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Macronutrients level in Commonly Consumed South Indian Breakfast Meals: An Analytical Study

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Abstract

The present study aims to develop a database on the macronutrient contents in 23 types of commonly consumed South Indian breakfast meals. AOAC methods were followed analysing protein, fat, total dietary fibre (TDF) and ash, whereas modified-Anthrone for available-carbohydrates to document the macronutrient contents. The macronutrient contents of all the breakfast meals were investigated on both meal (since all the foods are consumed in wet form) and dry basis. On meal basis, moisture ranged from 40.9 to 82.8%, protein 1.8 to 5.9%, ash 1.2 to 2.8%, fat 0.9 to 8.5%, TDF 0.9 to 5.2% and available-carbohydrate 12.2 to 41.4% respectively. Whereas on dry basis, moisture content ranged from 1.1 to 4.4%, protein 6.8 to 13.8%, ash 2.5 to 7.1%, fat 5.4 to 20.3%, TDF 2.2 to 12.4% and available-carbohydrate 49.6 to 71.8%. The data could be used for monitoring the macronutrient intake from breakfast foods while dealing with energy balance.

Keywords: Macronutrients, Carbohydrate, Protein, Fat, Ash, Total Dietary fiber.

Introduction

Macronutrients are the nutrients that provide calories or energy and are required for the body in large amounts to carry out daily life activities rhythmically and adequately. In addition to water, humans require four primary macronutrients from their staple foods, including carbohydrates, proteins, fats, and dietary fiber, which are often called proximate principles since they are the main bulk of the food [1].

The Food composition database symbolise significant role to analyse the dietary pattern and problems while dealing with public health nutrition, where only accuracy in the food composition databases can help in quantifying the nutrients to assess nutritional consumption [2]. Hence, it is paramount to keep the National food composition databases comprehensive and up-to-date by maintaining the inherent quality for nutritional monitoring [3]. Arabic comprehensive food composition database was developed in myfood24 by incorporating parameters, like food identification,

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cleaning, mapping, translation, allocating portion sizes, and quality checking [4]. In some way this kind of databases seems less implicit in addressing the actual energy balance.

The importance of carbohydrates in human nutrition has less been explored than those of macronutrient like proteins and fats, whereas, many foods composition database available in the world used the old and indirect, by "difference" method to analyse the carbohydrate content rather than analysing it directly [5]. Since the possible errors that arise from the individually analysed macronutrients (protein, fat, water, alcohol, and ash) are directly reflected on by "difference" value of carbohydrates, hence sophisticated method for estimating carbohydrate in food samples is the current trend among researchers because of its degree of accuracy in result which is also necessary for calculating the energy balance [6].

Indian citizen consumes cereals in excess quantity and neglects the intake of proper amounts of protein-based foods whereas in western countries, consumption of an excessive amount of animal protein is prevalent [7]. Insufficient protein consumption may cause many health complications like kwashiorkor, marasmus, impaired mental coordination, oedema, and failure in the organ system, wasting, and shrinkage of muscle tissues and the immune system [8]. Carbohydrates provide energy and contribute to subsequent weight gain if taken in excess [9], and linked with an elevated risk of mortality [10]. Breakfast foods are the part and parcel in almost all Indian households [11], such as idly, dosa, upma etc are more popular in South-India and most of them are prepared with cereals [12]. Children and adolescents of nuclear families consumed breakfast remarkably regularly compared to its counterpart. Apart from enhancing macro- and micronutrient intake and adjusting body weight, breakfast is a highly critical meal for increasing cognitive and academic accomplishments. Despite that, breakfast is the most disregarded meal in adolescent and school-going children's diet [13].

The macronutrient database in composite foods with all the items of ready-to-eat foods and food product is scanty. Therefore, the present study is an initiative to develop a database on macronutrients of commonly consumed south-Indian breakfast meals to help the consumers, aware of the amounts of macronutrients they are availing from their regular breakfast meals

Material and Methods

Sampling: It is a cross-sectional study with multi-stage random sampling procedures applied to collect the food samples. A total of 391 commonly consumed breakfast foods such as Idly sambar (20), MLA pesarattu (18), Onion dosa (19), Open dosa (26), Paneer dosa (14), Pesarattu (12), Rava paneer dosa (16), Set dosa (18), Vegetable dosa (21), Vada sambar (20), Onion dosa (18), Plain dosa (25), MLA dosa (8), Bisi bele bhath (7), Open vegetable dosa (14), Tomato bhath (14), Lemon rice (18), Chapathi (16), Tomato rice (15), Vegetable biryani (18), Curd rice (16), Parota (21) and Mysore bonda (17). All the food items of each breakfast foods were made into a fine paste using a mixer grinder, and the homogenate was dried in an oven at 45^0C for 12 hrs. The dried sample was made to flour, followed by passing through a 250 µm sieve. The obtained flour was used to develop the database of macronutrients.

