease (CVD) and blood pressure consequences[35-38]. The optimum Na/K ratio is 1.0, which is considered to be good for health[39]. In all the studied F_p food products the molar ratio of Na/K was found 1.23/1.78, which is greater than the acceptable Na/K ratio (1.00). The Na/K ratios in F_s and F_r food items varied from 0.300 – 11.0 and 0.330 – 6.62, respectively. The highest Na/K ratios (11.0 and 6.62) was found in the haleem of F_s and bhindi of F_r. Except naan and choley of F_s and naan and haleem of F_r, all F_s and F_r food products have greater Na/K ratios than the acceptable limit (1.00). The high Na/K ratio in certain foods might be due to the usage of salts with high salt content. Similarly, considerable differences in the Na/K ratio seen between different types of food products or between the same food products of F_p, F_s, and F_r might be attributed to differences in spices and salt application by different vendors. As a result, WHO suggested that Asian nations implemented the salt-reduction strategies and encourage people to consume more fruit and fresh vegetables, as well as improve their countries' nutrition plans[40].

Calcium magnesium phosphate and carbonate are formed by electrostatic interactions, and both are present in bones and teeth. Mg plays important role for the catalytic activity of enzyme (in about > 300 enzymatic reactions) [41]. It also plays a vital to transmit the nerve impulses in human and also important for the synthesis of fatty acid and protein [41].Mg concentrations in F_p food products were in the ranged of 2.55 – 4.96 mg/g, with the highest amount in karahi gosht and the lowest content in dal fry. Mg concentrations were highest in F_s choley, and chicken biryani (8.27, and 8.68 mg/g) and in F_r beef biryani (9.38 mg/g). On the other hand the rest of F_s and F_r food items have small Mg contents (1.00–5.00 mg/g). The beef and chicken spice biryani is made with a large amount of spices [garam masalah, (which contains a mixture of spice i.e., black cardamom, bay leaf, black cumin, clave, and cinnamon), ginger mace, garlic paste, nutmeg, green coriander powder, turmeric, and cumin powder) according to local papulation's preferences. On the other hand, choley is made with a lot of chat masala, black pepper, red chilli, turmeric, green coriander powder, tamarind, and cumin powder. Thus, the high Mg levels in beef/chicken biryani and choley may be owing to the usage of these spices, which have been linked to high Mg contents[32]. Ca is a key component of bone and teeth, giving them their stiffness[42]. It works as a cofactor in a variety of enzyme processes and is vital for intracellular functioning[41]. The analysed F_p, F_s, and $f_r$food items were effective in meeting the daily Ca requirement. However, the higher levels of Ca were found 7.58 and 6.59 mg/g in F_p chicken shami kabab and F_r daal, respectively Mg values were less than 4.0 mg/g in the remaining food items.

Cr levels in food items of F_p, F_r, and F_s were found in the range of 4.69 – 22.8 g/g, 2.87 – 17.4 g/g, and 4.33 – 6.55 g/g, respectively. In F_p the highest and lowest Cr content was observed in shahi qorma and dal fry, respectively (Table 5). However, in F_s and F_r the highest and lowest concentration of greatest concentrations of Cr were found 6.51 g/g and 4.51 g/g (in biryani and haleem) and 16.9 g/g and 3.05 g/g (in beef biryani and haleem), respectively. All food products, contain significant Cr levels (> 2.0 g/g), which may be attributed to the natural presence of Cr (in the form of Cr(III)) in foodstuffs, as well as stable cross linked protein molecules, which play a key role in carbohydrate and lipid metabolism[32, 43]

Co is a component of the vitamin B_{12} molecule (cobalamin), and acts as a catalyst in a number of biological processes, including the transfer of methyl (–CH_3) groups into DNA. Furthermore, vitamin B_{12} is absorbed to proteins in the meal and had a role in the vitamin's distribution in the digestive system[44, 45].According to the current analysis, the maximum concentration of Co was observed22.3 g/g in F_p dal fry, while the lowest concentration was found 6.97 g/g in F_p karahi gosht. However, in both F_s and F_r, the higher concentrations of Co were found 15.4 g/g and 8.57 g/g in chola biryani and chicken pulao, respectively (Table 5).

The lowest levels of Co were found 2.75 g/g in $F_s$naan, and 2.75 g/g in F_r chicken white qorma.