Estimation of macronutrients:

Macronutrients such as fat, moisture, crude fiber, and ash contents were analysed in the powdered samples by using AOAC-2006 (934.01, 942.05, 962.09, and 920.39, respectively) [14], and crude Protein by the AOAC Kjeldahl method (984.13) [14]. The estimation of available carbohydrates was carried out by using the modified Anthrone method as described by Buckan DS, 2015 [6].

Estimation of available carbohydrates:

Reagents:

Sugars: Glucose (>99.5 % purity; Sigma Chemical Co., St. Louis, MO, USA) was used in this study.

The standard glucose Stock solution: 100 mg glucose in 100 ml of distilled water.

Working standard: 10 ml of stock solution was diluted to 100 ml with distilled water (100 µg/ml).

Anthrone reagent: 200 mg of anthrone was dissolved in 100 ml of ice-cold sulphuric acid.

Enzymes: Total Dietary Fiber Kit (Sigma, TDF-100A) was used. This kit includes 10 ml heat-stable α-amylase, 500 mg protease, and 30 ml amyloglucosidase.

Phosphate buffer (0.08 M, pH 6.0): Dissolve 1.400 g anhydrous dibasic sodium (Na_2HPO_4) and 9.68 g monobasic sodium phosphate monohydrate (NaH_2PO_4. H_2O) in 1000 ml distilled water. Check the pH level and adjust if necessary.

NaOH (0.275 N): Dissolve 11.00 g NaOH in 1000 ml distilled water.

HCL (0.325 M): Dilute 325 ml 1 M HCL to 1000 ml distilled with water.

Procedure:

Triplicate test portions of commonly consumed breakfast food samples were treated with heat-stable α-amylase, protease, and amyloglucosidase in order to hydrolyze proteins and starch under laboratory conditions, as given in the following:

Food samples (100 mg) were taken into 16 X 125 mm tubes with screw caps in duplicate. 5 ml of (0.08M) phosphate buffer pH 6.0 was added to the tubes and stored at 4°C for 12 h for hydration of the matrix. After 12 h, hydration samples were subjected to enzyme hydrolysis to degrade soluble starch. The- amylase solution (50 µl) was added, and the tubes were placed in a water bath at 95°C for 30 min. After 30 min, the tubes were removed and cooled to 60°C and adjust to pH 7.5 with 1 ml of 0.275 M NaOH. Protease solution (50 µl) was added to the test tubes and then incubated at 60°C for 30 min. After that, 1 ml of 0.325M HCl was added to the tubes to decrease the pH to 4.5. After adjusting the pH, amyloglucosidase solution (150 µl) was added and then incubated at 60°C for 30 min. The residue was separated by centrifugation. The liquid portion was placed to a 100 ml volumetric flask and made up to the mark with deionized water. The concentration of glycemic sugars in the supernatant was determined by using anthrone reagent. Different volumes of supernatant, 0.2–1 ml into a series of test tubes were taken, and the volume was made up to 1 milliliter with distilled water to each tube. 4 ml of anthrone reagent were added, and the tubes were placed in a boiling water bath for 8 min. and then cooled rapidly under running tap water. The optical density of green to dark green was measured at 630 nm against a blank, and the concentration of glycemic carbohydrate was calculated using a standard glucose curve.

Statistical analysis

All experimental analysis was repeated 3 times. The results were presented as mean from three replications with standard deviation (SD). The mean values were tested for existence of difference by using Analysis of variance (ANOVA) and between the groups using t-test. Data was analyzed using SPSS 15.0 version.

Results

The individual breakfast foods, weight of individual items of each breakfast foods, total homogenate wet-weight and dry weight of the commonly consumed Indian breakfast meals are taken. The total wet weight of homogenate samples of each breakfast meals ranges from 159g (mysore bonda) to 665g (bisi bele bhath), and the dry weight of homogenate breakfast meals ranges from 71 g (mysore bonda) to 231g (open vegetable paneer dosa). For the first time macronutrient content of the various commonly consumed breakfast meals was investigated on a meal or wet and dry basis. The results of the macronutrients are represented in Figure 1 on meal or wet basis. Moisture content showed the lowest of 40.9% in set dosa and the highest of 82.8% in curd rice, protein percentage ranged from 1.8% in curd rice to 5.9% in rava paneer dosa, ash content represents the microelements which was falling within the range of 1.2% in curd rice to 2.8% in set dosa, fat content was observed in the range from 1% in curd rice to 8.5% in parotta, TDF content varied from 0.9% in pesarattu to 5.2% in mysore bonda, carbohydrate content was resulted in very high in all the foods. The percent of carbohydrates ranged between 12.2% in curd rice and 41.4% in set dosa.