Cu is a crucial importance for the functioning of a number of enzymes. As a result, it plays an important role in a variety of physiological processes in the human body, such as free radicals elimination, formation of connective tissues, and bone and, iron usage, synthesis of melanin[46]. Cu levels in PF, RF, and SF food items varied from 11.9 – 25.5 g/g, 9.05 – 35.6 g/g, and 8.13 – 19.6 g/g, respectively. Cu concentrations were observed highest in F_p bhindi masala, F_s chicken biryani and F_r chicken pulao (18.80 g/g, 18.9 g/g, and32.5 g/g), and lowest in F_p chicken achari, F_s chola biryani, and F_r haleem (13.10 g/g, 8.81 g/g, and 10.10 g/g), respectively. Generally the Cu concentrations in foods should not exceed from 10.0g/g(European Commission, 2006). Except for naan and chola biryani of F_s and choley and Haleem of F_r, all the food items of F_p, F_s, and F_r had higher Cu concentrations than the European Commission standard for Cu (10.0 g/g). As a result, high Cu levels in meals can induce abdominal pain, diarrhoea, dermatitis, vomiting, upper respiratory tract irritation, and nausea[32, 45]. However, mineral level may be influenced by daily mineral intake through food, as described in the daily intake portion.

Fe is an essential mineral for the production of myoglobin, and haemoglobin, as well as numerous enzymes and cytochrome enzymes in the electron transport chain. Its absence in the body might lead to anaemia [47]. Fe contents in food items of F_p, F_r, and F_s were found to be in the ranges of 22.9 – 123.0, 22.9 – 94.3, and 22.9 – 98.0g/g, respectively (Table 5). The highest levels of Fe content were found 94.3 g/g, 80.0 g/g, and 72.9 g/g in chicken shami kababs of F_p, F_s, and F_r, respectively. Fe content was found low in F_p chicken achari, F_s chicken biryani, and F_r chola (37.10, 30.00, and 26.40g/g, respectively). The Fe levels in food products of F_p were comparable to the values reported in the literature for appetisers and snacks in Turkey [48], ready-to-eat meals in Southern Nigeria [49], and processed traditional Indian dishes[9].Thus, these food products are the potential source of Fe for the local people. However, lack of Fe in body may cause anaemia.

Mn isa cofactor for numerous enzymes, and important for a variety of physiological functions in the body, including cellular energy balance, reproduction, and bone connective tissue and development. The deficiency of Mn may results the infertility, congenital limb deformities, slowed development, and Wilson disease[47].Mn levels in F_p, F_r, and F_s food items were determined to be less than 20.0 g/g (Table 5). Mn concentrations were highest in Lohori choley of F_p, chola biryani of F_s, and chicken pulao of F_r (20.80, 9.480, and 19.80 g/g, respectively), and lowest in chicken achari of F_p, haleem of F_s, and chapatti of F_r(5.87, 3.29, and 7.42 g/g, respectively).Mn levels in all the analysed F_p food products are comparable to Mn levels in several Indian F_p food products [9].

Zinc is necessary for a variety of biological processes, including DNA, and protein synthesis enzymatic reactions, gene expression, , immunological function, cell growth, wound healing, and development[50]. The deficiency of Zn may results some abnormalities like abortion, foetal mummification, extended labour, and low birth weight [47]. Zn levels in all the studied food products of F_p, F_r, and F_s were found in the range of 28.70 – 154 g/g. The highest and lowest Zn content was found in F_p karahi gosht and F_s chicken biryani (Table 5). Meat items had the maximum Zn levels, followed by mixed food products and grains/cereals. However, the relatively high Zn concentration in grains/cereals might be attributable to the use of spices in large quantities for flavouring and taste in meals. The observed Zn levels in the studied food products were much higher than those reported in the literature [9, 49, 51] and comparable with those values reported in Nigeria [52].

Estimation of daily intake and risk assessment

Tables 6 and 7 show the $DI_{est.}$ of each macro mineral (Ca, Na, K, Mg) and micro mineral (Co, Cr, Cu, Fe, Mn, and Zn) from each F_p, F_r, and F_s meal plate. There is no information in literature about the recommended daily consumption of macro minerals from common foods. Therefore, RDA and tolerated upper limit (TUL) of macro minerals from food stuff were considered by FNB, National Academies, Institute of Medicine, USA[31]. To compare the $DI_{est.}$ value the RDA and TUL (mg/day) were converted to RDA and TUL in mg/kg bw/day divided by 60 kg (average adult body weight). $DI_{est.}$ for Na and K in all F_p food products was lower than the RDA and TUL for adults in mg/kg bw/day (Table 6). The $DI_{est.}$ of Mg in all the analyzed food products was found to be 1 to 2 times higher than the RDA and TUL value in mg/kg bw /day might be related to the use of significant amounts of spices for seasoning, taste, and food preservation in aluminum packets. The $DI_{est.}$ of Ca in PF food products was found to be within the RDA value, but TUL values for Ca in foodstuffs for adults were much lower (Table 6).