The results of macronutrient content on dry basis are represented in Table 1. The percent of the moisture content was ranged from 1.1% (plain dosa) to 4.4% (mysore bonda), the percent of protein ranged from 6.8% in tomato rice to 13.8% in rava paneer dosa, ash content ranged from 2.5% in parota to 7.1% in curd rice, fat content was 5.4% in curd rice, 20.3% in vada

sambar, TDF ranged from 2.2% (set dosa) to 12.4% (vada sambar), carbohydrate content was very high in all the foods except vada sambar and the percent range observed from 49.6% (vada sambar) to 71.8% (vegetable biryani).

Table 1. Macronutrient composition of commonly consumed South Indian breakfast meals (g/100g on dry basis) [a]

Breakfast foods/ Plate	Moisture	Protein	Ash	Fat	TDF	Ava, CHO	Energy
Idly sambar	1.3±0.1	12.1±0.3	4.5±0.0	15.9±0.4	8.2±1.1	59.0±0.0	443.5
MLA pesarattu	2.4±0.0	9.5±0.4	5.0±0.0	13.4±0.7	4.4±0.9	66.3±0.1	432.8
Onion rava dosa	1.7±0.0	7.4±0.0	4.9±0.0	12.8±1.0	5.5±0.9	71.0±0.5	439.1
Open dosa	2.9±0.3	7.5±0.0	4.8±0.1	12.2±0.4	3.3±0.6	70.3±0.6	427.5
Paneer dosa	1.8±0.0	12.0±0.1	4.7±0.0	13.2±0.8	2.9±1.1	68.7±0.5	447.8
Pesarattu	2.0±0.2	8.9±0.0	4.9±0.1	15.8±0.3	2.3±1.1	65.8±0.2	445.4
Rava paneer dosa	2.2±0.3	13.8±0.2	4.7±0.0	13.3±0.9	3.8±0.6	65.2±3.1	442.7
Set dosa	1.5±0.1	9.3±0.3	4.8±0.0	13.9±0.3	2.2±0.6	69.9±0.2	445.9
Vegetable dosa	3.6±0.1	7.0±0.1	4.1±0.0	13.3±0.2	5.3±1.3	69.6±3.0	436.4
Vada sambar	1.2±0.1	13.1±1.0	4.2±0.6	20.3±0.2	12.4±1.7	49.6±1.5	458.8
Onion dosa	1.8±0.0	9.0±0.4	4.0±0.0	13.2±0.5	4.7±0.5	70.0±0.3	444.3
Plain dosa	1.1±0.1	8.1±0.1	5.2±0.0	12.6±0.1	3.4±0.6	70.8±1.6	435.8
MLA dosa	1.5±0.7	8.3±0.2	5.0±0.1	13.6±0.8	4.2±1.1	70.1±0.5	444.3
Bisi bele bath	3.0±0.5	8.5±0.6	5.4±0.0	20.2±0.7	8.4±0.7	57.0±0.2	460.7
Open vegetable. paneer dosa	1.8±0.1	9.7±0.1	5.5±0.0	16.2±0.5	2.7±0.9	66.3±0.9	455.8
Tomato bath	2.0±0.1	10.6±0.0	4.2±0.2	17.6±0.5	6.8±0.3	61.5±2.0	460.6
Lemon rice	2.7±0.3	7.6±0.1	4.7±0.1	12.7±0.3	3.8±0.5	70.4±0.0	433.9
Chapati	1.9±0.2	10.3±0.0	3.6±0.1	15.2±0.9	6.2±0.6	66.1±2.2	454.9
Tomato rice	2.6±0.1	6.8±0.0	3.9±0.1	12.3±0.9	5.6±0.6	71.4±0.3	434.2
Vegetable biryani	2.2±0.6	7.8±0.2	4.8±0.0	12.0±0.4	3.5±0.5	71.8±3.2	433.2
Curd rice	3.1±0.1	10.2±0.5	7.1±0.0	5.4±0.2	5.4±1.3	71.0±0.7	383.5
Parota	2.7±0.1	7.2±0.3	2.5±0.2	15.1±0.4	9.2±0.8	63.5±1.4	437.4
Mysore bonda	4.4±0.2	7.4±0.5	3.2±0.4	12.2±0.3	4.0±0.5	70.4±0.1	428.7

[a] Each value is the average of triplicate determinations.

±, One SD.

Note:

TD: Total dietary fiber

Ava, CHO: Available carbohydrates

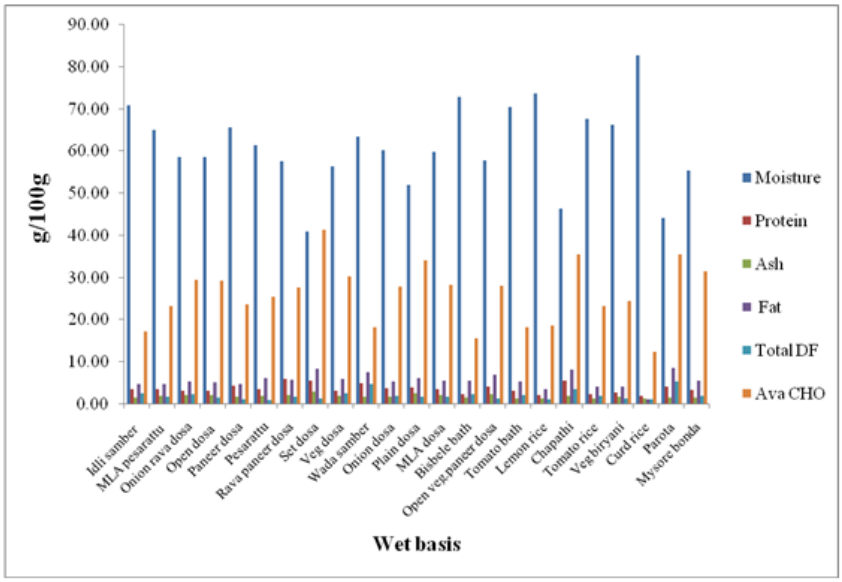

Figure 1 Macronutrient composition of commonly consumed South Indian breakfast meals (g/100g on wet basis)

Discussion

To our knowledge, this is the first study to report that, the accurate analysis of macronutrients in ready to eat breakfast foods. In the present trend for the macronutrient levels of meals was calculated using different methods: data from printed food composition tables, electronic databases, and food industry data. Data on macronutrients content of meals in the collective nutrition, obtained from food composition tables are mostly informative but not accurate because there were differences in macronutrient estimations depending upon the choice of the food composition tables. Though from the literature, many study available reporting the nutrient contents of ready-to-eat or cooked foods by researchers such as [15], who have reported the proximate composition of ready to eat foods of street foods in Nairobi. Sanni *et al.* [16] have reported the proximate composition of seven Nigerian street foods such as, cooked yam, cooked fufu, cooked rice, cooked beans, fried fish, stew and vegetable soups. Singh *et al.* (2003) [17] have analysed the proximate composition of commonly consumed sesame-based recipes of Himachal Pradesh, India. Das *et al.* [18] have assessed the nutritional composition of regional recipes of Assam and were observed a diversified range of nutritional profile. Pikuda and Ilelaboye[19] have reported the proximate composition of Street Snacks of Lagos, Nigeria. Atinuke [20] have analysed the proximate composition of ready-to-eat food such as Kilishi and rice. Koodagi *et al.* [21] have studied the macronutrient status of popular street foods in Karnataka. Amadi *et al.* [22] have studied the nutritional composition of traditional dishes such as Kekefiyai, Kiri-igina, and Opuru-fulou of Bayelsa State, Nigeria. Israel and Samuel (2020) [23] have studied the proximate composition in eight street foods such as roasted plantain, fish, yam, corn and dough nuts, suya, eggroll, meat-pie from parts of Lagos Nigeria. Similarly, Calubaquib and Suyu [24] have also examined the proximate contents of six fortified Filipino snacks. But the nutrient analysis of a complete meals category was lacking and our present study is stepping towards addressing the nutrient analysis by categorizing meals like breakfast meals

Conclusion

Many food composition databases are available on raw food basis; a negligible amount of data has reprinted so far to address the actual nutritional intake. We are reporting the actual consumption of macronutrients through commonly consumed south-Indian breakfast meals for the first time. The study indicated that almost all the breakfast meals' macronutrient composition are promising since they

contribute a large percentage of macronutrients as per the dietary guidelines for Indians. The data will serve as a foundation for calculating the macronutrient intake through breakfast meals. Nevertheless, the study was only an initial move toward developing a macronutrient database of commonly consumed breakfast meals. Therefore, more extensive research needs to be carried out in this direction for a complete database on ready to eat foods and food products of Indian, which has further applications in various health and nutritional issues.

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Conflict of Interest: Nil

Abbreviations:

AOAC: Association of Official Analytical Chemists

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