Except Na content in naan, and K content in haleem, the $DI_{est.}$ values of Na and Kin all food products of F_s were greater than the RDA in g/kg bw/day. Except Na in haleem and K in choley, the $DI_{est.}$ of Na and K in all F_s food products was within the TUL levels in adult food stuff. Except for bhindi masala, paratha, and chapati the $DI_{est.}$ of Na in meals for adults was under the TUL levels and RDA. In all the F_r food products the K contents was within the RDA, except for haleem, paratha, chapati, and naan, but $DI_{est.}$ of K was higher in haleem than TUL values. The $DI_{est.}$ values of Mg in all the F_s and F_r food items was observed higher than the RDA and TUL values in g/kg bw/day. The $DI_{est.}$ of Ca in all the SF food products was greater than the RDA value, except naan, however in food stuffs for adults the $DI_{est.}$ of Ca in chola biryani was higher than the TUL. In food stuffs of adults, the $DI_{est.}$ values of Ca in beef biryani, daal fry, chicken white qorma, paratha, chicken pulao, and choley were higher than the RDA (0.017–0.020 g/kg bw/day), whereas the $DI_{est.}$ values of Ca in beef biryani, paratha,anddaal fry were higher than the TUL (0.047 g/kg bw/day).

In the food products of adults, the $DI_{est.}$ values of Fe, Cr, Cu,, Mn, and Zn in F_p, F_s, and F_r food items were within the RDA, PTDI (Provisional Tolerable Daily Intake), PTWI (provisional tolerable weekly intake) values (taken in mg/kg bw /day) (Table 7) [53, 54].

However, the RDA values for Co and PTDI for Co and Mn in food is not reported in literature. Furthermore, $DI_{avrg.}$ values of F_p food items were substantially lower than those of F_r and F_s food products ($p > 0.05$). In F_p food items the I_h values of Co, Cr, Cu, Fe, Mn, and Zn were less than 1, so the individuals have no risk of these micro minerals by eating these food stuff. The I_h values of Coin F_s food items except choley, Fe in choley, and chola biryani, and Mn in choley, and chicken biryani were greater than 1.00, indicating that individuals (workers in auto mechanic shops) may be at risk of toxicity from consuming these F_s food products. However, according to the I_h study, the other micro minerals of SF_s food products may not have a health risk to the concern subjects. The I_h values of Co Cr, Cu, and Zn in F_r food items revealed that consuming F_s and F_r food stuffs have no hazardous risk of Co, Cr, Cu, or Zn. The I_h levels of Fe in haleem, chapatti, bhindi masala, naan, and paratha, ana Mn in F_r paratha, suggested the likelihood of hazardous risk for local residents.

Conclusion

This study concluded that the food dishes/products have different level of macro and micronutrients. The contents of the nutrients in local food dishes/products were deviated to each other based type and quantity of ingredients as well as their preparation recipe. The chicken shami kabab, Lahori choley, karahi gosht and bhindi masala of F_p showed highest moisture contents whilst lowest were observed in daal fry samples. Whereas all food products of F_s and F_r have moisture contents > 40.0 g $100g^{-1}$ except chapati, paratha, naan, and daal fry. Protein content in all food dishes/products of F_p, F_s, and F_r were high (> 6.0 g $100g^{-1}$) except bhindi masala of F_p, naan of F_s and chapati, paratha, and naan of F_r. The least contents of crude fat were observed in chicken Lahori choley, shami kabab, and bhindi masala. Chola biryani of F_s, and paratha of F_r showed the highest contents of fat and attributed to the application of hydrogenated oil (Ghee) and low-quality oil. The wheat flow (naan, chapati, and paratha) have highest contents of carbohydrate was observed highest in daal fry of F_p, and chicken biryani, haleem and choley of F_s, it was observed that all food products of F_p, F_s and F_r were found within the range. Bhindi masala of F_p has highest contents of crude fiber whereas other dishes of all three categories have fiber less than 2.00 g $100g^{-1}$. The proximate parameters, macro and micro minerals in the studied food dishes are contributed to a certain level to fulfil the RDA for a healthy person. The toxic assessment study based on the hazardous index (I_h) reflected that all food dishes/products of F_p may not have any risk for the consumers except that these products have possible elevated soluble contents of aluminium leached from the coated aluminium foil. However, I_h of Co (chicken briyani, chola biryani, and haleem), I_h of Fe (chola biryani, and choley), and I_h of Mn (chicken briyani, and choley) food dishes of F_s whilst I_h of Fe (haleem, bhindi, chapati, paratha, and naan), and I_h of Mn (paratha) food dishes of F_r may have possible toxic risk for the local people Hyderabad city. All these possible risks can be managed by controlling the contamination roots (hygienic condition and used water during preparation) and ingredients (levels of spices).

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